ONE

Dr. House, Meet Doctor Dolittle

Redefining the Boundaries of Medicine

In the spring of 2005, the chief veterinarian of the Los Angeles Zoo called me, an urgent edge to his voice.

"Uh, listen, Barbara? We've got an emperor tamarin in heart failure. Any chance you could come out today?"

I reached for my car keys. For thirteen years I'd been a cardiologist treating members of my own species at the UCLA Medical Center. From time to time, however, the zoo veterinarians asked me to weigh in on some of their more difficult animal cases. Because UCLA is a leading heart-transplant hospital, I'd had a front-row view of every type of human heart failure. But heart failure in a tamarin—a tiny, nonhuman primate? That I'd never seen. I threw my bag in the car and headed for the lush, 113-acre zoo nestled along the eastern edge of Griffith Park.

Into the tiled exam room the veterinary assistant carried a small bundle wrapped in a pink blanket.

"This is Spitzbuben," she said, lowering the animal gently into a Plexiglas-fronted examination box. My own heart did a little flip. Emperor tamarins are, in a word, adorable. About the size of kittens, these monkeys evolved in the treetops of the Central and South American rain forests. Their wispy, white Fu Manchu–style mustaches droop below enormous brown eyes. Swaddled in the pink blanket, staring up at me with that liquid gaze, Spitzbuben was pushing every maternal button I had.

When I'm with a human patient who seems anxious, especially a child, I crouch close and open my eyes wide. Over the years I've seen how this can establish a trust bond and put a nervous patient at ease. I did this with Spitzbuben. I wanted this defenseless little animal to understand how much I *felt* her vulnerability, how hard I would work to help her. I moved my face up to the box and stared deep in her eyes—animal to animal. It was working. She sat very still, her eyes locked on mine through the scratched plastic. I pursed my lips and cooed.

"Sooo brave, little Spitzbuben . . ."

Suddenly I felt a strong hand on my shoulder.

"Please stop making eye contact with her." I turned. The veterinarian smiled stiffly at me. "You'll give her capture myopathy."

A little surprised, I did as instructed and got out of the way. Human-animal bonding would have to wait, apparently. But I was puzzled. Capture myopathy? I'd been practicing medicine for almost twenty years and had never heard of that diagnosis. Myopathy, sure—that simply means a disease that affects a muscle. In my specialty, I see it most often as "cardiomyopathy," a degradation of the heart muscle. But what did that have to do with capture?

Just then, Spitzbuben's anesthesia took effect. "Time to intubate," the attending veterinarian instructed, focusing every person in the room on this critical and sometimes difficult procedure. I pushed capture myopathy out of my mind to be fully attentive to our animal patient.

But as soon as we were finished and Spitzbuben was safely back in her enclosure with the other tamarins, I looked up "capture myopathy." And there it was—in veterinary textbooks and journals going back decades. There was even an article about it in *Nature,* from 1974. Animals caught by predators may experience a catastrophic surge of adrenaline in their bloodstreams, which can "poison" their muscles. In the case of the heart, the overflow of stress hormones can injure the pumping chambers, making them weak and inefficient. It can kill, especially in the case of cautious and high-strung prey animals like deer, rodents, birds, and small primates. And there was more: locking eyes can contribute to capture myopathy. To Spitzbuben, my compassionate gaze wasn't communicating, "You're so cute; don't be afraid; I'm here to help you." It said: "I'm starving; you look delicious; I'm going to eat you."

Though this was my first encounter with the diagnosis, parts of it were startlingly familiar. Cardiology in the early 2000s was abuzz with a newly described syndrome called takotsubo cardiomyopathy. This distinctive condition presents with severe, crushing chest pain and a markedly abnormal EKG, much like a classic heart attack. We rush these patients to an operating suite for an angiogram, expecting to find a dangerous blood clot. But in takotsubo cases, the treating cardiologist finds perfectly healthy, "clean" coronary arteries. No clot. No blockage. No heart attack.

