CONTENTS

INTRODUCTION

"Animals are good to think with."

—Claude Lévi-Strauss

I was twelve weeks pregnant and nauseous, but excited. After two days of co-running a workshop in Mountain View, California, I had been handed an opportunity I couldn't resist, so I woke up at the crack of dawn and flew from San Jose to Denver to Boston to Zurich, and took multiple trains to Bavaria, Germany, determined to get to my destination: Ingolstadt.

Ingolstadt is a university town on the banks of the Danube River with beautiful red roofs and cobbled streets. It's famous for its nineteenth-century medical laboratory, where scientists and students performed experiments on dead pigs, inspiring Mary Shelley to situate a large part of her famous 1818 novel, *Frankenstein,* in this Bavarian city. But Frankenstein wasn't the reason I made the 5,800-mile trek. Ingolstadt also happens to be the home of Audi AG, the German luxury car manufacturer.

Audi had recently launched a research initiative to investigate societal questions around AI, autonomous vehicles, and the future of work, and I jumped at the invitation to attend a meeting in 2017, curious to know what was on their minds. By the time I made it to Audi's base of operations, fueled by adrenaline and excitement, my body was moving

into a new stage of pregnancy and my nausea was lifting (thankfully, as the catered buffet lunch in the room was a rich, pungent veal stroganoff on noodles). My visit included a tour of a factory floor where cars were made. It was a gray and cloudy day, and a bus picked us up outside the headquarters where the attendees had gathered and drove us through the drab and massive complex of buildings, dropping us off at a giant warehouse. I tossed my phone into a dirty rubber box in the hallway as instructed and followed our guide onto the factory floor.

In the factory, we marveled at massive cages encasing robotic arms that towered over our heads. The robots swung around and moved through their spaces in a fast, precise, and mesmerizing dance, sparks flying as they worked with the metal pieces that would eventually become cars. As we oohed and aahed over the spectacle, we gave barely any attention to the human workers who were stationed far away in another part of the room, doing something to the car bodies. The smooth operation of the robots seemed routine and almost boring to our guide, which was no surprise. Car companies have been working with caged robotic arms in their factories for decades. But the reason Audi had launched their new AI initiative was because the company knew that these factory robots, despite being an impressive display of high-quality German engineering, were not the robots of the future.

The world of robotics is changing. With increasing developments in sensing, visual processing, and mobility, robots are now able to move beyond their traditional caged existence in factories and warehouses and enter into new spaces—spaces that are currently occupied by humans. Companies like Audi are investing heavily in AI and robotics, not just in their factories but also in their cars. Robots are now being put to work inspecting our sewers, mopping our floors, delivering our burritos, and keeping our elderly relatives company. From our households to our workplaces, a revolution is coming. What does this mean for the people I saw working across the room in the car factory? According to some of the headlines, they aren't the only ones on the cusp of losing their jobs as robotic technology advances: we all are. Against the backdrop of broader economic and social anxiety, the conversation has turned from "Will robots replace me?" to "How soon will robots replace me?"

Many people are not thrilled by the anticipated robot takeover. Our

society?" It was the beginning of a completely different academic career than I had ever imagined for myself. For over a decade now, I've worked side by side with roboticists and applied my legal and social sciences background to the technology. I've researched literature, delved into human psychology, done experiments, and had conversations with people all over the globe.

It's clear to me that the idea of robots we are most familiar with comes from our science fiction. I've always loved science fiction. I grew up reading all the sci-fi I could find, from trashy pulp novels to great authors like Ursula Le Guin and Octavia Butler who opened my mind to new ways of thinking. But now that I work in robotics, I've also seen how our mainstream Western science-fictional portrayal of robots does the opposite. As technology critic Sara Watson points out, our stories, too often, compare robots to humans.

I believe that this human comparison limits us. It stirs confusion about the abilities of machines, stokes an exaggerated fear of losing human work, raises strange questions over how to assign responsibility for harm, and causes moral panic about our emotional attachments. But the main problem I have with our eagerness to compare robots to humans is that it gives rise to a false determinism. When we assume that robots will inevitably automate human jobs and replace friendships, we're not thinking creatively about how we design and use the technology, and we don't see the choices we have in shaping the broader systems around it.

