# Introduction

The first thing you have to do to study 4,000-year-old DNA is take off your clothes. I am standing with Oddný Ósk Sverrisdóttir in the air lock room next to the ancient-DNA laboratory at Uppsala University in Sweden,[1] preparing to see how she and her colleagues examine the bones of human beings and the animals they domesticated thousands of years ago. These scientists are looking for signs of changes in the genes that allow us to consume dairy products past the age of weaning, when all other mammals lose the ability to digest lactose, the sugar present in milk. After that time, dairy products can cause stomach upsets. But in some groups of humans, particularly those from northern Europe and parts of Africa, lactase—the enzyme that breaks down lactose—lingers throughout life, allowing them to take advantage of a previously unusable food source. Oddný and her PhD supervisor, Anders Götherström, study how and when this development occurred, and how it is related to the domestication of cows for their meat and milk. They examine minute changes in genes obtained from radiocarbon-dated bones from archaeological sites around Europe.

The first step is to extract the DNA from the bones. But when examining genes from other humans, you must avoid contaminating the samples with your own genetic material. Suddenly I feel sullied by my own DNA and imagine it floating all around me, like infestive dust motes, needing to be contained as if it were the miasma of a terrible plague. Oddný, a tall, blonde Icelandic woman who looks like my image of a Valkyrie, at least if Valkyries are given to cigarette breaks and bouts of cheerful profanity, has brought a clean set of clothes for me to put on under the disposable space-suit-like outfit I need to wear in the lab. I have to remove everything except my underwear, including my jewelry. Götherström says it is the only time he ever takes off his wedding ring. I don the clean outfit, followed by the white papery suit, a face mask that includes a transparent plastic visor over my eyes, latex gloves, and a pair of slip-on rubber shoes from a pile kept in the neverland between the lab and the outside world. Anything else that goes into the lab—a flash drive for the computer, say—cannot go back in once it has gone out, to prevent secondary contamination of the facility. Finally, I put on a hairnet and tuck my hair underneath.

We enter the lab, where the first thing we do is stretch another pair of gloves over the ones we just put on. Oddný takes out a plastic bin of bone samples, each in its own zip-top bag. The bones themselves have been bleached and then irradiated with ultraviolet light to remove surface contamination. Before setting the bin on the counter, she wipes the surface with ethanol, followed by a weak bleach solution, and then with more ethanol. Apparently the saying that one can't be too careful is taken literally in this lab. "We all have to be kind of OCD to do this work," says Oddný, smiling. Or at least I think she is smiling under her mask.

To obtain the DNA, the bones are drilled and the powder from the interior is processed so that the genetic sequences inside are amplified—that is, replicated to yield a larger amount of material for easier analysis. Some bones are more likely to be fruitful than others; we heft the samples, since Oddný says that the most promising ones are heavy for their size, and glossy. Most of the samples are about 4,000 years old, but one of them is around 16,000 years old. It has already been rendered into powder, and I look at it closely, but it doesn't seem any different from the others. One of the pieces is a flat section of skull, while others are sections of leg or arm bones, or a bit of pelvis. Oddný and I wonder briefly who all these people were, and what their lives were like. The details of their experiences, of course, are lost forever. But the signature of what they were able to eat and drink, and how their diet differed from that of their—our—ancestors, is forever recorded in their DNA.

Other than simple curiosity about our ancestors, why do we care whether an adult from 4,000 years ago could drink milk without getting a stomachache? The answer is that these samples are revolutionizing our ideas about the speed at which our evolution has occurred, and this knowledge, in turn, has made us question the idea that we are stuck with ancient genes, and ancient bodies, in a modern environment. We can use this ancient DNA to show that we are not shackled by it.

