DEADLY CLIMATE

Goodell, Jeff

ProQuest document link

ABSTRACT (ENGLISH)

According to the World Health Organization, before 1970, only nine countries had severe dengue epidemics. Once in Jones' bloodstream, it latched onto her white blood cells and began replicating. The Vibrio bacteria that causes cholera, a diarrheal disease that haunted big cities like London and New York in the 19th century and still kills tens of thousands each year, thrives in warmer water. An even more deadly strain of the same bacteria, Vibrio vulnificus, while rare, has been detected more and more frequently in bays and estuaries on the East Coast, particularly around Chesapeake Bay.

FULL TEXT

Headnote

Covid-19, Zika, Nipah virus, Ebola, dengue: How the climate crisis is ushering in a new pandemic era, and why we're woefully unprepared for what's to come

JENNiFER jones spent most of her summer at home, as so many of us did, trying to avoid the plague. Jones, 45, lives in Tavernier, a community in the Florida Keys just south of Key Largo, and spent a lot of the Covid shutdown in her yard, puttering around with plants. At some point, a mosquito landed on her. That's not unusual in Florida, and Jones doesn't remember this mosquito bite in particular. But it was not a garden-variety backyard mosquito. It was Aedes aegypti, an exquisitely designed killing machine that is one of the most deadly animals in human history. By one count, half the people who have ever lived have been killed by mosquito-borne pathogens. Aedes aegypti, which first arrived in North America on slave ships in the 17th century, is capable of carrying a whole arsenal of dangerous diseases, from yellow fever to Zika.

The mosquito could sense the heat of Jones' body and smell CO2 on her breath from more than 30 feet away. It landed on her exposed flesh, likely her arm or lower leg. The mosquito was a female - only females drink blood, which they need to produce their eggs. It worked quickly, knowing, in the genetic coding of its insect brain, that the longer it lingered the less likely it was to survive. First, it spit on Jones' skin to numb it so she wouldn't be alerted to the bite. Then it plunged its syringe-like proboscis, which is actually a sheath containing six needles, into Jones' skin. It probed around until it found an ideal place to tap into a blood vessel. Then it inserted two needles, each one serrated like a carving knife, to saw a hole in Jones' flesh. Two more needles pried the hole open, which allowed it to insert what looks like a tiny hypodermic syringe into Jones' blood vessel. And here is the important part: As it sucked out the blood, the mosquito spit its own saliva into Jones' veins, which contains an anticoagulant that prevents the blood from clotting at the puncture site. In this case, it also contained a virus that causes a tropical disease called dengue fever. When its appetite was sated and its belly full of blood, the mosquito flew off.

The word "dengue" most likely comes from the Swahili phrase "Ka-dinga pepo," meaning "cramp-like seizure caused by an evil spirit." Dengue is also known as "breakbone fever" because it feels like your bones are breaking when you have it. It has been around for centuries, and is most common in Asia and the Caribbean. According to the World Health Organization, before 1970, only nine countries had severe dengue epidemics. Since then, it has increased thirtyfold, making it endemic - that is, permanently embedded in the local mosquito population - in 128 countries. The WHO recorded 4.2 million cases of dengue in 2019. As the world warms, making more of the planet comfortable for heat-loving Aedes aegypti, the mosquito's range will expand northward, and to higher altitudes. By 2080, one recent study estimated, more than 6 billion people, or 60 percent of the world's population, will be at risk for dengue. "The

fact is, climate change is going to sicken and kill a lot of people," says Colin Carlson, a biologist at the Center for Global Health and Security at Georgetown University. "Mosquito-borne diseases are going to be a big way that happens."

It took a week or so for the virus to do its work. Once in Jones' bloodstream, it latched onto her white blood cells and began replicating. She was watering plants when she felt lightheaded, and then developed a fever. "I knew something weird was going on," she tells me. Rashes. Pain behind her eyes. And bone-break ache in her joints. "I felt like I was a 99-year-old lady who had been hit by a truck," she says. In rare cases, dengue can escalate to brain swelling and bleeding, which can be fatal (about 10,000 people a year die from dengue). But Jones was lucky. The pain and fever faded after four or five days, and she was almost recovered when her son called her to his room to point out the red splotches on his skin. As soon as she saw them, she knew: dengue.