This book offers a different analogy. It's one we're familiar with, and it's one that changes our conversations in surprisingly significant ways. Throughout history, we've used animals for work, weaponry, and companionship. Like robots, animals can sense, make their own decisions, act on the world, and learn. And like robots, animals perceive and engage with the world differently than humans. That's why, for millennia, we've relied on animals to help us do things we couldn't do alone. In using these autonomous, sometimes unpredictable agents, we have not replaced, but rather supplemented, our own relationships and skills.

We've domesticated oxen to plow our fields and learned to ride horseback, extending ourselves and our societies in new ways physically and economically. We've created pigeon delivery systems, set loose

flaming pigs to ward off elephant attacks, and trained dolphins to detect underwater mines. From the beginning of laws known to humankind, we've dealt with the question of responsibility when autonomous beasts cause harm, even putting animals themselves on trial for the crimes they committed. And we've also extended ourselves socially: throughout history, we've treated most animals as tools and products, but have also made some of them our friends.

Using animals to think about robots acknowledges our inherent tendency to project life onto this technology, something that has fascinated me for years. From the simple vacuum cleaner roaming around in our physical space, to dragonfly robots that flap their wings in a biologically realistic way, we respond viscerally to moving machines, even though we know that they aren't alive.

In comparing robots to animals, I'm not arguing that they are the same. Animals are alive and can feel, while robots suffer no differently than a kitchen blender. Animals are often more limited than robots—I can train Fido to retrieve a ball, but not to vacuum a floor—but they can also handle unanticipated situations more easily than any machine. The point is that this thought exercise lets us step out of the human comparison we're clinging to and imagine a different kind of agent.

In collecting some of the parallels in the past, present, and future of our relationships to both animals and robots, I've found that using animals to think through our most pressing concerns changes a lot of conversations. Just like animals, robots don't need to be a one-to-one replacement for our jobs or relationships. Instead, robots can enable us to work and love in new ways. Using a different comparison lets us examine how we can leverage different types of intelligences and skills to invent new practices, find new solutions, and explore new types of relationships—rather than re-creating what we already have. Setting aside our moral panic also helps us see some of the actual ethical and political issues we will be facing as we begin to live alongside these machines, from nonlinear economic disruption to emotional coercion.

This book begins with a contemporary exploration of how we are integrating robots into our spaces and systems, drawing parallels to how we've used animals in the past. In this first part, "Work, Weaponry, Responsibility," I pick up many familiar questions that are in the

foreground of our conversations about the future: Will robots replace our jobs? Is artificial superintelligence a threat? How do we assign responsibility for unanticipated robot behavior? What I want to illustrate is how much our perception of robots as quasi-humans (falsely) shapes those conversations, and that using an animal analogy leads us down a new path, one that doesn't force us to put productivity over humanity.

The second part of the book, "Companionship," moves slightly further into the future and explores emerging developments in robot companions. Social robots, while not yet widespread, are on the rise. These robots can't feel, but we feel for them, with people even mourning them when they "die." Here, our history with companion animals demystifies the human-replacement stigma around our emotional connections to robots. Recognizing our ability to form relationships with a wide variety of "others" helps us set aside moral panic, but also reveals some unresolved challenges with privacy, bias, and economic incentives that we need to pay closer attention to as we move ahead.

The third and final part of this book, "Violence, Empathy, and Rights," takes the animal analogy all the way into the very futuristic-sounding realm of robot rights. The humanlike machines in our science fiction stories have prompted conversations about our likely future treatment of robots. But looking at the convoluted path of Western animal rights provides a different prediction for how a robot rights movement would play out. Our history of relating to nonhumans shines a harsh and insightful light on how we choose which lives have value, revealing a new understanding of how we relate—not just to nonhumans but also to each other.

Historians and sociologists have long used animals to think about what it means to be human, but animals also have a lot to teach us about our relationship with robots. The robotic technologies that are increasingly woven into the fabric of our daily lives bring questions and choices that we, as societies, will face. This book is a compilation of those questions, those choices, gleaned from the fields of technology, law, psychology, and ethics, and set against a backdrop of our historical relationship with nonhumans, to try and make sense of what a future with this new breed means for us, and how we can shape it.

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AUTHOR'S NOTE

WHAT IS A ROBOT, ANYWAY?

"Never ask a roboticist what a robot is."

—Illah Nourbakhsh, a roboticist

Here's a surprisingly tricky question that I get a lot: what is a robot?