## The speed of evolution and our cave dweller past

Because we often think about evolution over the great sweep of time, in terms of minuscule changes over millions of years when we went from fin to scaly paw to opposable-thumbed hand, it is easy to assume that evolution always requires eons. That assumption in turn makes us feel that humans, who have gone from savanna to asphalt in a mere few thousand years, must be caught out by the pace of modern life, when we'd be much better suited to something more familiar in our history. We're fat and unfit, we have high blood pressure, and we suffer from ailments that we suspect our ancestors never worried about, like posttraumatic stress disorder and AIDS. Dr. Julie Holland, writing in *Glamour* magazine, counsels that if you "feel less than human," constantly stressed and run-down, you need to remember that "the way so many of us are living now goes against our nature. Biologically, we modern *Homo sapiens* are a lot like our cavewoman ancestors: We're animals. Primates, in fact. And we have many primal needs that get ignored. That's why the prescription for good health may be as simple as asking, What would a cavewoman do?"[2]

Along similar lines, here are some comments from readers of the *New York Times* health blog *Well*:

> Our bodies evolved over hundreds of thousands of years, and they're perfectly suited to the life we led for 99% of that time living in small hunting and gathering bands.[3]

> We are (like it or not) warm-blooded vertebrate mammals, i.e., part of the animal kingdom, and only in a very recent eyeblink of time become [*sic*] relatively free of the evolutionary pressures that shaped this species for millennia.[4]

> Probably goes all the way back to caveman days—women out gathering berries, sweeping up the place, generally always on the run. Cave Mr. Man out risking his neck, hunting a sabre tooth tiger or maybe a wooly mammoth, dragging the thing home, and then collapsing in a heap on the couch with a beer. I get it—makes sense.[5]

I am not suggesting that *Glamour* magazine or the readers of the *New York Times* have pinpointed the modern dilemma in its entirety. But it's hard to escape the recurring conviction that somewhere, somehow, things have gone wrong. In a time with unprecedented ability to transform the environment, to make deserts bloom and turn intercontinental travel into the work of a few hours, we are suffering from diseases our ancestors of a few thousand years ago, much less our prehuman selves, never knew: diabetes, hypertension, rheumatoid arthritis. Recent data from the Centers for Disease Control and Prevention (CDC) suggest that for the first time in history, the members of the current generation will not live as long as their parents, probably because obesity and associated maladies are curtailing the promise of modern medicine.

Some of this nostalgia for a simpler past is just the same old amnesia that every generation has about the good old days actually being all that good. The ancient Romans fretted about the young and their callous disregard for the hard-won wisdom of their elders. Several sixteenth- and seventeenth-century writers and philosophers famously idealized the Noble Savage, a being who lived in harmony with nature and did not destroy his surroundings. Now we worry about our kids as "digital natives," who grow up surrounded by electronics and can't settle their brains sufficiently to concentrate on walking the dog without simultaneously texting and listening to their iPods.

Another part of the feeling that the modern human is misplaced in urban society comes from the realization that people are still genetically close not only to the Romans and the seventeenth-century Europeans, but to Neandertals, to the ape ancestors Holland mentions, and to the small bands of early hominids that populated Africa hundreds of thousands of years ago. It is indeed during the blink of an eye, relatively speaking, that people settled down from nomadism to permanent settlements, developed agriculture, lived in towns and then cities, and acquired the ability to fly to the moon, create embryos in the lab, and store enormous amounts of information in a space the size of our handily opposable thumbs.

Given this whiplash-inducing rate of recent change, it's reasonable to conclude that we aren't suited to our modern lives, and that our health, our family lives, and perhaps our sanity would all be improved if we could live the way early humans did. Exactly what we mean by "the way early humans did" is a point of contention, and one I will return to in detail in Chapter 2, but the preconception—an erroneous one, as I will demonstrate—is the same: our bodies and minds evolved under a particular set of circumstances, and in changing those circumstances without allowing our bodies time to evolve in response, we have wreaked the havoc that is modern life.

