



## Environment and Empire

### THE SHAPE OF THE ROMAN EMPIRE

Rome's rise is a story with the capacity to astonish us, all the more so since the Romans were relative latecomers to the power politics of the Mediterranean. By established convention, Rome's ancient history is divided into three epochs: the monarchy, the republic, and the empire. The centuries of monarchy are lost in the fog of time, remembered only in fabulous origins myths that told later Romans how they came to be. Archaeologists have found the debris of at least transient human presence around Rome going back to the Bronze Age, in the second millennium BC. The Romans themselves dated their city's founding and the reign of their first king, Romulus, to the middle of the eighth century BC. Indeed, not far from where Claudian stood in the forum, beneath all the brick and marble, there had once been nothing more than a humble agglomeration of wooden huts. This hamlet could not have seemed especially propitious at the time.<sup>1</sup>

For centuries, Rome stood in the shadow of her Etruscan neighbors. The Etruscans in turn were outclassed by the political experiments underway to the east and south. The early classical Mediterranean belonged to the Greeks and Phoenicians. While Rome was still a village of letterless cattle rustlers, the Greeks were writing epic and lyric poetry, experimenting with democracy, and inventing drama, philosophy, and history as we know them. On nearer shores, the Punic peoples of Carthage built an ambitious empire, before the Romans knew how to rig a sail. Fifteen miles inland, along the soggy banks of the Tiber River, Rome was a backwater, a spectator to the creativity of the early classical world.<sup>2</sup>

Around 509 BC the Romans shuffled off their kings and inaugurated the republic. Now they gradually step into history. From the time they are known to us, Rome's political and religious institutions were a blend of the indigenous and the adopted. The Romans were unabashed borrowers. Even the first code of Roman law, the Twelve Tables, was proudly confessed to be plagiarized from Athens. The Roman republic belongs among the many

citizenship-based political experiments of the classical Mediterranean. But the Romans put their own accents on the idea of a quasi-egalitarian polity. Exceptional religious piety. Radical ideologies of civic sacrifice. Fanatical militarism. Legal and cultural mechanisms to incorporate former enemies as allies and citizens. And though the Romans themselves came to believe that they were promised *imperium sine fine* by the gods, there was nothing ineluctable about Rome's destiny, no glaring geographical or technological secret of superiority. Only once in history did the city become the seat of a great empire.

Rome's rise coincided with a period of geopolitical disorder in the wider Mediterranean in the last centuries before Christ. Republican institutions and militaristic values allowed the Romans to concentrate unprecedented state violence, at an opportune moment of history. The legions destroyed their rivals one by one. The building of the empire was bloody business. The war machine whetted its own appetite. Soldiers were settled in rectilinear Roman colonies, imposed by brute force all over the Mediterranean. In the last century of this age of unbridled conquest, grand Shakespearean characters bestride the stage of history. Not by accident is western historical consciousness so disproportionately concentrated in these last few generations of the republic. The making of Rome's empire was not quite like anything that had happened before. Suddenly, levels of wealth and development lunged toward modernity, surpassing anything previously witnessed in the experience of our species. The teetering republican constitution generated profound reflections on the meaning of freedom, virtue, community. The acquisition of imperial power inspired enduring conversations about its proper exercise. Roman law helped to birth norms of governance, by which even the masters of empire might be held to account. But the scaling up of sheer power also fueled the cataclysmic civil violence that ushered in an age of autocracy. In the apt words of Mary Beard, "the empire created the emperors—not the other way round."<sup>3</sup>

By the time Augustus (r. 27 BC–AD 14) brought the last meaningful stretches of the shore under Roman dominion, it was no idle boast to call the Mediterranean "*mare nostrum*," our sea. To take full measure of the Roman accomplishment, and to understand the mechanics of ancient imperialism, we must know some basic facts about life in an ancient society. Life was slow, organic, fragile, and constrained. Time marched to the dull rhythms of foot and hoof. Waterways were the real circulatory system of the empire, but in the cold and stormy season the seas closed, and every town became an island. Energy was forbiddingly scarce. Human and animal muscle for force, timber and scrub for fuel. Life was lived close to the land.