We all sort of know what a robot is: the metal Maschinenmensch from the 1920s science fiction classic *Metropolis*; Rosie from *The Jetsons*; and beloved *Star Wars* heroes R2-D2 and C-3PO. My toddler gleefully exclaims "beep boop" upon encountering a robot, like the vintage metal windup toy in his grandfather's office and the robot vacuum cleaner that roams our floor. But he also says "beep boop" to our office printer when it lights up and spits out pieces of paper, and he doesn't think that our computers are robots. The lines that adults draw aren't any less arbitrary. When digital rights expert Camille François and I ran a workshop with a fairly tech-savvy group of colleagues, they struggled to define the term and identify which of their household devices was a robot. Is it a machine that can perform tasks on its own? The dishwasher can do that, and so can a desktop computer, but people hesitated to put them in the robot category on our whiteboard.

Our colleagues weren't being ignorant: the definition of robot is elusive. Coined in 1920 by Karel Čapek, the term "robot" (*robota* = forced labor in Czech) originates from his play titled *R.U.R.* (*Rossum's*

Universal Robots), a story about the exploitation of artificial people who are put to work as "robots" in factories and eventually rise up against their makers. Early on, we started to use "robot" to refer to technologies that replaced humans with machines, applying the term to anything from gyrocompasses to vending machines. Some people say that the definition of a robot is simply a machine that's new and unfamiliar to the general public, and that these robots become "dishwashers" and "automatic thermostats" once the novelty wears off.

Asking roboticists for a concrete definition doesn't help very much, either. Their answers tend to be more technical and narrowly defined, but still leave plenty of fuzzy edges. Most of them agree that a robot needs a body. Artificial intelligence has been a hot topic of discussion for the past few years, but this book is mainly about physical robots for reasons I'll elaborate on in chapter 4—their embodiment has some pretty unique effects.

Some roboticists say that a robot is a constructed system with mental and physical agency that's not "alive" in the biological sense. Others use a paradigm called "sense, think, act," which describes machines that can sense, make autonomous decisions, and act on their physical environments. This sounds pretty good, but it gets tricky when drilling down on what terms like "act" mean exactly. My smartphone has sensors, can make decisions, and act on its environment (by making sounds, displaying light, vibrating, etc.), yet many roboticists don't believe a smartphone is a robot.

Without a concise definition, how can anyone even begin to write a book about robots? I asked one of my most respected friends and mentors, law professor Jamie Boyle, and he responded: "If anyone insists you give them an essential definition of a robot, you tell them, 'Definitions don't work the way you think they do, dumbass'" (the latter word presumably being a term of art in the law). The idea that there could be a definition of anything is a philosophical mistake. Our language is community- and context-specific, something that University of Washington researchers Meg Young and Ryan Calo have demonstrated in the case of "robot": how you define it depends on the field you're in. And that's fine. In fact, the very purpose of this book is to challenge a singular view of robots.

The reason this challenge to our thinking is so important is that robots are unique in a specific way: unlike other new technologies, like a cryptocurrency that people may struggle to picture in their minds, we all have a vivid image of what a robot is. It's an image that's heavily influenced by science fiction and pop culture. This book questions that image, of robots as quasi-humans, and shows that it seeps into how we design and integrate real robots in our world. A lot of the framing here applies to our thinking on artificial intelligence more broadly. At the same time, the ideas here don't apply to every single physical device that could technically be defined as a robot. Instead of establishing perfect definitions and rules that universally apply to all thinking machines, this book encourages us to stretch our minds and question our underlying assumptions.

This exercise begins in Part I in the workplace, where we should be thinking of robots not as our replacements, but more creatively: as a partner in what we're trying to achieve.

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WORKERS TRAINED AND ENGINEERED

[Content warning for this chapter: animal cruelty]

> "We have used pigeons, not because the pigeon is an intelligent bird, but because it is a practical one and can be made into a machine, from all practical points of view."
>
> —B. F. Skinner

One of the most enjoyable experiences in Claire Spottiswoode's life was the first time she walked through the woods, letting a little bird lead her to honey. Spottiswoode is a zoologist at the University of Cambridge and the University of Cape Town. She's done extensive field research in the savannas of southern Africa, learning how the Yao villagers communicate with a bird called the honeyguide.