In short, we have what the anthropologist Leslie Aiello, president of the renowned Wenner-Gren Foundation, called "paleofantasies."[6] She was referring to stories about human evolution based on limited fossil evidence, but the term applies just as well to the idea that our modern lives are out of touch with the way human beings evolved and that we need to redress the imbalance. Newspaper articles, morning TV, dozens of books, and self-help advocates promoting slow-food or no-cook diets, barefoot running, sleeping with our infants, and other measures large and small claim that it would be more natural, and healthier, to live more like our ancestors. A corollary to this notion is that we are good at things we had to do back in the Pleistocene, like keeping an eye out for cheaters in our small groups, and bad at things we didn't, like negotiating with people we can't see and have never met.

I am all for examining human health and behavior in an evolutionary context, and part of that context requires understanding the environment in which we evolved. At the same time, discoveries like those from Oddný's lab in Sweden and many more make it clear that we cannot assume that evolution has stopped for humans, or that it can take place only ploddingly, with tiny steps over hundreds of thousands of years. In just the last few years we have added the ability to function at high altitudes and resistance to malaria to the list of rapidly evolved human characteristics, and the stage is set for many more. We can even screen the entire genome, in great gulps of DNA at a time, looking for the signature of rapid selection in our genes.

To think of ourselves as misfits in our own time and of our own making flatly contradicts what we now understand about the way evolution works—namely, that rate matters. That evolution can be fast, slow, or in-between, and that understanding what makes the difference is far more enlightening, and exciting, than holding our flabby modern selves up against a vision—accurate or not—of our well-muscled and harmoniously adapted ancestors. The coming chapters will show just how much we know about that harmony, about the speed of evolution, and what these findings mean about the future of human evolution.

## Our maladapted ancestors

The paleofantasy is a fantasy in part because it supposes that we humans, or at least our protohuman forebears, were at some point perfectly adapted to our environments. We apply this erroneous idea of evolution producing the ideal mesh between organism and surroundings to other life-forms too, not just to people. We seem to have a vague idea that long long ago, when organisms were emerging from the primordial slime, they were rough-hewn approximations of their eventual shape, like toys hastily carved from wood, or an artist's first rendition of a portrait, with holes where the eyes and mouth eventually will be. Then, the thinking goes, the animals were subject to the forces of nature. Those in the desert got better at resisting the sun, while those in the cold evolved fur or blubber or the ability to use fire. Once those traits had appeared and spread in the population, we had not a kind of sketch, but a fully realized organism, a fait accompli, with all of the lovely details executed, the anatomical t's crossed and i's dotted.

But of course that isn't true. Although we can admire a stick insect that seems to flawlessly imitate a leafy twig in every detail, down to the marks of faux bird droppings on its wings, or a sled dog with legs that can withstand subzero temperatures because of the exquisite heat exchange between its blood vessels, both are full of compromises, jury-rigged like all other organisms. The insect has to resist disease, as well as blend into its background; the dog must run and find food, as well as stay warm. The pigment used to form those dark specks on the insect is also useful in the insect immune system, and using it in one place means it can't be used in another. For the dog, having long legs for running can make it harder to keep the cold at bay, since more heat is lost from narrow limbs than from wider ones. These often conflicting needs mean automatic trade-offs in every system, so that each may be good enough but is rarely if ever perfect. Neither we nor any other species have ever been a seamless match with the environment. Instead, our adaptation is more like a broken zipper, with some teeth that align and others that gape apart. Except that it looks broken only to our unrealistically perfectionist eyes—eyes that themselves contain oddly looped vessels as a holdover from their past.

Even without these compromises from natural selection acting on our current selves, we have trade-offs and "good enough" solutions that linger from our evolutionary history. Humans are built on a vertebrate plan that carries with it oddities that make sense if you are a fish, but not a terrestrial biped. The paleontologist Neal Shubin points out that our inner fish constrains the human body's performance and health because adaptations that arose in one environment bedevil us in another.[7] Hiccups, hernias, and hemorrhoids are all caused by an imperfect transfer of anatomical technology from our fish ancestors. These problems haven't disappeared for a number of reasons: just by chance, no genetic variants have been born that lacked the detrimental traits, or, more likely, altering one's esophagus to prevent hiccups would entail unacceptable changes in another part of the anatomy. If something works well enough for the moment, at least long enough for its bearer to reproduce, that's enough for evolution.