As it turned out, the Florida Keys, already hit hard by the coronavirus, was in the middle of a dengue outbreak too. COVID-19 likely emerged from the wilds near southern China, then found residence in horseshoe bats before making the jump to humans. The virus, as of this writing, has infected 63 million people and caused 1.5 million deaths around the world. The global economic impact of the pandemic was estimated at $8 trillion to $16 trillion in July 2020 - it may be $16 trillion in the U.S. alone by the fourth quarter of 2021 (assuming vaccines are effective at controlling it by then). The amount of human suffering this tiny microbe has caused is incalculable: lost loved ones, vanished jobs, broken families, and lingering sickness from a virus that will eventually retreat but will never disappear.

And yet we got lucky. "It could have been much worse," says Scott Weaver, director of the Galveston National Laboratory in Texas, one of the top viral-research centers in the country. Compared with other pathogens out there, Covid-19 is relatively docile. It is an easily transmissible virus that is far more deadly than the flu, and has mysterious long-term effects. But it doesn't kill three out of four people it infects, like the Nipah virus. It doesn't cause people to bleed out of their eyes and rectums like Ebola. "Imagine a disease with 75 percent case fatality that is equally transmissible," says Stephen Luby, an epidemiologist at Stanford University. "That would be an existential threat to human civilization."

The Covid-19 pandemic is often compared to the 1918 influenza, which killed at least 50 million people globally. But it is perhaps more accurately seen as a preview of what's to come. "We have entered a pandemic era," wrote Dr. Anthony Fauci of the National Institute of Allergy and Infectious Diseases in a recent paper he co-authored with his NIAID colleague David Morens. The paper cites HIV/AIDS, which has so far killed at least 37 million, as well as "unprecedented pandemic explosions" of the past decade. It's a deadly list, starting with the H1N1 "swine" influenza in 2009, chikungunya in 2014, and Zika in 2015. Ebola fever has burned in large parts of Africa for the past six years. In addition, there are seven different known coronaviruses that can infect humans. SARS-CoV spilled over from an animal host, likely a civet cat, in 2002-03, and caused a near-pandemic before disappearing. Middle East respiratory syndrome (MERS) coronavirus jumped from camels to people in 2012, but never found a way to spread efficiently among humans, and died out quickly. Now we have SARS-CoV-2, the virus that causes Covid-19.

The reasons for this new era of pandemics are complex, but as Fauci and Morens point out, one of the main drivers is the climate crisis, which is shaking up the natural world and rewriting disease algorithms on the planet. Thawing permafrost in the Arctic is releasing pathogens that haven't seen daylight for tens of thousands of years. The Vibrio bacteria that causes cholera, a diarrheal disease that haunted big cities like London and New York in the 19th century and still kills tens of thousands each year, thrives in warmer water. An even more deadly strain of the same bacteria, Vibrio vulnificus, while rare, has been detected more and more frequently in bays and estuaries on the East Coast, particularly around Chesapeake Bay. Vibrio vulnificus, if you happen to eat shellfish, might give you a bad stomachache (in rare cases, it can be fatal). If the bacteria gets in a cut or wound, however, it becomes a flesh-eating horror and kills one in five people who come in contact with it.

But the biggest impact may be on the emergence of new pathogens from animals. Through intensive agriculture, habitat destruction, and rising temperatures, we are forcing creatures to live by the cardinal rule of the climate crisis: adapt or die. For many animals, that means migrating to more hospitable environments. In one recent study that

tracked the movement of 4,000 species over the past few decades, as many as 70 percent had moved, almost all of them seeking cooler lands and waters. Some animals have made big leaps. Atlantic cod have moved more than 120 miles per decade. In the Andes Mountains in South America, frogs and fungi species have climbed a quarter mile higher over the past 70 years. In Alaska, hunters are discovering parasites from more than 950 miles southeast in Canada, alive under the skin of wild birds (tiny parasites adapt better to rapidly changing temperatures than large animals). Great white sharks are turning up as far north as Maine. "A wild exodus has begun," writes Sonia Shah in The Next Great Migration. "It is happening on every continent and in every ocean."

During this wild exodus, these animals are likely to bump into new animals and humans they have never crossed paths with before. Carlson, the Georgetown biologist, calls these events "meet cutes" - random encounters where viruses jump species and new diseases are often born. The vast majority of the new infectious diseases that have emerged in recent decades have come from these zoonotic pathogens, as they are called, with bats, mosquitoes, and ticks being among the most competent carriers of new viruses. When they jump to humans, we get pandemics like Covid-19. What's next? "It's really a roll of the dice," says Raina Plowright, an epidemiologist at Montana State University who studies the emergence of new diseases. By one count, an estimated 1.7 million currently undiscovered viruses are thought to exist in mammal and avian hosts. Of these, more than 800,000 could have the ability to infect humans.