On closer inspection, doctors notice a strange, lightbulb-shaped bulge in the left ventricle. As the pumping engines for the circulatory system, ventricles must have a particular ovoid, lemonlike shape for strong, swift ejection of blood. If the end of the left ventricle balloons out, as it does in takotsubo hearts, the firm, healthy contractions are reduced to inefficient spasms—floppy and unpredictable.

But what's remarkable about takotsubo is what *causes* the bulge. Seeing a loved one die. Being left at the altar or losing your life savings with a bad roll of the dice. Intense, painful emotions in the brain can set off alarming, life-threatening physical changes in the heart. This new diagnosis was proof of the powerful connection between heart and mind. Takotsubo cardiomyopathy confirmed a relationship many doctors had considered more metaphoric than diagnostic.

As a clinical cardiologist, I needed to know how to recognize and treat takotsubo cardiomyopathy. But years before pursuing cardiology, I had completed a residency in psychiatry at the UCLA Neuropsychiatric Institute. Having also trained as a psychiatrist, I was captivated by this syndrome, which lay at the intersection of my two professional passions.

That background put me in a unique position that day at the zoo. I reflexively placed the human phenomenon side by side with the animal one. *Emotional trigger . . . surge of stress hormones . . . failing heart muscle . . . possible death.* An unexpected "aha!" suddenly hit me. Takotsubo in humans and the heart effects of capture myopathy in animals were almost certainly related—*perhaps even the same syndrome with different names.*

But a second, even stronger insight quickly followed this "aha." The key point wasn't the overlap of the two conditions. It was the gulf between them. For nearly four decades (and probably longer) veterinarians had known this could happen to animals—that extreme fear could damage muscles in general and heart muscles in particular. In fact, even the most basic veterinary training includes specific protocols for making sure animals being netted and examined don't die in the process. Yet here were the human doctors in early 2000 trumpeting the finding, savoring the fancy foreign name, and making academic careers out of a "discovery" that every vet student learned in the first year of school. These animal doctors knew something we human doctors had no clue existed. And if that was true . . . what else did the vets know that we didn't? What other "human" diseases were found in animals?

So I designed a challenge for myself. As an attending physician at UCLA I see a wide variety of maladies. By day on my rounds, I began making careful notes of the conditions I came across. At night, I combed veterinary databases and journals for their correlates, asking myself a simple question: "Do Animals Get [*fill in the disease*]?"

I started with the big killers. Do animals get breast cancer? Stress-induced heart attacks? Leukemia? How about melanoma? Fainting spells? Chlamydia? And night after night, condition after condition, the answer kept coming back "yes." The similarities clicked into place.

Jaguars get breast cancer and may carry the BRCA1 genetic mutation that predisposes many Jews of Ashkenazi descent and others to the disease. Rhinos in zoos get leukemia. Melanoma has been diagnosed in the bodies of animals from penguins to buffaloes. Western lowland gorillas die from a terrifying condition in which the body's biggest and most critical artery, the aorta, ruptures. Torn aortas also killed Lucille Ball, Albert Einstein, and the actor John Ritter, and strike thousands of less famous human beings every year.

I learned that koalas in Australia are in the middle of a rampant epidemic of chlamydia. Yes, *that* kind—sexually transmitted. Veterinarians there are racing to produce a koala chlamydia vaccine. That gave me an idea: doctors around the United States are seeing human chlamydia infection rates spike. Could the *koala* research inform *human* public health strategies? Since unprotected sex is the only kind koalas have (my searches for condom use by animals came up short), what might those koala experts know about the spread of sexually transmitted diseases in a population that practices nothing but "unsafe" sex?

I wondered about obesity and diabetes—two of the most pressing health concerns of our time. I burned midnight pixels investigating questions like: Do wild animals get medically obese? Do animals overeat or binge-eat? Do they hoard food and eat in secret at night? I learned that yes, they do. Comparing animal grazers, gorgers, and regurgitators to human snackers, diners, and dieters transformed my views on conventional human nutritional advice—and on the obesity epidemic itself.