We can acknowledge that evolution is continuous, but still it seems hard to comprehend that this means each generation can differ infinitesimally from the one before, without a cosmic moment when a frog or a monkey looked down at itself, pronounced itself satisfied, and said, “Voilà, I am done.” Our bodies therefore reflect a continuously jury-rigged system with echoes of fish, of fruit fly, of lizard and mouse. Wanting to be more like our ancestors just means wanting more of the same set of compromises.

## When was that utopia again?

Recognizing the continuity of evolution also makes clear the futility of selecting any particular time period for human harmony. Why would we be any more likely to feel out of sync than those who came before us? Did we really spend hundreds of thousands of years in stasis, perfectly adapted to our environments? When during the past did we attain this adaptation, and how did we know when to stop?

If they had known about evolution, would our cave-dwelling forebears have felt nostalgia for the days before they were bipedal, when life was good and the trees were a comfort zone? Scavenging prey from more formidable predators, similar to what modern hyenas do, is thought to have preceded, or at least accompanied, actual hunting in human history. Were, then, those early hunter-gatherers convinced that swiping a gazelle from the lion that caught it was superior to that newfangled business of running it down yourself? And why stop there? Why not long to be aquatic, since life arose in the sea? In some ways, our lungs are still ill suited to breathing air. For that matter, it might be nice to be unicellular: after all, cancer arises because our differentiated tissues run amok. Single cells don’t get cancer.

Even assuming we could agree on a time to hark back to, there is the sticky issue of exactly what such an ancestral nirvana was like. Do we follow the example of the modern hunter-gatherers living a subsistence existence in a few remaining parts of the world? What about the great apes, the animals that most closely resemble the ancestors we (and they) split off from millions of years ago? How much can we deduce from fossils? People were what anthropologists call "anatomically modern," meaning that they looked more or less like us, by about 200,000 years ago, but it's far less clear when "behaviorally modern" humans arose, or what exactly they did. So, trying to deduce the classic lifestyle from which we've now deviated is itself a bit of a gamble. In his book *Before the Dawn*, science writer Nicholas Wade points out, "It is tempting to suppose that our ancestors were just like us except where there is evidence to the contrary. This is a hazardous assumption."[8]

You might argue that hunter-gatherers, or the cavemen of our paleofantasies, were better adapted to their environment simply because they spent many thousands of years in it—much longer than we've spent sitting in front of a computer or eating Mars bars. That's true for some attributes, but not all. Continued selection in a stable environment, as might occur in the deep sea, can indeed cause ever more finely honed adaptations, as the same kinds of less successful individuals are weeded out of the population. But such rock-solid stability is rare in the world; the Pleistocene varied considerably in its climate over the course of thousands of years, and when people move around, even small shifts in the habitat in which they live, going from warm to cool, from savanna to forest, can pose substantially new evolutionary challenges. Even in perfectly stable environments, trade-offs persist; you can't give birth to large-brained infants and also walk on two legs trouble-free, no matter how long you try.

Incidentally, it's important to dispel the myth that modern humans are operating in a completely new environment because we only recently began to live as long as we do now, whereas our ancestors, or the average hunter-gatherer, lived only until thirty or forty, and hence never had to experience age-related diseases.

While it is absolutely true that the average life span of a human being has increased enormously over just the last few centuries, this does not mean that thousands of years ago people were hale and hearty until thirty-five and then suddenly dropped dead.