"We really need to be prepared - both from a public-health standpoint as well as from a scientific standpoint," Fauci tells me. "The way we are now interacting on our planet with the environment... will have a great effect on vector-borne diseases [those carried by animals like mosquitoes and ticks]. We've just got to be prepared and [understand] that this is something of our own doing. Some of it we can reverse, some of it we can't. [But] we've got to make sure we are aware that this will happen, and our preparedness has to be commensurate with that risk."

Right now, it is not. After four years of President Trump, public-health infrastructure has been gutted and trust in science undermined. Trump dismantled the pandemic response team created by Obama and moved to withdraw the U.S. from the WHO. Guidelines to control the pandemic from the Centers for Disease Control and Prevention, the most respected public-health agency in the world, have been ignored. Simple measures that can save countless lives, like wearing a mask, have been transformed into political statements. President-elect Biden has vowed a restoration, but the 74 million people who voted for Trump in 2020 are going to fight hard for their God-given right to believe in pseudo-science and quack cures. Viruses aren't political, but our response to them is. If the Covid-19 pandemic has taught us anything, it's that we're woefully unprepared for what's coming.

IN 1994, in the small town of Hendra, in the suburbs of Brisbane, Australia, a number of racehorses at one of the stables in town started to get sick. No one knew why. The horses were disoriented, their faces swelled, a bloody froth poured out of their nostrils. One of them was seen banging its head against a concrete wall. Several horses collapsed and died. At about the same time, a man named Vic Rail, who worked at the stable, came down with what he thought was the flu. He ended up in intensive care, where his lungs filled up with fluid. Shortly afterward, he died. Six hundred miles north of Brisbane, another man who lived and worked on a horse farm got a mysterious illness, with seizures, convulsions, and brain swelling before dying 25 days after he was admitted to the hospital. Before the outbreaks ended, 70 horses were sick, and seven humans died who had been in close contact with dead or ill horses.

It took months of sleuthing before scientists figured out what was happening: Giant fruit bats - the Aussies call them "flying foxes" - likely congregated in fruit trees in a horse pasture. The big bats have been common to that part of Australia for 20 million years. But as the rainforests that were their natural habitat were fragmented by roads, logging, and farms, and their food sources became more and more difficult to locate due to a changing climate, they moved into civilization. They roosted in the trees in the pasture, contaminating the grass with their urine, which was laced with a virus that nobody had ever seen before - it would become known as Hendra virus. It leapt to the horses, which had grazed on the grass, and then to the humans who cared for them. Luckily, Hendra virus was not highly transmissible, and was quickly brought under control.

This story is important for two reasons. First, it's a classic "spillover event," and one that echoes the emergence of

Covid-19, which likely originated in a horseshoe bat somewhere in southern China, northern Vietnam, or Laos. No one is sure exactly where and how the jump from bats to humans happened. The virus was first detected in Wuhan, China, in late 2019, but that doesn't necessarily mean that it first infected humans there. One hypothesis is that the virus made the leap to humans while someone was exploring a cave and came in contact with infected guano. That person, or perhaps someone they transmitted it to, then traveled to Wuhan, where the virus spread widely enough to be noticed. Another hypothesis is that the virus first jumped to an intermediate host, such as a pangolin, an armadillo-like creature prized in some Asian cultures for the delicacy and medicinal properties of its flesh. The pangolin was then sold at a wildlife market in Wuhan, where the virus jumped to humans. (The theory that the virus escaped from a Chinese lab has been thoroughly debunked.) "We may never know exactly where or how this virus first made the jump from bats to people," says Plowright. It took 30 years of detective work to determine that HIV likely emerged in 1908 in Cameroon, during a bloody interaction between a human and a chimpanzee.

The second reason the Hendra virus is important is that it alerted scientists to just how good bats are at harboring infectious diseases. The list of viruses that have jumped from bats to humans is long and terrifying: Hendra, Marburg, Ebola, rabies (it can be transmitted by dogs, raccoons, and many other mammals, but in the U.S. bats are the main reservoir). Why are bats so good at harboring deadly viruses? For one thing, bats have immune systems tolerant of infection that allow them to host a wide variety of viruses without getting sick. They live long lives (up to 40 years), giving them plenty of time to spread disease. They are very mobile - some species range 30 miles or so each night in their hunt for food. And more important, as the climate warms, they can relocate. "Climate change is affecting bats in profound ways," says Plowright. "Many bat species are insectivorous, and so climate change has a big impact on their food sources, as well as on their physiological stress and where they live and how they interact with humans."