Very quickly, I found myself in a world of surprising and unfamiliar new ideas, the kinds I'd never been encouraged to entertain in all my years of medical training and practice. It was, frankly, humbling, and I started to see my role as a physician in a whole new way. I wondered: Shouldn't human and veterinary doctors be partnering, along with wildlife biologists, in the field, the lab, and the clinic? Maybe such collaborations would inspire a version of my takotsubo moment, but for breast cancer, obesity, infectious disease, or other health concerns. Perhaps they would even lead to cures.

The more I learned, the more a tantalizing question started creeping into my thoughts: Why *don't* we human doctors routinely cooperate with animal experts?

And as I searched for that answer, I learned something surprising. We used to. In fact, a century or two ago, in many communities, animals and humans were cared for by the same practitioner—the town doctor, as he set broken bones and delivered babies, was not deterred by the species barrier. A leading physician of that era named Rudolf Virchow, still renowned today as the father of modern pathology, put it this way: "Between animal and human medicine there is no dividing line—nor should there be. The object is different but the experience obtained constitutes the basis of all medicine."*

However, animal and human medicine began a decisive split around the turn of the twentieth century. Increasing urbanization meant fewer people relied on animals to make a living. Motorized vehicles began pushing work animals out of daily life. With them went a primary revenue stream for many veterinarians. And in the United States, federal legislation called the Morrill Land-Grant Acts of the late 1800s relegated veterinary schools to rural communities while academic medical centers rapidly rose to prominence in wealthier cities.

*One of Virchow's most illustrious students was the Canadian doctor William Osler, revered by American medical students as a father of modern medicine. What's less well known to physicians is that veterinarians also consider Osler a father of their profession. He was a key advocate for the comparative method and influential in shaping what became McGill University's School of Veterinary Medicine in Montreal.

As the golden age of modern medicine dawned, there was simply more money, prestige, and academic reward to be had in pursuing human patients. For physicians, this era all but erased their tarnished image as the leech purveyors and potion makers of times past. But veterinarians enjoyed little to none of this skyrocketing social status and its accompanying wealth. The two fields moved through the twentieth century for the most part on divided, yet parallel, paths.

Until 2007. That's when a veterinarian named Roger Mahr and a physician, Ron Davis, arranged a meeting in East Lansing, Michigan. They compared notes on similar problems they encountered in their animal and human patients: cancer, diabetes, the adverse effects of secondhand smoke, and the explosion of "zoonoses" (diseases that spread from animals to humans, like West Nile virus and avian flu). They called for physicians and veterinarians to stop segregating themselves based on the species of their patients and start learning from one another.

Because Davis was president of the American Medical Association (AMA) and Mahr headed the American Veterinary Medical Association (AVMA), their meeting carried more weight than the handful of previous attempts to reunify the fields.*

But the Davis-Mahr announcement received little notice in the popular media, or even among medical professionals, especially physicians. True, One Health (the favored term for this movement) has gotten notice from the World Health Organization, the United Nations, and the Centers for Disease Control and Prevention.† The Institute of Medicine, which is the health arm of the National Academy of Sciences, hosted a One Health summit in Washington, D.C., in 2009. And veterinary schools, including those at the University of Pennsylvania, Cornell, Tufts, UC Davis, Colorado State, and the University of Florida, have embarked on One Health collaborations in education, research, and clinical care.

Yet, the truth is that most physicians will go through their entire careers never interacting with veterinarians, at least not professionally.

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*One of the first modern efforts at unification came in the 1960s from the eminent veterinary-epidemiologist Calvin Schwabe, who is regarded as a pioneer of this field.

†The movement has gone by several different names over the years, including comparative medicine and One Medicine.

Until I started consulting at the zoo, the only time I even thought about animal doctors was when I brought my own dogs in for an exam or vaccination. My veterinary colleagues tell me they regularly read human medical journals to keep up on the latest research and techniques. But most physicians I know—including myself, until recently—would never dream of consulting an animal-focused monthly, even one as highly respected as the *Journal of Veterinary Internal Medicine*.