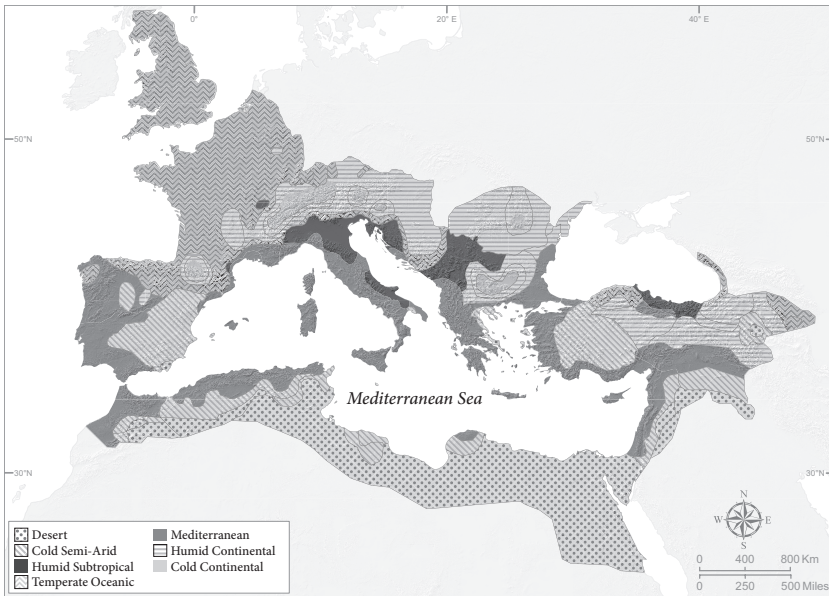
Eight in ten people lived outside of cities. Even the towns had a more rural character than we might imagine, made lively by the bleats and brays—and pungent smells—of their four-legged inhabitants. Survival depended on the delivery of rain in a precarious environment. For the vast majority, cereals dominated the diet. “Give us this day our daily bread” was a sincere petition. Death always loomed. Life expectancy at birth was in the 20s, probably the mid-20s, in a world where infectious disease raged promiscuously. All of these invisible constraints were as real as gravity, defining the laws of motion in the world the Romans knew.<sup>4</sup>

These limits cast into relief the sheer spatial achievement of the Roman Empire. Without telecommunications or motorized transport, the Romans built an empire connecting vastly different parts of the globe. The empire’s northern fingers reached across the 56<sup>th</sup> parallel, while the southern edges dipped below 24° N. “Of all the contiguous empires in premodern history, only those of the Mongols, Incas, and Russian czars matched or exceeded the north-south range of Roman rule.” Few empires, and none so long-lived, grasped parts of the earth reaching from the upper mid-latitudes to the outskirts of the tropics.<sup>5</sup>

The northern and western parts of the empire were under the control of the Atlantic climate. At the ecological center of the empire was the Mediterranean. The delicate, moody features of the Mediterranean climate—arid summers and wet winters against a relatively temperate backdrop—make it a distinct type of climate. The dynamics of a giant, inland sea, combined with the knuckled texture of its inland terrains, pack extreme diversity into miniature scale. Along the empire’s southern and eastern edges, the high pressure of the subtropical atmosphere won out, turning the land into pre-desert and then true desert. And Egypt, the breadbasket of the empire, plugged the Romans into wholly other climate regimes: the life-bringing Nile floods originated in Ethiopian highlands watered by the monsoons. The Romans ruled all this.<sup>6</sup>

The Romans could not impose their will on so vast a territory by violence alone. The maintenance of the empire required economies of force and constant bargaining with those inside Roman boundaries and beyond. Over the course of the empire’s long life, the inner logic of imperial power, those economies and bargains, shifted shape many times.

Augustus gave order to the regime we recognize as the high Roman Empire. Augustus was a political genius, gifted with an uncannily long lifespan, who presided over the death throes of the republican constitution. During his reign, the campaigns of conquest, which had been fueled by elite competition for power in the late republican regime, started to slow. His reign



*Map 2. Ecological Zones of the Roman Empire*

was advertised as a time of peace. The gates to the Temple of Janus, which the Romans left open in times of war, had been closed twice in seven centuries. Augustus made a show of closing them three times. He demobilized the permanent citizen legions and replaced them with professional armies. The late republic had still been an age of gratuitous plunder. Slowly but surely, though, norms of governance and justice began to prevail in the conquered territories. Plunder was routinized, morphed into taxation. When resistance did flare, it was snuffed out with spectacular force, as in Judea and Britain. New citizens were made in the provinces, coming like a trickle at first, but subsequently faster and faster.