An average life expectancy is just that—an average of all the ages that the people in the population attain before they die. A life expectancy of less than forty can occur without a single individual dying at or even near that age if, for example, childhood mortality from diseases such as measles or malaria is high—a common pattern in developing countries. Suppose you have a village of 100 people. If half of them die at age five, perhaps from such childhood ailments, twenty die at age sixty, and the remaining thirty die at seventy-five, the average life span in the society is thirty-seven, but not a single person actually reached the age of thirty hale and hearty and then suddenly began to senesce. The same pattern writ large is what makes the life expectancy in developing countries so shockingly low. It isn't that people in sub-Saharan Africa or ancient Rome never experienced old age; it's that few of them survived their childhood diseases. Average life expectancy is not the same thing as the age at which most people die. Old age is not a recent invention, but its commonness is.

## The pace of change

If we do not look to a mythical past utopia for clues to a way forward, what next? The answer is that we start asking different questions. Instead of bemoaning our unsuitability to modern life, we can wonder why some traits evolve quickly and some slowly. How do we know what we do about the rate at which evolution occurs? If lactose tolerance can become established in a population over just a handful of generations, what about an ability to digest and thrive on refined grains, the bugaboo of the paleo diet? Breakthroughs in genomics (the study of the entire set of genes in an organism) and other genetic technologies now allow us to determine how quickly individual genes and gene blocks have been altered in response to natural selection. Evidence is mounting that numerous human genes have changed over just the last few thousand years—a blink of an eye, evolutionarily speaking—while others are the same as they have been for millions of years, relatively unchanged from the form we share with ancestors as distant as worms and yeast. The pages to come will explore which genes and traits have changed, which have not, how we know, and why it matters.

What's more, a new field called experimental evolution is showing us that sometimes evolution occurs before our eyes, with rapid adaptations happening in 100, 50, or even a dozen or fewer generations. Depending on the life span of the organism, that could mean less than a year, or perhaps a quarter century. It is most easily demonstrated in the laboratory, but increasingly, now that we know what to look for, we are seeing it in the wild. And although humans are evolving all the time, it is often easier to see the process in other kinds of organisms. Humans are not the only species whose environment has changed dramatically over the last few hundred years, or even the last few decades. Some of the work my students and I have been doing on crickets found in the Hawaiian Islands and in the rest of the Pacific shows that a completely new trait, a wing mutation that renders males silent, spread in just five years, fewer than twenty generations.[9] It is the equivalent of humans becoming involuntarily mute during the time between the publication of the Gutenberg Bible and *On the Origin of Species*. This and similar research on animals is shedding light on which traits are likely to evolve quickly and under what circumstances, because we can test our ideas in real time under controlled conditions.

Over the last decade, our understanding of such rapid evolution, also called "evolution in ecological timescales," has increased enormously. And studying the rate of evolution also has practical implications. For example, fishermen often take the largest specimens of salmon or trout from streams and rivers. Fish usually need to reach a certain size before becoming sexually mature and capable of reproduction, after which growth slows down. Like other animals, fish show a trade-off between large size and time of reproduction: if you wait to be large before producing offspring, you probably will be able to produce more of them, and having greater numbers of offspring is favored by evolution, but you also risk dying before you are able to reproduce at all. But where overfishing has removed a substantial portion of a population, the average size of fish is now substantially smaller, because the fishermen have inadvertently selected for earlier reproduction, and evolution has favored fish that get to the business of sex sooner. It's not just that the larger fish have all been taken; it's that the fish are not reaching such sizes to begin with. The genes responsible for regulating growth and size at sexual maturity are now different because evolution has occurred. To bring back the jaw-dropping trophy fish of decades past, scientists say, people will have to change their ways.

It's common for people talk about how we were "meant" to be, in areas ranging from diet to exercise to sex and family. Yet these notions are often flawed, making us unnecessarily wary of new foods and, in the long run, new ideas. I would not dream of denying the evolutionary heritage present in our bodies—and our minds. And it is clear that a life of sloth with a diet of junk food isn't doing us any favors. But to assume that we evolved until we reached a particular point and now are unlikely to change for the rest of history, or to view ourselves as relics hampered by a self-inflicted mismatch between our environment and our genes, is to miss out on some of the most exciting new developments in evolutionary biology.