I think I know why. Most physicians see animals and their illnesses as somehow "different." We humans have our diseases. Animals have theirs. And I suspect there's another reason. The human medical establishment has an undeniable, though unspoken, bias against veterinary medicine. While most physicians have many laudable attributes—tireless work ethics, the desire to help others, a sense of duty to the community, scientific rigor—we have some dirty laundry I must reluctantly air. Doctors, it may or may not surprise you to learn, can be snobs. Ask your (non-M.D.) podiatrist, optometrist, or orthodontist if he's ever felt condescension from someone with those two hallowed initials after her name, and you'll likely hear some juicy tidbits about physician arrogance or that special brand of M.D. noblesse oblige.

By the way, we do it even to each other. You won't find a group of cocky neurosurgical residents sharing coffee and muffins with the cheerful family practice team or the empathetic psych interns. There is an unwritten hierarchy. The more competitive, lucrative, procedure-driven, and "elite" specialties sit at the top of the physician self-importance pyramid. Given how readily physicians rank themselves based on which body part they minister to, just imagine the disdain they might work up for mere "animal docs." I'm sure it would shock some of my colleagues to learn that vet school is now harder to get into than med school.

When some vets tell me about this historical antipathy between our fields, many bristle about not being taken seriously as "real" doctors. But while it rankles when M.D.'s condescend, most vets simply take a resigned approach to their glitzier counterparts on the human side. Several have even confided to me a veterinarians' inside joke: *What do you call a physician? A veterinarian who can treat only one species.*

Still, among physicians, welcoming animal doctors as peers just "isn't done." As Darwin shrewdly observed, "we do not like to consider [animals] our equals." And yet, all of biology, the foundation of medicine itself, relies on the fact that we *are* animals. Indeed, we share the vast majority of our genetic code with other creatures.

And, of course, on some level we accept this vast biological overlap: almost every medicine we take—and prescribe—has been tested on animals. Indeed, if you asked most physicians what animals can teach us about human health, there is one place they would automatically point: the lab. But that is precisely not what I am talking about.

This book isn't about animal testing. Nor is it about the complex and important ethical issues of lab animal investigation. Instead, it introduces a new approach that could improve the health of both human *and* animal patients. This approach is based on a simple reality: animals in jungles, oceans, forests, and our homes sometimes get sick—just as we do. Veterinarians see and treat these illnesses among a wide variety of species. And yet physicians largely ignore this. That's a major blind spot, because we could improve the health of all species by learning how animals live, die, get sick, and heal in their *natural* settings.

As I started to focus on sameness, instead of being distracted by difference, it changed how I viewed my patients, their diseases, and even what it means to be a doctor. The line between "human" and "animal" started to blur. It was unsettling at first. Every echocardiogram I performed—on humans at UCLA and animals at the L.A. Zoo—suddenly exploded with familiarity and new meaning. Every mitral valve, every left ventricular apex, carried the echoes of our shared evolution and health challenges.

The cardiologist in me was thrilled with this new perspective, the myriad overlaps. But as a psychiatrist, I wasn't so sure. Physical similarities were one thing. Blood, bones, and beating hearts animate not just primates and other mammals but also birds, reptiles, and even fish. Still, I assumed, our uniquely developed human brains meant the similarities ended with our bodies. Certainly the overlap couldn't extend to our minds and emotions. So I came at the question from a psychiatric perspective.

Do animals get . . . obsessive-compulsive disorder (OCD)? Clinical depression? Substance addiction and abuse? Anxiety disorders? Do animals ever take their own lives? And again I sat back, a little astounded, while my research yielded a series of fascinating and surprising answers.

Octopuses and stallions sometimes self-mutilate, in ways that echo the self-injuring patients we call "cutters." Chimpanzees in the wild experience depression and sometimes die of it. The compulsions psychiatrists treat in their patients with OCD resemble behaviors veterinarians see in animal patients and call "stereotypies."