The grand and decisive imperial bargain, which defined the imperial regime in the first two centuries, was the implicit accord between the empire and “the cities.” The Romans ruled through cities and their noble families. The Romans coaxed the civic aristocracies of the Mediterranean world into their imperial project. By leaving tax collection in the hands of the local gentry, and bestowing citizenship liberally, the Romans co-opted elites across three continents into the governing class and thereby managed to command a vast empire with only a few hundred high-ranking Roman officials. In retrospect, it is surprising how quickly the empire ceased to be a mechanism of naked extraction, and became a sort of commonwealth.<sup>7</sup>

The durability of the empire depended on the grand bargain. It was a gambit, and it worked. In the course of the *pax Romana*, as predation turned to governance, the empire and its many peoples flourished. It started with population. In the most uncomplicated sense, people multiplied. There had never been so many people. Cities spilled beyond their accustomed limits. The settled landscape thickened. New fields were cut from the forests. Farms crept up the hillsides. Everything organic seemed to thrive in the sunshine of the Roman Empire. Sometime around the first century of this era, the population of Rome itself probably topped one million inhabitants, the first city to do so, and the only western one until London circa 1800. At the peak in the middle of the second century, some seventy-five million people in all came under Roman sway, a quarter of the globe's total population.<sup>8</sup>

In a slow-moving society, such insistent growth—on this scale, over this arc of time—can easily spell doom. Land is the principal factor of production, and it is stubbornly finite. As the population soared, people should have been pushed onto ever more marginal land, harder and harder pressed to extract energy from the environment. Thomas Malthus well understood the intrinsic and paradoxical relationships between human societies and their food supplies. “The power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race. The vices of mankind are active and able ministers of depopulation. They are the precursors in the great army of destruction, and often finish the dreadful work themselves. But should they fail in this war of extermination, sickly seasons, epidemics, pestilence, and plague advance in terrific array, and sweep off their thousands and tens of thousands. Should success be still incomplete, gigantic inevitable famine stalks in the rear, and with one mighty blow levels the population with the food of the world.”<sup>9</sup>

Yet . . . the Romans manifestly did not succumb to mass-scale starvation. Herein is to be found the hidden logic of the empire's success. Far from steadily sinking into misery, the Romans achieved per capita economic growth, straight into the teeth of headlong demographic expansion. The empire was able to defy, or at least defer, the grim logic of Malthusian pressure.

In the modern world, we are accustomed to annual growth rates of 2–3 percent, on which our hopes and pension plans depend. It was not so in ancient times. By their nature, pre-industrial economies were on a tight energy leash, constrained in their ability to extract and exchange energy more efficiently on any sustainable basis. But premodern history was neither a slow, steady ascent toward modernity, nor the proverbial hockey stick—a

flat-line of bleak subsistence until the singular energy breakthroughs of the Industrial Revolution. Rather, it was characterized by pulses of expansion and then disintegration. Jack Goldstone has proposed the term “efflorescence” for those phases of expansion, when background conditions conduce to real growth for some happy length of time. This growth can be extensive, as people multiply and more resources are turned to productive use, but as Malthus described, this kind of growth eventually runs out of room; more promisingly, growth can be intensive, when trade and technology are employed to extract energy more efficiently from the environment.<sup>10</sup>

The Roman Empire set the stage for an efflorescence of historic proportions. Already in the late republic, Italy experienced precocious leaps forward in social development. To a certain extent, the prosperity of Italy might be written off as the result of sheer takings, naked political rents seized as the fruits of conquest. But underneath this veneer of extracted wealth, real growth was afoot. This growth not only continued after the military expansion had reached its outer bounds—it now diffused throughout the conquered lands. The Romans did not merely rule territory, transferring some margin of surplus from periphery to center. The integration of the empire was catalytic. Slowly but steadily, Roman rule changed the face of the societies under its dominion. Commerce, markets, technology, urbanization: the empire and its many peoples seized the levers of development. For more than a century and a half, on a broad geographical scale, the empire writ large enjoyed both intensive and extensive growth. The Roman Empire both staved off Malthusian reckoning and earned uncalculated political capital.<sup>11</sup>