The influential twentieth-century biologist George Gaylord Simpson wrote a book called *Tempo and Mode in Evolution*, published in 1944. It is admirable from many perspectives, not least of which is the distinction it makes between the rate at which evolution occurs (tempo) and the pattern of evolution itself (mode). Simpson, a paleontologist by training, saw the work as an attempt to merge the then-new field of genetics with his own—a procedure he admitted to be "surprising and possibly hazardous":

> Not long ago paleontologists felt that a geneticist was a person who shut himself in a room, pulled down the shades, watched small flies disporting themselves in milk bottles, and thought that he was studying nature. A pursuit so removed from the realities of life, they said, had no significance for the true biologist. On the other hand, the geneticists said that paleontology had no further contributions to make to biology, that its only point had been the completed demonstration of the truth of evolution, and that it was a subject too purely descriptive to merit the name "science." The paleontologist, they believed, is like a man who undertakes to study the principles of the internal combustion engine by standing on a street corner and watching the motor cars whiz by.[10]

We still sometimes think that paleontology, or evolution at grand scales—the rise and fall of dinosaurs, the origin of land animals—has little in common with the minuscule goings-on of the genes from one generation to the next. But Simpson recognized that the two processes, while having some distinctive components, are still linked, and that the disporting flies exhibit many of the same characteristics as those million-year-old bones. It's just that the scale of measurement differs.

The title of Simpson's book is particularly germane to my argument here, calling up as it does a rather orchestral view of evolution, with allegro and adagio components. Seeing evolution without appreciating its variously fast and slow parts is like making all the movements of a symphony happen at the same pace; you get the same notes, but most of the joy and subtlety are missing. New advances in biotechnology have made the merger of paleontology and genetics more feasible than Simpson could have imagined. We have not yet cloned dinosaurs à la *Jurassic Park*, but we are not too far off. And this merger means that we can examine not only what evolution has wrought, but also the pace at which it operates, just as Simpson hoped.

## Change doesn't always do you good

At the same time that we wistfully hold to our paleofantasy of a world where we were in sync with our environment, we are proud of ourselves for being so different from our apelike ancestors. Animals like crocodiles and sharks are often referred to as "living fossils" because their appearance is eerily similar to that of their ancestors from millions of years earlier that are preserved in stone. But there is sometimes a tone of disparagement in the term; it is as though we pity them for not keeping up with trends, as if they are embarrassing us by walking (or swimming) around in the evolutionary equivalent of mullet haircuts and suspenders. Evolving more recently, so that no one would mistake a human for our predecessors of even a couple of million years back, seems like a virtue, as if we improved ourselves while other organisms stuck with the same old styles their parents wore.

Regardless of the shaky ground on which that impression lies, we don't even win the prize for most recent evolution; in fact, we lose by a wide margin. Strictly speaking, according to the textbook definition of evolution as a change in gene frequencies in a population, many of the most rapidly evolving species, and hence those with the most recent changes, are not primates but pathogens, the disease-causing organisms like viruses and bacteria. Because of their rapid generation times, viruses can produce offspring in short order, which means that viral gene frequencies can become altered in a fraction of the time it would take to do the same thing in a population of humans, zebras, or any other vertebrate.

Evolution being what it is—namely, without any purpose or intent—evolving quickly is not necessarily a good thing. Often the impetus behind rapid evolution in nonhuman organisms is a strong and novel selective agent: a crop is sprayed with a new insecticide, or a new disease is introduced to a population by a few individuals who stray into its boundaries. Those who are resistant, sometimes an extremely tiny minority, survive and reproduce, while the others perish. These events are not confined to crops, or even to nonhumans. Some estimates of death rates from the medieval outbreak of bubonic plague called the Black Death in Europe have gone as high as 95 percent.