Suddenly, the benefits for human *mental* health seemed enormous. Perhaps a human patient compulsively burning himself with cigarettes could improve if his therapist talked shop with a bird specialist who had treated dozens of parrots with feather-picking disorder. Maybe Princess Diana or Angelina Jolie (who both publicly admitted cutting themselves with blades) could have found solace in discussing their urges with an equestrian expert who treats horses that compulsively bite themselves.

Significantly for addicts and their therapists, species from birds to elephants are known to seek out psychotropic berries and plants for the presumed purpose of changing their sensory states—a.k.a. getting high. Bighorn sheep, water buffaloes, jaguars, and primates of many kinds consume—and then show the effects of—narcotics, hallucinogens, and other intoxicants. Naturalists have been noting these behaviors in the field for decades. Is a treatment—or at least a new perspective—for alcoholism or addiction lying dormant in all that animal research?

I also searched for veterinary examples of depression and suicide. It seemed unlikely that animals would experience the same psychiatric urges to kill themselves that humans do. While the similar nature of their emotions has been persuasively described by behaviorists and veterinarians, I doubted that other animals share our foresight of death or knowledge of its power. Still I asked, "Do animals commit suicide?"

Well, they don't tie nooses around their necks or shoot themselves with revolvers, and they don't leave notes explaining why they did it. But examples of what appears to be grief-related and life-threatening "self-neglect" (refusing food and water) crop up throughout the scientific literature and in accounts that veterinarians and pet owners tell. And insect suicide, driven by parasitic infection, has been well documented by entomologists.

Which raises an interesting issue. Our physical body structures evolved over hundreds of millions of years. Perhaps modern human emotions too have evolved over millennia. Has natural selection played a role in what we feel, from anxiety, grief, and shame to pride, joy, and even schadenfreude?

Although Darwin himself studied and wrote extensively about natural selection's influence on human and animal emotions, none of my psychiatric training even touched on the possibility that human feelings could have evolutionary roots. In fact, it was almost the opposite. My education included stern warnings against the tantalizing pull to anthropomorphize. In those days, noticing pain or sadness on the face of an animal was criticized as projection, fantasy, or sloppy sentimentality. But scientific advancements of the past two decades suggest that we should adopt an updated perspective. Seeing too much of ourselves in other animals might not be the problem we think it is. Underappreciating our own animal natures may be the greater limitation.

As a psychiatrist, I was officially convinced. Remaining ignorant of the mental and physical disorders of animals, I began to feel, was as narrow-minded as refusing to seek out important human research simply because it was reported in a foreign language.

Still, the skeptic in me looked for any reason to explain away the similarities. Perhaps it was simply our shared environment. And after all, we humans have commandeered the food chain, imposing our dominant diets, weapons, and diseases on everything below us.

So I began to look anew at conditions I'd long assumed to be uniquely human and modern. And with that I came across some remarkable findings: dinosaurs with gout, arthritis, stress fractures . . . even cancer. Not so long ago, paleontologists uncovered a mass in the fossilized skull of a *Gorgosaurus,* a close relative of *Tyrannosaurus rex.* A brain tumor, they said, had brought down one of the Earth's most notorious carnivores, connecting a late-Mesozoic cancer patient to human brain cancer victims, including the composer George Gershwin, reggae artist Bob Marley, and U.S. Senator Ted Kennedy.

Having spent a career taking care of human patients in the here and now, I was suddenly confronted by a shifted boundary. Cancer has struck and killed its victims for at least seventy million years. I wondered how this knowledge might redefine how patients and physicians view the disease . . . or even how oncologists might search for ways to cure it.

Around this time I started working with Kathryn Bowers, a science journalist. A nondoctor with a background in social science and literature, she saw wider implications in these medical similarities. She urged me to view my overlapping experiences at the zoo and the hospital in a broader context. Together we began to research and write this book, bringing together medicine, evolution, anthropology, and zoology.

We started with a survey of how philosophers and scientists through the centuries have positioned our species among our fellow creatures. Clearly, for as long as humans have been able to ponder it, we've been of two minds about the apparent fact that we *are* animals. Judging by the written record going back at least as far as Plato, our ancestors acknowledged the obvious similarities between us and the so-called lesser creatures. Plato mused, "Man is the plumeless genus of bipeds; birds are the plumed." At the same time, people have long wanted to preserve a definition of humanity that kept us on a higher plane.