The honeyguide is one of the few avians that can digest wax. To access their food of choice, they have evolved to attract the attention of humans, then lead them to beehives. Once people have harvested the sweet, golden honey, the honeyguide gobbles up the exposed comb and grubs. The birds and humans form a perfect team: the honeyguides are far better at finding beehives, which are often located high in the trees, but they need human help to open them.

The honeyguide-human collaboration goes back to at least the 1500s, but some zoologists think that we've searched for beehives together for closer to 1.9 million years. Honeyguides aren't the only animals that

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INTEGRATING THE NEW BREED

[Content warning for this chapter: child abuse]

> "[M]an had always assumed that he was more intelligent than dolphins because he had achieved so much—the wheel, New York, wars and so on—whilst all the dolphins had ever done was muck about in the water having a good time. But conversely, the dolphins had always believed that they were far more intelligent than man—for precisely the same reasons."
>
> —Douglas Adams, *The Hitchhiker's Guide to the Galaxy*

The animal world contains a wide variety of different talents, many of which exceed human abilities. Yet when it comes to robots and AI, we're hung up on a very specific type of intelligence and skill: our own. From the moment I was visibly pregnant, I heard one phrase over and over again: "You must find it so interesting to watch your child's brain develop, given your love for robots." This phrase is a great conversation starter, and rather than tire of it, I find it very interesting that people make this well-intended inference repeatedly.

Of course, it's fascinating to observe how babies learn about the world. After I had my son, I spent many hours in a yellow IKEA armchair, holding my newborn and watching his every move. Witnessing the moment he discovered his own hand was completely mind-blowing and, no exaggeration, one of the most profound experiences of my life. But when we compare children to robots, we sometimes

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TRESPASSERS

ASSIGNING RESPONSIBILITY FOR AUTONOMOUS DECISIONS

[Content warning for this chapter: death, animal cruelty]

> "[T]he machine like the djinnee, which can learn and can make decisions on the basis of its learning, will in no way be obliged to make such decisions as we should have made, or will be acceptable to us. For the man who is not aware of this, to throw the problem of his responsibility on the machine, whether it can learn or not, is to cast his responsibility to the winds, and to find it coming back seated on the whirlwind."
>
> —Norbert Wiener, mathematician and philosopher

> "Where my beasts of their own wrong without my will and knowledge break into another's close, I shall be punished, for I am the trespasser with my beasts."
>
> —Anonymous case during the reign of Henry VII

In the depths of the winter of 1457, in the town of Savigny-sur-Etang, in Bourgogne, France, a five-year-old boy named Jehan Martin was murdered. Witnesses reported the horrific crime to the authorities, and they were able to arrest the killer, who was a mother herself. Some of the witnesses suspected that her six children had participated in the crime,

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COMPANIONSHIP

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ROBOTS VERSUS TOASTERS

"Man is by nature a social animal."

—Aristotle

Around 2014, Hiroshi Funabashi received an odd request from a client. Funabashi was the supervisor of repairs for A-Fun Co., a Japanese company that specialized in fixing old Sony products that had been discontinued or fallen out of warranty. A seventy-five-year-old woman had submitted a robotic dog called an AIBO for repair, but instead of describing a technical problem, she wrote in asking whether anything could be done for her robot's "aching joints." In his correspondence with the woman, Funabashi realized that she viewed the robot dog as her pet.

This wasn't accidental on Sony's part. The little metallic cyber-dog AIBO (Japanese for "pal" or "partner") was marketed as "Man's Best Friend for the 21st Century." Launched in 1999, AIBO was one of the most sophisticated interactive toys to hit the market. The little companion dog had a persona, reacted to people, and could act happy and sad. According to Sony's description, AIBO had "real emotions and instincts." That was, technically speaking, false advertising, but it didn't matter. People knew that their AIBO couldn't feel, and yet many of them treated it as though it did.