Natural selection thus produces a bottleneck, through which only the individuals with the genes necessary for survival can pass. The problem is, that bottle also squeezes out a lot of other genetic variation along with the genes for susceptibility to the insecticide or the ailment. Suppose that genes for eye color or heat tolerance or musical ability happen to be located near the susceptibility genes on the chromosome. During the production of sex cells, as the chromosomes line up and the sperm and egg cells each get their share of reshuffled genes, those other genes will end up being disproportionately likely to be swept away when their bearer is struck down early in life by the selective force—the poison or pathogen. The net result is a winnowing out of genetic variants overall, not just those that are detrimental in the face of the current selection regime.

## Future evolution, and the downside to immortality

Evolution is constantly at work, altering a gene here or a set of co-occurring attributes there. It's not always visible, at least not at first, but it's still happening. And it provides a little-considered flaw to that long-sought goal of humanity: immortality. Imagine that you, like a character in one of those vampire novels that are so popular these days, can live forever. Day in and day out, as the seasons change and the years go by, you remain deathless and unaltered, while those around you wither and die. Except for the inconvenience of having to hide your ageless physique from the mortals around you, and the necessity of catching up with new fashions not once during a single period of youth but over and over again as hemlines rise and fall, it would be perfect, right?

Or maybe not. And not for the usual literary-device reasons, like losing your purpose in life, lacking a need to leave your mark before you expire, or having to watch loved ones succumb to the ravages of time. No. As generations came and went, it would become increasingly apparent that the problem was the inability to evolve. Individuals never can evolve, of course; members of a population just leave more or fewer genetic representations of themselves. But since we are never around to see more than a couple of generations before or after us, we don't notice the minute changes that are occurring in the rest of the group. After a while, and not all that long a while at that, your fifteenth-century vampire self would start looking, well, maybe not like a Neandertal, but just a bit different. You would be shorter than your peers, for example. And even if you didn't look different, your insides would lack those latest-model advances, those features that make the new version the one to buy, such as resistance to newfangled diseases like malaria. Natural selection happened while you just kept on being a bloodsucker.

Evolutionary biologist Jerry Coyne, author of *Why Evolution Is True* and an eponymous website, says that the one question he always gets from public audiences is whether the human race is still evolving.[11] On the one hand, modern medical care and birth control have altered the way in which genes are passed on to succeeding generations; most of us recognize that we wouldn't stand a chance against a rampaging saber-toothed tiger without our running shoes, contact lenses, GPS, and childhood vaccinations. Natural selection seems to have taken a pretty big detour when it comes to humans, even if it hasn't completely hit the wall. At the same time, new diseases like AIDS impose new selection on our genomes, by favoring those who happen to be born with resistance to the virus and striking down those who are more susceptible.

Steve Jones, University College London geneticist and author of several popular books, has argued for years that human evolution has been "repealed" because our technology allows us to avoid many natural dangers.[12] But many anthropologists believe instead that the documented changes over the last 5,000–10,000 years in some traits, such as the frequency of blue eyes, means that we are still evolving in ways large and small. Blue eyes were virtually unknown as little as 6,000–10,000 years ago, when they apparently arose through one of those random genetic changes that pop up in our chromosomes. Now, of course, they are common—an example of only one such recently evolved characteristic. Gregory Cochran and Henry Harpending even suggest that human evolution as a whole has, on the contrary, accelerated over the last several thousand years, and they also believe that relatively isolated groups of people, such as Africans and North Americans, are subject to differing selection.[13] That leads to the somewhat uncomfortable suggestion that such groups might be evolving in different directions—a controversial notion to say the least.

The "fish out of water" theme is common in TV and movies: city slickers go to the ranch, Crocodile Dundee turns up in Manhattan, witches try to live like suburban housewives. Misunderstandings and hilarity ensue, and eventually the misfits either go back where they belong or learn that they are not so different from everyone else after all. Watching people flounder in unfamiliar surroundings seems to be endlessly entertaining. But in a larger sense we all sometimes feel like fish out of water, out of sync with the environment we were meant to live in. The question is, did that environment ever exist?