With *The Origin of Species,* Charles Darwin gave us a new (and, to many, unnerving) way to conceive of ourselves in relation to animals—positing that man and beast exist as different branches of the same tree rather than on different sides of a schism. Scholars of all stripes weighed in on whether and how humans were related to apes and other species.

In the mid-twentieth century, this debate was reignited by *The Naked Ape.* With studied objectivity, Desmond Morris, a zoologist and former curator of mammals at the London Zoo, described human feeding, sleeping, fighting, and parenting the way a biologist would document animal behavior in the field.

At about the time Morris was pointing out how similar we are to apes, two pioneering primatologists were documenting the many ways *apes* act like *us.* Jane Goodall was among the first to observe wild chimpanzees using tools and engaging in a type of organized warfare. For nearly twenty years, Dian Fossey lived near a group of gorillas in Rwanda, studying their vocalizations and social organization. Fossey's and Goodall's authoritative writings and memorable media appearances about the apes' distinct personalities and extended family relationships fed a growing public interest in human-ape crossover even as the two women advanced serious scientific knowledge.

Subsequently, many scholars attempted to demystify contemporary human life by studying animals and evolutionary biology. Two clashing powerhouses were the Harvard-based polymaths Edward O. Wilson and the late Stephen Jay Gould.

Wilson rocked academia and the wider public discourse in 1975 with the publication of *Sociobiology.* Inspired by his extensive research on ants, Wilson connected social behavior in animals to evolutionary forces, including natural selection. When extended to human societies, this suggested that our genes outline many aspects of our nature and behavior. But Wilson's theories were introduced in a particularly inhospitable climate. A mere three decades after eugenic theories were used to justify genocide, the world was not ready to hear that any aspects of human nature might be genetically predetermined. And as the civil rights and feminist movements were gearing up to dismantle centuries of racial, gender, and economic discrimination, public opinion would simply not tolerate theories with even a faint suggestion that "biology is destiny." Furthermore, with the scientific revolutions of molecular biology and genome mapping a decade and a half in the future, Wilson didn't yet have access to the high-tech tools that would ultimately back up many of his theories.

Wilson was harshly branded by some of his academic colleagues as a racist, sexist "determinist." One of his main detractors was Gould, a prominent paleontologist, geologist, and historian of science (who also happened to be one of my advisers on the undergraduate thesis I wrote about Darwin's influence on public perceptions of physical deformity). In books such as *The Panda's Thumb,* Gould argued that the subtleties of the human condition cannot be understood solely through natural selection. He cautioned readers that an overly genetic explanation of human behavior could reinforce regressive social agendas. His views matched the academic climate of the 1970s and '80s—the same era in which New Historicists were reinterpreting literature and deconstructionists dismantling Western civilization courses.

It was during this fertile period that Richard Dawkins published such provocative books as *The Selfish Gene* and *The Blind Watchmaker.* Dawkins characterized evolution as an unsentimental process, a self-interested and unceasing race among rival genes. Criticized, like Wilson, for having overstated the dominance of genetics over culture, Dawkins, an Oxford professor, nonetheless continues to probe the biological basis of human behavior, including its role in religion and belief in God. In a later work, *The Ancestor's Tale,* Dawkins explored the concept of a unified biology, identifying the shared ancestry across species—among them hippos, jellyfish, and single-celled organisms.

In 2005, *Nature* published a study that redefined the conversation: the human genome is 98.6 percent similar to that of chimpanzees. That single statistic inspired many people, and not only scientists, to reconsider what defines us as humans. Now, instead of trying to prove the *existence* of a connection between animals and humans, the race is on to explore the depth and breadth of this enormous overlap.