This prosperity was the condition and the consequence of the empire’s grandeur. It was a charmed cycle. The stability of the empire was the enabling background of demographic and economic increase; people and prosperity were in turn the sinews of the empire’s power. Soldiers were plentiful. Tax rates were modest, but collections were abundant. The emperors were munificent. The grand bargain with the civic elites paid out for both sides. There seemed to be enough wealth everywhere. The Roman armies enjoyed tactical, strategic, and logistical advantages over enemies on every front. The Romans had achieved a kind of favorable equilibrium, if more fragile than they knew. Gibbon’s great *History of the Decline and Fall of the Roman Empire* launches from the sunny days of the second century. In his famous verdict, “If a man were called to fix the period in the history of the world, during which the condition of the human race was most happy and prosperous, he would, without hesitation, name that which elapsed from the death of Domitian [AD 96] to the accession of Commodus [AD 180].”<sup>12</sup>

The Romans had edged outward the very limits of what was possible in the organic conditions of a premodern society. It is no wonder that the fall of such a colossus, what Gibbon called “this awful revolution,” has been the object of perennial fascination.

## OUR FICKLE PLANET

By AD 650, the Roman Empire was a shadow of its former self, reduced to a Byzantine rump state in Constantinople, Anatolia, and a few straggled possessions across the sea. Western Europe was broken into fractious Germanic kingdoms. Half the former empire was swiftly carved off by armies of believers from Arabia. The population of the Mediterranean basin, which once stood at seventy-five million people, had stabilized at maybe half that number. Rome was inhabited by some 20,000 souls. And its denizens were none the richer for it. By the seventh century, one measly trunk route still connected east and west across the sea. Currency systems were as fragmented as the political mosaic of the early middle ages. All but the crudest financial institutions had vanished. Everywhere apocalyptic fear reigned, in Christendom and formative Islam. The end of the world felt nigh.

These used to be called the Dark Ages. That label is best set aside. It is hopelessly redolent of Renaissance and Enlightenment prejudices. It altogether underestimates the impressive cultural vitality and enduring spiritual legacy of the entire period that has come to be known as “late antiquity.” At the same time, we do not have to euphemize the realities of imperial disintegration, economic collapse, and societal simplification. These are brute facts in need of explanation, as objective as an electricity bill—and measured in similar units. In material terms, the fall of the Roman Empire saw the process of efflorescence run in reverse, toward lower levels of energy capture and exchange. What we are contemplating is a monumental episode of state failure and stagnation. In Ian Morris’s valiant effort to create a universal scale of social development, the fall of the Roman Empire emerged as the single greatest regression, *in all of human history*.<sup>13</sup>

Explanations for the fall of Rome have never been lacking. There is a traffic jam of contending theories. A German classicist catalogued 210 hypotheses on offer. Some of these have held up to scrutiny better than others, and the two that enjoy pride of place as leading contenders for large-scale explanation emphasize the inherently unsustainable mechanics of the imperial system and the gathering external pressures along the frontiers of empire.



The first emperor, Augustus, established the constitutional framework of monarchy; rules of succession were purposefully indeterminate, and the accidents of Fortune played a perilously large role. As time progressed, contests for power and legitimacy played out as self-destructive wars for command of the armies. Concurrently, the ever-growing professional corps of imperial administrators displaced the webs of local elites in running the empire, making for a more bureaucratic and more brittle state. The mounting fiscal pressures progressively overheated the system.<sup>14</sup>

Meanwhile, the borders of empire stretched across northern Britain, along the Rhine and Danube and Euphrates, and past the edges of the Sahara. Beyond the march, jealous and hungry peoples dreamed of their own destiny. Time was their ally; the process we now call secondary state formation saw Rome's adversaries become more complex and formidable over the centuries. These threats relentlessly drained the resources of frontier zones and heartland alike. In tandem with dynastic strife, they were fatal to the fortunes of empire.

These familiar theories have much to recommend them, and they remain integral to the story presented in these pages. But in recent years, students of the past have been increasingly confronted by what might be called *natural* archives. Natural archives come in many forms. Ice cores, cave stones, lake deposits, and marine sediments preserve records of climate change, written in the language of geochemistry. Tree rings and glaciers are records of the environment's history. These physical proxies preserve the encoded record of the earth's past. Equally, evolutionary and biological history have left a trail for us to follow. Human bones, in their size and shape and scars, preserve a subtle record of health and disease. The isotope chemistry of bones and teeth can tell stories about diet and migration, biological biographies of the silent majority. And the greatest natural archive of all may be the long strands of nucleic acids we call genes. Genomic evidence can cast light on the history of our own species as well as the allies and adversaries with whom we have shared the planet. Living DNA is an organic record of evolutionary history. And the ability to extract and sequence ancient DNA from archaeological contexts is allowing us to reconstruct the tree of life into the deep past. Occasionally, it has let us finger some of history's microbial mass murderers with forensic identification as dramatic and final as any courtroom evidence. Technology is revolutionizing what we know about the evolutionary story of microbes and men.<sup>15</sup>