If the Hendra virus alerted epidemiologists to the link between fruit bats and viruses, that link got weirder in 1998, when the Nipah virus, a close relative of Hendra virus, showed up in Malaysia. Around the same time, two other viruses originating from bats were detected in Asia and Australia, a sign of a serious leap. "Four viruses to emerge from one host animal is unprecedented," Plowright says. The question was, "Why?"

Nipah virus was particularly scary. Nipah is a horrible pathogen, causing fever, brain swelling, and convulsions. Its fatality rate is as high as 75 percent. Of those who survive, one-third have neurological damage. It was initially isolated and identified in 1999 among pig farmers and people who had close contact with pigs in Malaysia and Singapore. Fruit bats hanging in the trees near a piggery dropped fruit infected with saliva, which the pigs ate. Nipah virus caused a relatively mild disease in pigs, but nearly 300 human cases with more than 100 deaths were reported. To stop the outbreak, more than a million pigs were slaughtered. Then in 2001, a second outbreak occurred, in Bangladesh. This time, people contracted the virus by drinking date palm sap that had been infected by the bats. Of 248 Nipah virus cases identified in Bangladesh between 2001 and 2014, 82 were caused by person-to-person transmission, and 193 ended in death - a 78 percent fatality rate. "The only thing that prevented Nipah from being a widespread pandemic was that it was not transmitted asymptomatically," says Plowright. "With Nipah, people are only contagious when they already know they have it, which makes the virus much easier to contain."

But viruses mutate, and new strains can emerge. Nipah virus belongs to a family (paramyxoviruses) that includes measles and mumps, both of which spread really well in human populations. Small changes in Nipah could enhance its ability to spread human to human, creating a pandemic with a high mortality rate. "If Nipah did become more transmissible," says Stanford's Stephen Luby, "that would be a really Black Death, plague-level concern."

To Plowright, the link between the climate crisis and disease is evident. "These bats are dependent on food collection that is regulated by climate," she explains. "When does a forest flower, and what triggers it to happen? It's not well understood, but it's a whole bunch of factors that come together, like the temperature, the season, the rainfall. Climate is a key factor. Things are changing really quickly. You can imagine a network of food caches across a landscape - some of the bats are moving from one patch to the next; one has flowers and nectar, then they die off, and the bats go to the next patch. You start taking away those patches, get to a point where there's no food, so they end up in people's yards, or at horse stables, or anywhere food is plentiful."

The more contact these bats have with other animals, as well as people, the more opportunities the viruses they carry have to spill over. "SARS-Cov-2 has been a humanitarian disaster," Plowright says. "But can you imagine if it was killing half the people it infected after some period of asymptomatic transmission? That's the risk we are taking here. And the quicker the climate changes, the bigger the risk grows."

IN A small, sparsely equipped lab in a downand-out neighborhood in Houston, Max Vigilant is sorting through a pile of hundreds of dead mosquitoes, looking for the winged terrorist Aedes aegypti. Vigilant, 58, is the head of operations at the mosquito and vector control division of the Harris County Department of Public Health - basically, he is the head mosquito hunter in what is widely recognized as one of the top mosquito-control operations in the United States. His expertise is hard-won: On the Caribbean island of Dominica, where he was born, he got dengue fever when he was 16, sweating through it with a home remedy of lemon water. The experience changed his life, and ever since, he has been working at the intersection of mosquitoes and human health.

A few hours earlier, this pile of now-dead mosquitoes had been buzzing around a Houston neighborhood. Vigilant retrieved them from a trap, tossed them in a freezer at the lab for three minutes ("Doesn't take [Cont. on 80]), and now he is sorting out what he's got. Soon these mosquitoes will be ground up and run through a series of tests to determine what, if any, pathogens they contain. There are millions of mosquitoes in Harris County. Every week, a few thousand are ground up to see if anything scary pops out. It's not exactly sophisticated screening, but it's more than most cities do.

Most of the mosquitoes in Vigilant's pile belong to the Culex genus, ordinary backyard mosquitoes that are pretty much everywhere in the South. But Vigilant is looking for something else. He pokes through the pile, then plucks one out. At first glance, it looks the same as the others. He points out the bushy eyebrows, which is one way you distinguish a male from a female (this is a female). "See the white stripes on her abdomen?" he says to me, holding it under a big magnifying glass mounted on the desk. "She looks like she is wearing a white tuxedo."

He holds her up like a prize, twisting her around so I can see her from every angle. "That's Aedes aegypti," he says. "She's kind of beautiful, isn't she?"