The challenge has led scientists to explore far beyond great apes. Biologists are rapidly uncovering ancient genetic similarities that link diverse species—mammals, reptiles, birds, and even insects. The discovery is astonishing: nearly identical clusters of genes have been passed down for billions of years, from cell to cell and organism to organism. These remarkably unchanged gene groups code for similar structures and even similar reflexes across species. In other words, a common genetic "blueprint" instructed the embryos of Shamu, Secretariat, and Kate Middleton to grow different, yet homologous, limbs: steering flippers, thundering hooves, and regal, waving arms. *Deep homology* is the term coined by biologists Sean B. Carroll, Neil Shubin, and Cliff Tabin to describe these genetic kernels we share with nearly all creatures. Deep homology explains how genes taken from a sighted mouse and placed into a blind fruit fly cause the insect to grow structurally accurate fly eyes. And it is a deep homology that genetically connects keen, light-responsive vision in a hawk to photosensitivity in green algae. Deep homology traces our molecular lineage to our most ancient common ancestors. It proves that all living organisms, including plants, are long-lost relatives.

Today, the specific nature/nurture controversy that so dominated the academic scene in the 1980s is something of a historical footnote. Advances in molecular biology, genetics, and neuroscience have shifted the debate away from *whether* there's a genetic basis for behavior and toward a more nuanced conversation about how genes, culture, and environment *interact*. This has given rise to a burgeoning new field called "epigenetics." Among other things, epigenetics considers how infection, toxins, food, other organisms, and even cultural practices can turn genes on and off to alter an animal's development.

Think about what that means. Evolution doesn't just happen over huge numbers of generations or millions of years. It can happen to you or me, or any animal, within our own lifetimes. Amazingly, epigenetic changes to our DNA mean that the genes we pass on to our children can differ from the ones we inherited. Epigenetics and deep homology are two sides of the evolutionary coin. Epigenetics helps explain rapid evolutionary changes and highlights the role environments can play in genetic health. Deep homology reminds us of our ancient origins and the glacial pace at which much evolutionary change occurs.

This stunning new perspective has started to change many fields, including biology, medicine, and psychology. When it was published in 2008, *Your Inner Fish*—Neil Shubin's illuminating journey through our shared anatomy with ancient life forms—ignited excitement about the power of comparative biology to inspire new ideas in modern medicine. Shubin, a paleontologist and biologist at the University of Chicago, joins Randolph Nesse, George Williams, Peter Gluckman, and Stephen Stearns in advancing a new field of evolutionary medicine in their books *Why We Get Sick, The Principles of Evolutionary Medicine,* and *Evolution in Health and Disease.* Other influential scientists who've blazed trails through the shared terrain of human and animal biology include Sean B. Carroll (*Endless Forms Most Beautiful*), Jared Diamond (*The Third Chimpanzee*), Steven Pinker (*The Blank Slate*), Frans de Waal (*Our Inner Ape*), Robert Sapolsky (*A Primate's Memoir*), and Jerry Coyne (*Why Evolution Is True*), to name just a few.

Interest in the mental life of animals, dismissed for many years as too speculative and an exercise in anthropomorphizing, has gained greater acceptance, too. Books by Temple Grandin (*Animals Make Us Human* and *Animals in Translation*), Jeffrey Moussaieff Masson (*When Elephants Weep*), Marc Bekoff (*The Emotional Lives of Animals*), and Alexandra Horowitz (*Inside of a Dog*) have demonstrated animal cognition and behavior that resemble what we might call foresight, regret, shame, guilt, revenge, and love.

Yet, while inspiring and illuminating, their books left me wanting a concrete way I could use their insights to improve my work as a physician. I wanted to break down the wall between physicians, veterinarians, and evolutionary biologists because together we are uniquely situated to explore the animal-human overlap where it matters most urgently—in the effort to heal our patients.

What had captivated me as a physician, what launched me on a journey that reshaped my entire approach to medicine, was a simple idea: to distill these decades of evolutionary research together with the collective wisdom of animal caregivers into a form both my patients and I could use within the four walls of my examining room.

Kathryn and I had found, practically without exception, an animal correlate to every human disease we could think of—from "Jurassic cancer" to "diseases of civilization." What we lacked was a name for this new fusion of veterinary, human, and evolutionary medicine.