Most histories of Rome's fall have been built on the giant, tacit assumption that the environment was a stable, inert backdrop to the story. As a by-product of our own urgent need to understand the history of earth systems,



and thanks to dizzying advances in our ability to retrieve data about the paleoclimate and genomic history, we know that this assumption is wrong. It is not only wrong—it is immodestly, unnervingly wrong. The earth has been and is a heaving platform for human affairs, as unstable as a ship's deck in a violent squall. Its physical and biological systems are a ceaselessly changing setting, and they have given us what John Brooke calls “a rough journey” for as long as we have been human.<sup>16</sup>

Our awareness of climate change is understandably preoccupied by the fact that greenhouse gas emissions are altering the earth's atmosphere at an alarming and unprecedented pace. But anthropogenic climate change is a recent problem—and frankly only part of the picture. Since long before humans started to load the atmosphere with chemicals that trap heat, the climate system has swayed and varied due to natural causes. For most of the two-hundred thousand years or so of human history, our forebears lived in the Pleistocene, an age of jagged climate oscillations. Small changes in the path of the earth, and slight variations in the tilt and spin of the earth around its axis, are constantly changing the amount and distribution of energy arriving from our nearest star. Across the Pleistocene, these mechanisms, known as orbital forcing, created icy interludes lasting millennia. Then, about 12,000 years ago, the ice broke, and the climate entered the warm and stable interglacial known as the Holocene. The Holocene was the necessary backdrop to the rise of agriculture and the growth of complex political orders. But it turns out the Holocene has been a time of sharp climate changes, dramatically important on human scales.<sup>17</sup>

While orbital mechanics still drive deep changes in the Holocene climate, solar energy varies in other consequential ways on shorter time-scales. The sun itself is an inconstant star. The eleven-year sunspot cycle is only the most familiar of an array of periodic variations in the solar dynamo; some drastically affect the earth's insolation. And our planet has played a role in natural climate change: volcanic eruptions spew reflective sulfate aerosols high into the atmosphere, screening the arrival of the sun's heat. Even in the friendly Holocene, then, orbital, solar, and volcanic forcing interacted with the inherently variable systems of the earth to make the climate far more volatile, and precarious, than we might have thought.<sup>18</sup>

The discovery of rapid climate change in the Holocene is a revelation. We are learning that the Romans were, in planetary perspective, lucky. The empire reached its maximal extent and prosperity in the folds of a late Holocene climate period called the Roman Climate Optimum (RCO). The RCO reveals itself as a phase of warm, wet, and stable climate across much of the Mediterranean heartland of empire. It was an inviting moment to

Table 1.1 Roman climate periods

Roman Climate Optimum	ca. 200 BC–AD 150
Roman Transitional Period	ca. AD 150–AD 450
Late Antique Little Ice Age	ca. AD 450–AD 700

make an agrarian empire out of a pyramid of political and economic bargains. Alongside trade and technology, the climate regime was a silent, co-operative force in the seemingly virtuous circle of empire and prosperity. As the Romans stretched their empire to its limits, they had no idea of the contingent and parlous environmental foundations of what they had built.

From the middle of the second century, the Romans’ luck ran into short supply. The centuries that form the object of our inquiry witnessed one of the most dramatic sequences of climate change in the entire Holocene. First, a period of climate disorganization covering three centuries (AD 150–450) set in, which we will propose to call the Roman Transitional Period. At crucial junctures, climate instability pressed on the empire’s reserves of strength and intervened dramatically in the course of events. Then, from the later fifth century, we sense the stirrings of a decisive reorganization that culminated in the Late Antique Little Ice Age. A spasm of volcanic activity in the AD 530s and 540s brought on the most frigid spell in the entire Late Holocene. Concurrently, the level of energy arriving from the sun slipped to its lowest point in several millennia. As we will see, the deterioration of the physical climate coincided with unprecedented biological catastrophe to overwhelm what was left of the Roman state.