There are roughly 3,000 species of mosquitoes in the world. Of those, only a small percentage are of concern from a public-health perspective: Culex pipiens, which carries West Nile virus, and Aedes albopictus, also known as the Asian Tiger mosquito, which has recently arrived in the U.S. from Asia and can carry dengue and Zika, but does not lust after human blood like Aedes aegyp

Aedes aegypti is an extremely competent vector for dengue and Zika, as well as yellow fever and chikungunya, making it one of most dangerous animals on Earth. But it is also one of the most companionable (or, as Fauci puts it, Aedes aegypti is "uniquely anthropophilic"). It's the Labrador retriever of mosquitoes, happiest when it is living in or near our homes, laying eggs in little puddles of clean, fresh water in a bottle cap or the rim of a planter. And because it thrives in higher temperatures than other mosquitoes, it is well-adapted to life on a warming planet.

The impact of climate change on mosquitoes is fairly easy to model, in part because mosquitoes are very sensitive to temperature changes and will basically move to stay in their happy zone. And that happy zone is expanding. Aedes aegypti-transmitted diseases already cause more than 50 million infections every year worldwide, including in the United States, and cases have increased by thirtyfold in the past 50 years because of changes in climate, land use, and population. Mexico City, for example, has always been a few degrees too cold for Aedes aegypti to get established. Because of that, the city has always been blissfully free of yellow fever, dengue, and Zika, which have haunted the lowlands of Mexico. But now, as temperatures rise, Aedes aegypti is moving in. For the 21 million people who live in the city, it's an alarming development. Wherever Aedes aegypti turns up, dengue, Zika, and other diseases are sure to follow. You can already see this happening in places like Nepal, which, until recently, was nearly free of mosquito-borne diseases. In 2015, Nepal had 135 cases of dengue. In 2019, there were 14,662 cases. Last summer's dengue outbreak in Florida was fairly small, only about 60 cases (there were no fatalities), but it is a sign that the disease is gaining a foothold in the U.S. and could spread northward.

In other places, the changes in mosquito-borne diseases will be more complex. Malaria kills more than 400,000 people a year, mostly children in sub-Saharan Africa. The most deadly form of the disease is caused by the parasite

Plasmodium falciparum, which is carried by the Anopheles gambiae mosquito, a smaller, less elegant creature than Aedes aegypti, and more sensitive to high temperatures. As the planet warms, West Africa is likely to grow too hot for Anopheles gambiae, which will shiftto cooler regions in Eastern and Southern Africa. A recent study by Sadie Ryan, a medical geographer at the University of Florida, found that, under a high carbon-emissions scenario (which would cause more severe global warming), an additional 76 million people could be at risk from exposure to malaria transmission in Eastern and Southern Africa by the year 2080. At the same time, heat-loving Aedes aegypti will move into West Africa, vacated by Anopheles gambiae, putting millions of Africans at risk for dengue, Zika, and other diseases.

In Houston, as in most of the South, Aedes aegypti is established but less common. The city had its first outbreak of dengue in 2003, and a flare-up of Zika in 2016. Vigilant and other members of Harris County Mosquito Control are constantly on the lookout for Aedes aegypti, knowing they are harbingers of doom. Their only real tool to fight them is to spray insecticides, which they do from the back of pickup trucks whenever there is evidence of a flare-up. But Aedes aegypti, as well as other mosquitoes, are developing immunity to many commercial insecticides. "We are losing the war," says Galveston lab director Scott Weaver. Technological advances, such as genetically engineering mosquitoes to produce female offspring that are infertile, may hold some promise in the future, but right now Aedes aegypti reigns supreme as the most insidious and unstoppable vector of future diseases. As Anthony Fauci wrote, "Any virus that can efficiently infect Aedes aegypti also has potential access to billions of humans."

T he Galveston National Laboratory is a fortress of pathogens, although you would never know if from the outside. It sits on the campus of the University of Texas Medical Center like any other building. There are some concrete barriers on the outside, and a bunch of weird-looking exhaust systems on the roof, but otherwise, it could easily be the building where you took Chemistry 101 in college. Inside, in one of about a dozen Biosafety Level 4 labs in the United States, scientists work on some of the most lethal viruses in the world: Ebola, Nipah, Marburg, and others

The BSL-4 lab is Dennis Bente's workroom. A broad-shouldered guy with a full dark beard and a slight German accent, Bente grew up in a small town in northwest Germany and studied veterinary medicine in Hannover before developing an interest in vector-borne diseases. He worked with mosquitoes for a while, then decided ticks were more compelling.