Finding nothing in the literature, we decided to come up with our own: "zoobiquity." From the Greek for "animal," *zo,* and the Latin for "everywhere," *ubique,* "zoobiquity" joins two cultures (Greek and Latin), just as we are joining the "cultures" of human and animal medicine.

Zoobiquity looks to animals, and the doctors who care for them, for answers to humankind's pressing concerns. It peers back into our deep past—pausing but not stopping at great apes or even primates on the evolutionary timeline. It opens our minds to the common illnesses and shared vulnerabilities of the mammals, reptiles, birds, fish, insects, and even the bacteria with whom we evolved and share Earth.

Engineers already seek inspiration from the natural world, a field called biomimetics. Wings and fins inspire designers to create vehicles that float and fly more efficiently. Cockroaches helped solve the pressing problem of how to keep a robot stable as it climbs over uneven terrain, after researchers copied the insect's double-tripod legs and produced a machine that rarely tips over and can right itself when it does. Termites, mosquitoes, toucans, glowworms, and moths are just a few of the animals with superpower-like adaptations that scientists are trying to bring to a human market.

Now it's medicine's turn. I was in the right place at the right time to put takotsubo together with capture myopathy. (You'll find more on this finding in Chapter 6, "Scared to Death.") Zoobiquity encourages similar interdisciplinary experiences for other physicians. And this field-merging approach could have other important benefits. If studies funded by the National Institutes of Health expanded the boundaries of their inquiry by adding the simple question "Do animals get ____?" the benefits of scientific investigation could be vastly amplified.

A comparative approach could extend far beyond the walls of a human or veterinary hospital. It could help aspiring businessmen or middle school girls navigate complex hierarchies—by exposing similar challenges within a school of salmon or a herd of bighorn sheep. It points out the overlaps in the ways animals protect and defend their territories—and how and why we humans create borders, castes, kingdoms, and prisons. It dangles the possibility that human parenting could be informed by a greater knowledge of how our animal cousins solve issues of child care, sibling rivalry, and infertility.

Of course, human beings are unique as a species. Contained in our mere 1.4 percent genetic difference from chimpanzees are the physical, cognitive, and emotional features responsible for Mozart, the Mars rover, and the study of molecular biology itself. But the magnificent glare of this crucial but tiny percentage blinds us to our 98.6 percent sameness. Zoobiquity encourages us to look away, for a moment, from the obvious yet narrow range of differences and embrace the many enormous similarities.

Sadly, Spitzbuben the tamarin later died—not, I hasten to add, because of my attempt to befriend her. After her necropsy (the term for an animal autopsy), I took a slide of some of her heart cells to one of the most respected cardiac pathologists in the country, a colleague of mine at UCLA, Michael Fishbein.

As we peered through Fishbein's microscope, I noted how the damaged heart muscle cells seemed ensnared and strangled by the surrounding tissue. I felt a jolt of dreadful recognition as I spotted familiar-looking pink and purple shapes illuminated in the glaring white circle of the microscope's frame. Although the abnormal cardiac cells belonged to a furry, tailed tree dweller, they were essentially identical to human heart cells with the disease.

But this was more than a cellular display of our common ancestry with animals. The patterns illustrated a simple fact well known to veterinarians but unknown or ignored by modern physicians. Animals and humans share a vulnerability to the same infections, illnesses, and injuries.

As he had done so many times before with human heart specimens, Fishbein studied the slide carefully before he spoke. "Cardiomyopathy," I recall him observing. "Could be viral—looks just like a human's."

His phrase contained the essence of zoobiquity. Undistracted by fur and a tail, we saw, under that microscope, not "heart disease in a tamarin" but, rather, "heart disease in a primate"—gorilla, gibbon, chimpanzee, tamarin . . . or human.

As I heard Fishbein's words, my single-species focus officially died. Emerging in its place was zoobiquity, a connecting, *species-spanning* approach to the diagnostic challenges and therapeutic puzzles of clinical medicine. I would never look at another heart, human or animal, the same way again.