This book will argue that the influence of the climate on Roman history was by turns subtle and overwhelming, alternately constructive and destructive. But climate change was always an *exogenous* factor, a true wild card transcending all the other rules of the game. From without, it reshaped the demographic and agrarian foundations of life, upon which the more elaborate structures of society and state depended. With good reason, the ancients revered the fearsome goddess *Fortuna*, out of a sense that the sovereign powers of this world were ultimately capricious.<sup>19</sup>

Nature wielded still another terrible device, capable of crashing in upon human societies like an army in the night: infectious disease. Biological change was even more forceful than the physical climate in deciding the fate of Rome. Of course, the two were not, and are not, unconnected. Climate change and infectious disease have been overlapping but not coterminous forces of nature. Sometimes climate change and pandemic disease were synergistic in their effects. At other times, they were more than temporally

coincident, since perturbation in the physical climate can instigate ecological or evolutionary changes that spill over into disease events. In the course of the centuries we will consider, they often worked in concert to bear on the destiny of the Roman Empire.<sup>20</sup>

There is one truly categorical difference between climate change and infectious disease. The climate system, until recently, vibrated on its own tempo and terms, without human influence. By contrast, the story of infectious disease is far more intimately shaped by human interference. Human societies in effect create the ecologies within which deadly microbes live, move, and have their being. In many ways, an unintended and paradoxical consequence of the Roman Empire's ambitious social development was the lethal microbial environment that it fostered. Inadvertently, the Romans were complicit in building the disease ecologies that haunted their demographic regime.

To understand how the Romans lived and died, much less the fate of their empire, we must try to reconstruct the specific juncture of human civilization and disease history that the Romans encountered. The pathogens that have regulated human mortality are not an undifferentiated array of enemies. The biological particulars of germs are unruly and decisive facts of history. The history of germs has been dominated by the brilliant model devised in the 1970s and most famously expressed by William McNeill in his classic *Plagues and Peoples*. For McNeill, the connective thread of the story was the rise and then confluence of different Neolithic germ pools. Agriculture brought us into close contact with domesticated animals; cities created the population densities needed for germs to circulate; the expansion of trading networks led to the "convergence of the civilized disease pools," as pathogens that were endemic in one society leapt ravenously into virgin territories.<sup>21</sup>

In recent years the shine of the classic model has started to fade. The ground has quietly but decisively shifted around it. The 1970s were the peak of a triumphant moment in western medicine. One by one the scourges of the past fell before the advance of science. There was confident talk of a transition in which infectious disease would become a thing of the past . . . But the terrifying roster of emerging infectious diseases—HIV, Ebola, Lassa, West Nile, Nipah, SARS, MERS, and now Zika, to name only a few of several hundred—shows that nature's creative destruction is far from spent. And all of these emerging infectious diseases have something insidious in common: they arose from the wild, not from domesticated species. Pathogen evolution and zoonotic diseases from the wild now loom larger than before in the dynamics of emerging infectious diseases.<sup>22</sup>

These insights have yet to be applied in a complete and consistent way to the study of the past, but the implications are revolutionary for the way we think about the place of Roman civilization in the history of disease. We should try to imagine the Roman world, through and through, as an ecological context for microorganisms. To start with, the Roman Empire was precociously urbanized. The empire was a great buzzing switchboard of cities. The Roman city was a marvel of civil engineering, and no doubt toilets, sewers, and running water systems alleviated the most dread effects of waste disposal. But these environmental controls were poised against overwhelming forces, a thin and leaky tide-wall against an ocean of germs. The city crawled with rats and teemed with flies; small animals squawked in alleys and courtyards. There was no germ theory, little hand washing, and food could not be kept from contamination. The ancient city was an insalubrious home. Humble diseases spread by the fecal-oral route, inducing fatal diarrheas, were probably the number one killer in the Roman Empire.

Outside the cities, landscape transformation exposed the Romans to equally perilous threats. The Romans did not just modify landscapes; they imposed their will upon them. They slashed and burned forests. They moved rivers and drained basins and built roads through the most intractable swamps. Human encroachment on new environments is a dangerous game. It not only exposes us to unfamiliar parasites but can trigger cascading ecological change with unpredictable consequences. In the Roman Empire, the revenge exacted by nature was grim. The prime agent of reprisal was malaria. Spread by mosquito bite, malaria was an albatross on Roman civilization. The vaunted hills of Rome are knobs rising above a glorified swamp. The river valley, not to mention the pools and fountains throughout the city, were a haven for the mosquito vector and made the eternal city a malarial bog. Malaria was a vicious killer in town and country, anywhere the *Anopheles* mosquito could thrive.<sup>23</sup>

The Roman disease environment was also formed by the connectivity of the empire. The empire created an internal zone of trade and migration as had never existed. The roads and sea lanes of the empire moved not only peoples, ideas, goods—they moved germs. We can watch this pattern unravel at different rates of speed. It is possible to follow the diffusion of sluggish killers, such as tuberculosis and leprosy, which spread across the Roman Empire with a slow burn, like lava. When fast-moving infectious diseases finally hopped onto the great conveyor belt of Roman connectivity, the consequences were electric.