When Sony announced the first few limited runs of the toy in Japan and in the US, every unit sold out within minutes. Sony ramped up

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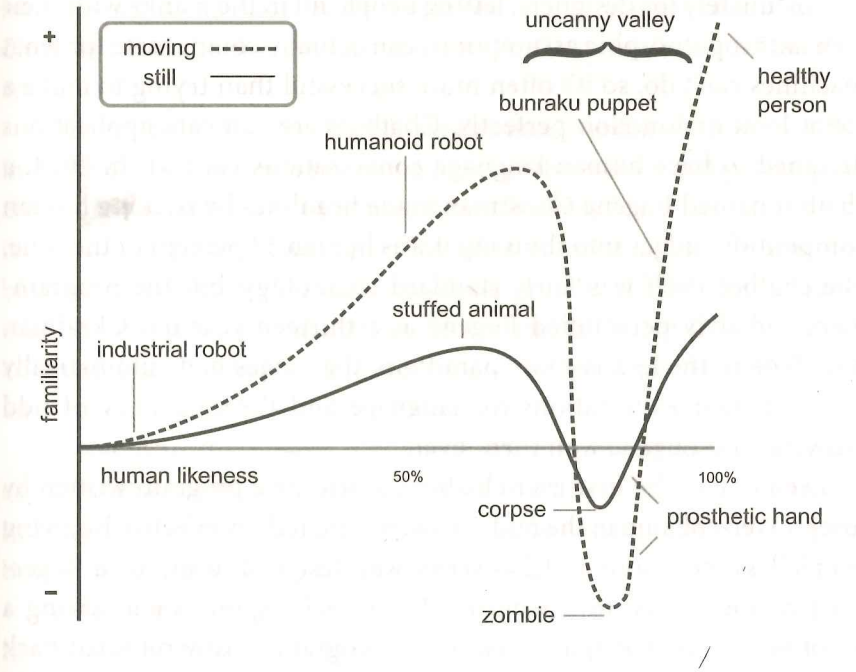
reason not to aim for human replicas: the "uncanny valley" (bukimi* no tani genshō (不気味の谷現象). In the 1970s, Masahiro Mori, a professor of engineering at the Tokyo Institute of Technology, came up with the idea that we increasingly enjoy robots the more humanlike they become, but as the design gets too close to humans without replicating them exactly, our affinity for them changes to revulsion. Mori's theory also explains, for example, why we think zombies and prosthetic hands are creepy, but not (for the most part) other people or stuffed teddy bears.

Not everyone agrees with the hypothesis. The valley itself has been tested empirically, and the results have been mixed. But Mori's concept persists and continues to resonate intuitively. One of the areas where it



The uncanny valley hypothesis, according to Mori

* Bunraku is a form of traditional Japanese puppet theater from the seventeenth century.

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(HU)MAN'S BEST FRIEND

THE HISTORY OF COMPANION ANIMALS

[Content warning for this chapter: animal suffering]

> "I sometimes think that, in the desperate straits of humanity today, we would be grateful to have nonhuman friends, even if they are only the friends we build ourselves."
>
> —Isaac Asimov, *Robot Visions*

In World War II, some countries asked their citizens for more than just human recruits—they also asked for their dogs. A 1930s rally in Germany urged German families to donate over 16,000 personal pets to the military's canine corps. America followed suit in the 1940s, when an organization called Dogs for Defense ran radio advertisements and posters to convince tens of thousands of Americans to send their puppies to war. So many pets were donated in response to the "dog soldier" recruitments that the number of dog shows in America plummeted. Dogs went from chasing neighborhood squirrels to being spies, guards, and messengers in the war. But the armed forces didn't fully anticipate what this would mean.

The US military suddenly found itself inundated with letters from the owners asking about the pets that they had sent in. According to Susan Orlean, author of *Rin Tin Tin: The Life and the Legend*, "Just as people wanted to know how their friends and family were getting along in the

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A NEW CATEGORY OF RELATIONSHIP

"The ontology of companion species makes room for odd bedfellows."

—Donna Haraway

Vicki Boyd is the facility manager at the Gunther Village aged care home in Gayndah. The sunny, rural town in Queensland is one of the oldest in Australia, with a population of 1,981 people, 52 of whom reside in the Gunther Village facility. One of Boyd's main priorities is figuring out how to provide an enjoyable end of life experience for her dementia patients. "We try to make it their home," she says.

A few years ago, Boyd introduced the home's residents to a robot named PARO. PARO looks like a stuffed animal. It has a soft, white baby seal body and blinks its long eyelashes over its big black eyes, makes little whimpers and other cute sounds, and nuzzles in response to touch. The Japanese robot, an FDA-approved, Class 2 medical device in the United States, was designed to give its holder the sense of nurturing something lifelike.