The BSL-4 lab is basically a big concrete box within the larger lab. Entering it is like a journey into deep space. Bente first passes through a buffer corridor, where he grabs a clean pair of scrubs. Then he enters a changing room, where he strips offhis street clothes and pulls on the scrubs. Next is the suit room, where he steps into what he calls his "space suit," including built-in gloves and a clear plastic helmet. To pressurize the suit, and give himself air to breathe, Bente hooks up to an air hose and inflates like the Michelin Man. If all is well, he steps into the air lock, which is the most important barrier between the deadly pathogens and the outside world. He opens a heavy, airtight submarine door, closes it, walks a few feet, then opens another heavy, airtight submarine door. Finally, he steps into the hot zone.

Inside, he works with a group of ornate-looking ticks that are native to the Mediterranean basin, known as Hyalomma ticks. They are brown, with yellow stripes on their legs, which are much longer than the stubby legs on deer ticks you see in Upstate New York. They look almost spidery, which is not surprising - ticks are arachnids, not insects, in the same family as spiders and scorpions. With their long legs, Hyalomma ticks are the speed demons of the tick world. (On YouTube, you can find videos of Hyalommas running after people like tiny lions in pursuit of an antelope.) Unlike many other ticks, Hyalommas are predators. They are one of the few species of ticks that have eyes (the word "Hyalomma" is derived from the Greek words for "glass" and "eye"). Instead of using CO2 sensors like other ticks to locate a blood meal, Hyalommas sense vibrations in the ground, and watch for shadows, to chase down a nearby human (or livestock, one of their favorite foods).

But Bente is not studying Hyalomma ticks because of their athletic ability or visual acuity. He is studying them because they are the most competent carriers and transmitters of Crimean Congo Hemorrhagic Fever (CCHF) to humans. One way to think about CCHF is it's basically a slightly less awful version of Ebola. CCHF often starts with high fever, joint pain, and vomiting. Red spots appear on your face and throat. Then by the fourth day, you get

severe bruising and nosebleeds, and in many cases, uncontrolled bleeding from other orifices. It lasts for two weeks or so. There is no treatment, no vaccine, no cure. The fatality rate for people with CCHF ranges from about five percent to 30 percent.

Right now, as far as Bente knows, the only Hyalomma ticks in America are in the Galveston lab. In the wild, they are found in North Africa, Asia, and parts of Europe (in Turkey, there are about 700 CCHF cases a year). The ticks, which thrive in warm, dry climates, are expanding their range. In recent years, CCHF has killed people in Spain and northern India.

Bente keeps a colony of Hyalomma ticks in his lab and feeds them on mice and rabbits that he deliberately infects with the CCHF virus. ("The virus has no impact on these animals," Bente points out. "It's only dangerous to humans.") He is studying fundamental questions about Hyalomma ticks and CCHF that should freak out anyone who'd like to walk through nature without worrying whether they'll contract a virus that will make their eyeballs bleed: Can Hyalomma ticks be established in the U.S.? (It's extremely unlikely.) Might other types of ticks be carrying CCHF in Africa? (Yes, but so far, they are only "a sideshow," Bente says). Is airborne transmission of CCHF possible? ("CCHF is a very old virus," Bente says. "Why mutate now?") But Bente still has concerns.

As disease vectors, ticks are very different from mosquitoes. They live up to two years instead of a few weeks. But like mosquitoes, they are sensitive to changes in temperature and can't survive long in cold or dry climates. As the world warms, they are following the heat. Some tick species are moving as much as 30 miles north each year - an unseen parade of bloodsuckers conquering new terrain. They are difficult to target with insecticides, and have many remarkable survival tricks, such as the ability to go long periods without water by basically spitting into a pile of leaves and then drinking it later when they are thirsty. Heat is also changing ticks' appetites. A recent study found that as temperatures rise, brown dog ticks that transmit Rocky Mountain Spotted Fever - a disease with a four percent fatality rate - are twice as likely to choose to bite people over dogs. In the U.S., ticks can carry more than 20 different pathogens - and more are being discovered all the time. "The more we look at ticks, the more viruses we continue to find," says Bobbi Pritt, a microbiologist at the Mayo Clinic in Rochester, Minnesota.

Lyme disease is emblematic of the threat ticks pose in a warming world. It is caused by deer ticks carrying the bacteria Borrelia burgdorferi. Lyme was discovered in Connecticut in the mid-1970s. Today it is a major, and growing, health threat. According to the CDC, reported cases in the U.S. have tripled since the late Nineties. Lyme disease has become an almost "unparalleled threat to regular American life," as Bennett Nemser, an epidemiologist who manages the Cohen Lyme and Tickborne Disease Initiative at the Steven &Alexandra Cohen Foundation, has said. "Really anyone - regardless of age, gender, political interest, affluence - can touch a piece of grass and get a tick on them."