We will emphasize the paradoxical relationship between Roman social development and the disease ecology of the empire. Despite the benefits

of peace and prosperity, the empire's inhabitants were unhealthy, even by premodern standards. One sign of their low level of biological well-being is their short stature. Someone like Julius Caesar, who was said to have been tall, may only have stood out in a society where men were, on average, a little under 5' 5". The burden of infectious disease weighed visibly on Roman health. But here is where we need to pay closer attention to the specificity of the Roman disease pool. If we look carefully at the patterns of mortality in space and time, we note a telling absence in the Roman world. There were not large-scale, interregional epidemic outbreaks. Most epidemics were spatially contained, local or regional affairs. The reasons for this absence lie in the intrinsic biological limits of the germs themselves. Microbes that depend on fecal-oral transmission, or hitchhiking inside arthropods, can only spread so far so fast. But starting in the second century, the combination of Roman imperial ecology and pathogen evolution created a new kind of storm, the pandemic.<sup>24</sup>

The centuries of later Roman history might be considered the age of pandemic disease. Three times the empire was rocked by mortality events with stunning geographical reach. In AD 165 an event known as the Antonine Plague, probably caused by smallpox, erupted. In AD 249, an uncertain pathogen swept the territories under Roman rule. And in AD 541, the first great pandemic of *Yersinia pestis*, the agent that causes bubonic plague, arrived and lingered for over two hundred years. The magnitude of these biological catastrophes is almost incomprehensible. The least of the three pandemics, by casualty count, was probably the mortality known as the Antonine Plague. We will argue that it carried off perhaps seven million victims. That is considerably lower than some estimates. But the bloodiest day of battle in imperial history was the rout of the Romans at Adrianople, when a desperate force of Gothic invaders overran the main body of the eastern field army. At most twenty thousand Roman lives were lost on that baleful day, and while it magnified the problem that these were soldiers, the lesson of the comparison is all the same: germs are far deadlier than Germans.

The great killers of the Roman Empire were spawns of nature. They were exotic, deadly intruders from beyond the empire. For this reason, a parochial history of the Roman Empire is a kind of tunnel vision. The story of Rome's rise and fall is entwined with global environmental history. In the Roman period, there was a quantum leap forward in global connectivity. Roman demand for silk and spices, slaves and ivory, fueled frenzied motion across borders. Merchants moved over the Sahara, along the Silk Roads, and above all across the Indian Ocean and into the Red Sea ports built by the

power of empire. The exotic beasts brought to the slaughter in the Roman spectacles are like macroscopic tracers, illuminating for us the very routes that brought the Romans into contact with unimaginable new frontiers of disease. The most basic fact of global biodiversity is the latitudinal species gradient, the greater richness of all life in proximity to the equator. In temperate and polar regions, recurring ice ages have periodically scraped clean the experiments of evolution, and there is simply less energy and less biotic interaction in colder climes. The tropics are a “museum” of biodiversity, where time and higher levels of solar energy have conspired to weave imponderably dense tapestries of biological complexity. This pattern holds for microorganisms, including pathogenic ones. In the Roman Empire, human-built networks of connectivity sprawled insouciantly across zones of nature’s making. The Romans helped build a world where sparks could light a conflagration on an intercontinental scale. Roman history is a critical chapter in the bigger, human story.<sup>25</sup>

There is an evolutionary history of germs that we are only beginning to see, but here we can make an earnest deposit by trying to see Roman history as one, perhaps unusually important, chapter in a much longer, global story of pathogen evolution. The Romans helped to create the microbial environment within which the random game of genetic mutation played out its cunning experiments. If the fate of the Roman Empire was shaped by the overwhelming force of pandemic disease, it was an uncanny mixture of structure and chance.

The urgent study of earth science and the genomic revolution are teaching us that climate change and emerging infectious diseases have been an integral part of the human story all along. The hard question has become not whether, but how, to insert the influences of the natural environment into the sequence of cause and effect.