Interacting with the device is soothing. The first time I held PARO, I wanted to take the fluffy seal home with me. The robot is well engineered: its soft yet robust body contains hidden, quiet motors, and each PARO has a handmade face that takes two hours to produce in order to make each seal unique. As a medical device, PARO needs to clear strict regulations in many countries, and the current price for a robot seal

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THE REAL ISSUES WITH ROBOT COMPANIONSHIP

"Artifacts can have political qualities."

—Langdon Winner

When Maddy was eight years old, her grandfather bought a Jibo robot. He put the table lamp–sized device on the counter next to the refrigerator in his Tennessee home where it swiveled its head to greet people, played music, and told corny jokes. Just like my son, Maddy fell in love. Whenever she visited his house, she would chat with Jibo for hours, asking the robot every question she could think of.

For Maddy and the other grandchildren, Jibo was much more than just a household appliance: the quirky little robot was part of the family. But one day, her grandfather received some bad news: the company that had created Jibo was no longer financially solvent and was shutting down. Without access to the servers, Jibo was going to lose most of its functionality. When her grandfather broke the news to her, Maddy was sad. In an interview, he said, "It's like you had a pet for years and all of a sudden they're going to disappear, and so she was a little devastated by it. She didn't break down cry or anything, but I think sincerely, she was disappointed and sad that Jibo's kind of been a part of her life and that Jibo could possibly go away."

Shortly after he told her about Jibo's impending termination, Maddy

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WESTERN ANIMAL AND ROBOT RIGHTS THEORIES

> "Hardly worth anyone's while to help a menial robot is it? . . . I mean where's the percentage in being kind or helpful to a robot if it doesn't have any gratitude circuits?"
>
> —Marvin the Paranoid Android,
> *The Restaurant at the End of the Universe* by Douglas Adams

Two men in cowboy hats sit across from each other on a train pulled by a steam engine, chugging its way through a beautiful desert landscape. One of them leans against the window with an air of arrogance, recounting: "Now the first time, I played it white hat. My family was here; we went fishing, did the gold hunt in the mountains . . ." The other man asks, "And last time?" The first man gazes out the window, smirking slightly, and answers, "Came alone . . . Went straight evil. [pause] It was the best two weeks of my life." The train arrives at an old-fashioned-looking station. As all of the passengers disembark, a woman looks in awe at her surroundings, which are designed to look like the old Wild West, and exclaims, "Oh my god, it's incredible!" Her companion mutters, "It better be . . . for what we're paying." They laugh and enter the park.

This is one of the opening scenes from the 2016 TV show *Westworld*, a science fiction series based on the 1973 movie with the same name.

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FREE WILLY

WESTERN ANIMAL RIGHTS IN PRACTICE

[Content warning for this chapter: Holocaust, vivisection, animal abuse]

> "[People] don't agonize over whether one should throw a switch that would send a hypothetical train careening into an old man or a group of endangered chimpanzees. They don't care whether the correct route to animal liberation runs through Bentham or Kant. Nor do they feel guilty over the fact that they refuse to eat beef but wear leather shoes."
>
> —Hal Herzog, *Some We Love, Some We Hate, Some We Eat*

> "No one will protect what they don't care about, and no one will care about what they have never experienced."
>
> —David Attenborough

While I was researching this book, I took a horse-whispering class in Palm Springs, California. It was a hot day, and as I gathered with a bunch of strangers at the horse ranch, we quickly moved toward the one tree that provided some shade. The class involved taking turns leaving the shade and climbing into a pen with a small herd of horses. We were supposed to bond with one of them and then convince our new equine pal to move to a specific place in the fenced area by using only our body language. When my turn came up, I was terrible. The

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DON'T KICK THE ROBOT

[Content warning for this chapter: physical violence, child abuse, nonconsensual sexual acts, animal abuse]

> "To endow animals with human emotions has long been a scientific taboo. But if we do not, we risk missing something fundamental, about both animals and us."
>
> —Frans de Waal

Twelve years ago, in 2008, I was giddy with excitement as I unboxed a package from Hong Kong containing a small robot dinosaur. Modeled after a baby camarasaurus, the animatronic toy had green, rubbery skin, a large head, and big eyes. Pleo was the latest and greatest in robot pets and from the moment I heard about it, I was eager to purchase one. The robot could move in a fairly lifelike way, blinking its eyes, craning its long neck, and wagging its tail. It could walk around the room and grab a plastic leaf in its mouth. The little dinosaur had a camera-based vision system in its snout, microphones, infrared detection, and force feedback sensors that let it respond to sound and touch and react to its environment. For example, if Pleo encountered a table edge, it would sense the drop-off and lower its head, pull in its tail, and start backing up, whimpering pitifully.