It's not just the heat that has expanded the range of Lyme-carrying ticks. It's also the increasingly fragmented landscapes in the Northeast. As forests are cut up into suburban developments, the populations of foxes and owls decline, which leads to an explosion in the population of white-footed mice, which are the main reservoir for Borrelia burgdorferi. Young larval ticks feed on the infected mice, and then pick up Lyme and later spread it to anyone passing by.

But in Bente's view, the most worrisome development in TickWorld is the invasion of Asian longhorned ticks in the U.S., which he calls "a cautionary tale." Nobody is quite sure how or when the first Asian longhorned tick (a.k.a. Haemaphysalis longicornis) arrived in the continental U.S. They are native to East Asia, including Australia and New Zealand. They were first reported in 2017, in New Jersey. Within a year, researchers had found the tick in eight other states, and its territory continues to expand. One key contributor to its rapid spread is the fact that females can reproduce through cloning themselves, without the need for mating, a process called parthenogenesis. This makes it extremely hard to control. "In practice, it's impossible to eradicate this species," says Illa Rochlin, an entomologist at Rutgers University.

Asian longhorned ticks are aggressive biters, and can gang up on prey to drink large quantities of blood. Their preferred meal is cattle. In parts of New Zealand and Australia, the ticks have reduced production in dairy cattle by 25 percent. So far, there is no evidence that Asian longhorns in North America have transmitted diseases to

humans. But that could change. Pritt calls the longhorned invasion "extremely worrisome." They can carry several deadly human pathogens, including potentially fatal severe fever with thrombocytopenia syndrome (SFTS) virus and Rickettsia japonica, which causes Japanese spotted fever. "While these pathogens have yet to be found in the United States, there is a risk of their future introduction," Pritt told me.

A close cousin of SFTS, as it turns out, is CCHF. What worries Bente is the possibility of what scientists call "vector switching." That is, that somehow the CCHF virus jumps from Hyalomma ticks, which are not yet in the U.S. outside of Bente's lab, to Asian longhorned ticks, an aggressive biter that is becoming widespread.

Could CCHF make the leap to Asian longhorned ticks? "Nature is complex," Bente tells me. "I don't like the narrative that says we are one tick bite away from catastrophe. But at the same time, I can't say it won't happen."

I ask Max Vigilant to show me the most mosquito-infested neighborhood in Houston, the place where, if dengue or Zika or some other virus were to emerge, people would be most at risk. We leave the mosquito control center and drive (in separate vehicles, due to Covid) 30 blocks or so into a mostly black and Hispanic neighborhood with flatroofed homes. At the time, Covid was raging, the streets were empty, hospitals were at max capacity, and the fourth-largest city in America felt like a ghost-town. We park at a nondescript intersection and get out and stand across from a lot with abandoned cars and a motorcycle propped up on a milk crate, missing its front wheel. There is a lot of green - long-limbed oaks, shaggy palms, uncut grass. My first thought is, if I were a microbe, this would be a good place to hide. My second thought is, poverty. I notice a ripped window screen on a house nearby. And despite the heat, I hear no hum of air conditioning.

"This is mosquito heaven," Vigilant says. He points to a drainage ditch near the side of the road where mosquitoes could spawn, to all the greenery, where they could rest in the shade during the day, and the easy access to human blood, through the ripped screens and open windows. "It reminds me of my home in Dominica."

Among public-health officials, scientists, and philanthropists concerned about the new pandemic era, there is much talk about the need for preparedness. "We need a global disease-surveillance system," says Mark Smolinski, the president of Ending Pandemics, a nonprofit that is engaged in eight countries to deploy cellphone and other simple technology to allow people to notify public-health officials of suspicious outbreaks. In the U.S., there have been ambitious federal programs, including PREDICT, which was designed to detect and help prepare for new outbreaks. It started in 2009 as part of the Obama administration's Emerging Pandemic Threats program, inspired by the 2005 H5N1 bird-flu scare. PREDICT spent more than $200 million to train about 5,000 scientists in 30 African and Asian countries, and to build or strengthen 60 laboratories to help detect animal viruses that could endanger humans. Scientists working for PREDICT collected more than 160,000 biological samples and found nearly 1,000 new viruses, including a new strain of Ebola. But the Trump administration wasn't interested in continuing any program that contributed to the greater global good, especially if it had been set up under Obama. Funding ran out in October 2019, just a few months befor the Covid-19 pandemic hit. Last April, the Trump administration granted the program an emergency extension, but by then it was too late. President-elect Biden has promised to relaunch PREDICT, as well as restore the White House National Security Council Directorate for Global Health Security and Biodefense, which the Trump administration had folded into another organization in 2018. Biden's new chief of staff, Ron Klain, is widely respected for his role as Obama's "Ebola czar" during the outbreak of the virus in Africa in 2015, and will surely put the White House on a wartime footing against Covid.