Created by the (now bankrupt) company Ugobe, Pleo was pitched as a "lifeform" that went through different development stages and had an

FINAL THOUGHTS

PREDICTING THE FUTURE

> "We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run."
>
> —Amara's law

As I was finishing this book, the *New York Times* published an interview with billionaire entrepreneur and Tesla CEO Elon Musk, in which he said with confidence, "We're headed toward a situation where A.I. is vastly smarter than humans and I think that time frame is less than five years from now." He followed up by saying that anyone who couldn't imagine that a computer could be smarter than a human was "just way dumber than they think they are."

When it comes to the prediction that artificial intelligence will "outsmart" us within five years, I have two thoughts. First, a simple calculator and an octopus are both vastly smarter than Elon Musk in many ways. Second, as Maciej Cegłowski has said, there are "a lot of things that we are terribly mistaken about, and unfortunately we don't know what they are." Technology predictions are hard and continuously humbling. Marvin Minsky, one of the AI pioneers in the 1960s, thought that machine vision would be so simple to develop that he gave it to a graduate student to do over the summer. Instead, it took experienced scientists all over the world many decades to solve. In 2005, Toyota

NOTES

INTRODUCTION

xi **Quote:** Claude Lévi-Strauss, *The Savage Mind* (Chicago: University of Chicago Press, 1966).

xi **a large part of her famous 1818 novel:** Mary Wollstonecraft Shelley, *Frankenstein; or, The Modern Prometheus*, in *Three Gothic Novels* (London: Penguin, 1968).

xiii **"the Frankenstein complex":** Isaac Asimov, "The Machine and the Robot," in *Science Fiction: Contemporary Mythology*, eds. Patricia Warrick, Martin Harry Greenberg, and Joseph Olander (New York: Harper and Row, 1978).

xiii **Sophia:** Chris Weller, "A Robot That Once Said It Would 'Destroy Humans' Just Became the First Robot Citizen," *Business Insider*, October 26, 2017, https://www.businessinsider.com/sophia-robot-citizenship-in-saudi-arabia-the-first-of-its-kind-2017-10; Janice Williams, "Sophia the Robot Wants Women's Rights for Saudi Arabia," *Newsweek*, December 5, 2017, https://www.newsweek.com/sophia-robot-saudi-arabia-women-735503; see also Jaden Urbi and MacKenzie Sigalos, "The Complicated Truth about Sophia the Robot—an Almost Human Robot or a PR Stunt," CNBC, June 5, 2018, https://www.cnbc.com/2018/06/05/hanson-robotics-sophia-the-robot-pr-stunt-artificial-intelligence.html.

xiv **As technology critic Sara Watson points out:** Sara M. Watson, "We Need to Tell Better Stories about Our AI Future," *Vice*, February 11, 2017, https://www.vice.com/en_us/article/z4yq3w/we-need-to-tell-better-stories-about-our-ai-future.

xvi **Historians and sociologists have long used animals to think about what it means to be human:** Adrian Franklin, *Animals and Modern Cultures: A Sociology of Human-Animal Relations in Modernity* (London: Sage, 1999).

ACKNOWLEDGMENTS

First and foremost, this book would not have been possible without the support of my husband, Gregory Leppert, who stepped up to be the primary caregiver for our child for five months during the COVID-19 pandemic while I wrote this book. I am also eternally grateful to my son, Benefox Darling, who interrupted my writing process with smiles, hugs, and gifts of rocks that he had collected outdoors. Many thanks to my editor, Serena Jones, for her unwavering support and for believing in me. Chia Evers and Anna Nowogrodzki provided invaluable research assistance during the writing process, and I owe my friend and science journalist Chris Couch the world for editing and fact-checking a large chunk of the manuscript. (Any errors are mine, not theirs.) This book benefited immensely from the thoughts, comments, and corrections of early draft readers Jamie Boyle, Bruce Schneier, Jeanne Darling, Jonathan Zittrain, and Sara Watson. Thank you so much to the hundreds of friends, colleagues, strangers, researchers, designers, company founders, executives, government representatives, robots, and animals I got to meet and learn from in the course of my research. Finally, I would like to thank Teddie Natural Peanut Butter for comprising 80 percent of my food intake while writing.

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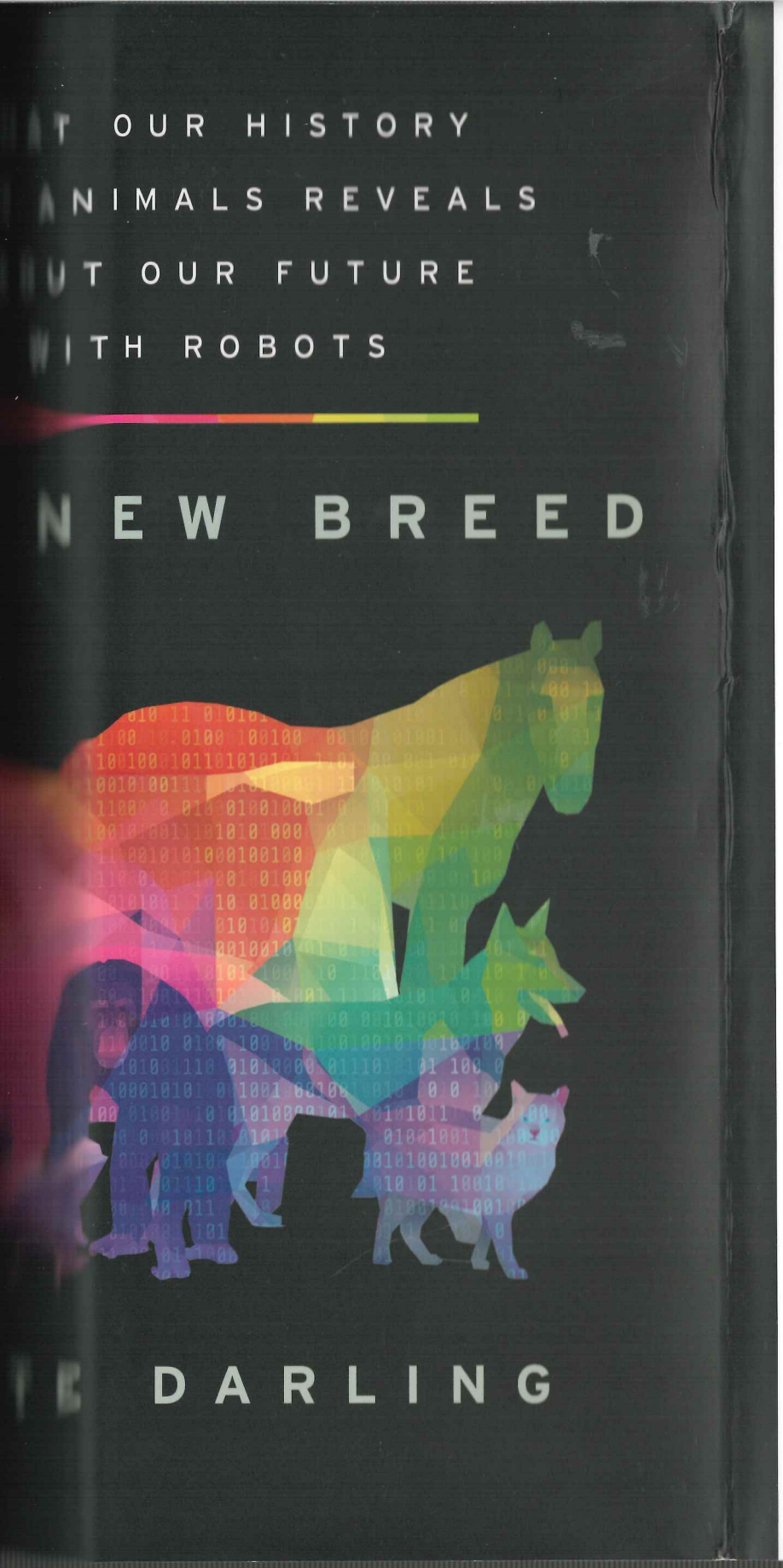

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DR. KATE DARLING is a leading expert in robot ethics and policy. She's a researcher at the Massachusetts Institute of Technology Media Lab and a former fellow at the Harvard Berkman Klein Center for Internet & Society and the Yale Information Society Project. Darling's work has been featured by the *New Yorker*, the *Guardian*, PBS, the *Boston Globe, Wired, Slate*, NPR, and more.

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