But standing on that forlorn street in the fossilfuel capital of the world made it clear to me that a lack of disease surveillance is not the main problem. The main problem is how we live. We mow down forests to build suburbs and raise cattle in meat factories and power our homes and cars with fossil fuels that are heating the planet and upending the natural world. As Dr. Aaron Bernstein, the interim director of the Center for Climate, Health, and the Global Environment at Harvard's T.H. Chan School of Public Health, put it: "If you wanted to do something to prevent disease emergence, first of all we need to seriously reconsider how we do business with the biosphere. We can't simply pretend that we can extract things and put species in assortments that they've never been in before, and hope that somehow doesn't lead to disease emergence."

And it's not just new diseases. Climate change will also increase our vulnerability to old ones. Food production in

some of the most desperate regions of the world will decline due to increased heat and drought. "The biggest impact climate change has on human health is likely to be the rise in common diseases like tuberculosis and measles in malnourished people in places like Ethiopia and Mali," says Stanford's Stephen Luby. "When people are starving, they are more vulnerable to bacteria and viruses."

In Texas, the first state to hit 1 million cases of Covid-19, better disease surveillance would not have changed anything. People were practically dropping dead in the street from the virus, and still you could wander through a medium-size town in the state and not see a single person wearing a mask. Texas Gov. Greg Abbott, a staunch Republican, clashed with mayors and county judges over their authority to shut down businesses and enforce face-mask orders. The people who suffered most, as always, were poor people, people of color, people without health insurance, people on the margins of our high-tech fossil-fuel-powered society. In the end, pandemics are a political problem, not a scientific one.

But the fight continues. After we talk for a few minutes, Vigilant grabs a pickax out of the back of his truck. He walks over to a manhole cover in the middle of the street, sticks the pick into a hole, and muscles it open. Dangling from the underside of the cover is a mosquito trap. A canister of dry ice and a light dangles from a chain, with a mesh container at the bottom. The light and the CO2 from the dry ice attract the mosquitoes, and the mesh traps them inside. If there is a new microbe in town, there's a decent chance it will show up here.

Vigilant unhooks the trap and holds it up so I can see the mosquitoes. There are hundreds of them, buzzing around, each one its own package of pathogens, each one potentially carrying a virus or parasite that humans have never encountered before. Maybe the new pathogen doesn't survive the leap to humans. Or maybe it takes hold, replicates a few billion times, and changes the course of civilization.

Sidebar

Contributing editor Jeff Goodell wrote about Trump's undermining of science in November.

IMAGINE A DISEASE WITH 75 PERCENT CASE FATALITY THAT IS EQUALLY TRANSMISSIBLE," SAYS AN EPIDEMIOLOGIST. "THAT WOULD BE AN EXISTENTIAL THREAT TO HUMAN CIVILIZATION."

I don't like the narrative that says we are one tick bite away from catastrophe," says a researcher. "At the same time, I can't say it won't happen

DETAILS

Subject:	Pathogens; Fatalities; Zika virus; Severe acute respiratory syndrome coronavirus 2; Animals; Disease; Pandemics; Epidemics; Bacteria; Influenza; Skin; Fever; Ebola virus; Mosquitoes; Respiratory diseases; Coronaviruses; Climate change; Tropical diseases; COVID-19
Location:	Florida Keys; United States--US
Publication title:	Rolling Stone; New York
Issue:	1347
Pages:	68-73
Publication year:	2021
Publication date:	Jan 2021
Publisher:	Rolling Stone Licensing LLC

Place of publication:	New York
Country of publication:	United States, New Yor k
Publication subject:	Music
ISSN:	0035791X
Source type:	Magazine
Language of publication:	English
Document type:	Feature
ProQuest document ID:	2474915453
Document URL:	https://uc.idm.oclc.org/login?qurl=https%3A%2F%2Fwww.proquest.com%2Fmagazines%2Fdeadly-climate%2Fdocview%2F2474915453%2Fse-2%3Faccountid%3D2909
Copyright:	Copyright Rolling Stone Licensing LLC Jan 2021
Last updated:	2023-04-12
Database:	Music Periodicals Database,Research Library

LINKS

Check for full text via ArticleLinker, Check Full Text Finder for Full Text

Database copyright © 2023 ProQuest LLC. All rights reserved.

Terms and Conditions Contact ProQuest