## A HUMAN STORY

The integration of knowledge from fields as disparate as the natural, social, and humanistic sciences is called *consilience*. *Integration* means that historians are far from passive recipients of new data from the sciences. Indeed, the interpretation presented in this book relies on our still advancing knowledge of those entirely human parts of the narrative. Centuries of ongoing humanistic scholarship have helped us understand the stresses and strains—the true nature and inner workings—of the Roman Empire at

a level of detail that would make Gibbon jealous. This book tries to build on those insights, which are as fresh, ingenious, and surprising as the latest genomic study or paleoclimate archive.<sup>26</sup>

The question is how to explain the long sequence of momentous changes that rendered an empire that was integrated, populous, prosperous, and complex at one moment in time—in the age of Marcus Aurelius (AD 161–180)—into something unrecognizable five centuries later. It is an intertwined story of state failure and stagnation. The Roman Empire was built in a Malthusian world of energy constraints, but it was able to shove back those limits through a heady combination of trade and technical advance. The power of the empire was both a premise and an outcome of demographic expansion and economic growth. The state and social development went hand in hand. The rousing forces of climate change and infectious disease constantly acted upon this complex system, in a series of two-way relationships. Even in the case of the physical environment, where forces entirely beyond human control operated, the effects of climate change depended on the specific arrangements between an agrarian economy and the machinery of empire. And the history of infectious disease is always thoroughly dependent on ecologies constructed by human civilization.

We will not shy away from attributing great causal influence to natural forces, even as we strive to avoid flattening out the texture of events in reductionist fashion. Relationships between the environment and the social order were never tidy and linear. Even in the face of the sharpest challenges, the people we will meet in these pages surprise us with the depth of their response to adversity. The capacity to absorb and adapt to stress is measured in the term *resilience*. The empire might be construed as an organism with batteries of stored energy and layers of redundancy that permitted it to endure and recover from environmental shocks. Resilience is not infinite, however, and to look for it in ancient societies is also to be alert for the signs of persistent stress and the thresholds of endurance beyond which lie cascading change and systemic reorganization.<sup>27</sup>

The end of the Roman Empire, as contemplated here, was not a continuous decline leading to inevitable ruin, but a long, circuitous, and circumstantial story in which a resilient political formation endured and reorganized itself, until it fell apart, first in the west and then in the east. The pattern of change will always be presented as a highly circumstantial interplay between nature, demography, economy, politics, and even, we will argue, something so ethereal and quixotic as systems of belief, which were repeatedly unsettled and reconfigured in the course of these centuries. The charge of history is to interweave these threads of the story in the right



way, with a healthy respect for the realm of freedom and contingency, and a strong dose of sympathy for the humans who made their lives under the circumstances they were given.

As we set out to explore a historical episode of this magnitude, it is worth declaring at the outset a few of the main contours of the narrative. It is a story with four decisive turns, when the pace of events gathered momentum and disruptive change trailed close behind. At each of the points of transformation in the transit between the high empire and the early middle ages, we will try to seek out the specific and intricate lines of connection between natural and human systems.

(1) The first was a multifaceted crisis during the age of Marcus Aurelius, triggered by a pandemic disease, that interrupted the economic and demographic expansion. In its aftermath, the empire did not fall or disintegrate, but instead recovered its previous form without the same commanding dominance as before.

(2) Then, in the middle of the third century, a concatenation of drought, pestilence, and political challenge led to the sudden disintegration of the empire. In what has been called the “first fall” of the Roman Empire, the bare survival of an integrated imperial system was an act of willful reconstitution, and a close-run thing. The empire was rebuilt, but in a new guise—with a new kind of emperor, a new kind of government, a new kind of money, and, soon to follow, a new kind of religious faith.

(3) This new empire then roared back. But in a decisive and dramatic period of two generations spanning the end of the fourth and beginning of the fifth centuries, the coherence of the empire was conclusively broken. The entire weight of the Eurasian steppe seemed to lean, in new and unsustainable ways, against the edifice of Roman power, and as it chanced to happen, the western half of the empire buckled. This cataclysm, which Stilicho had aimed to avert, probably ranks as the most familiar version of Rome’s fall. In the course of the fifth century, the Roman Empire was dismembered—in the west. But it was not the grand finale of the Roman Empire.

(4) In the east, a resurgent Roman Empire enjoyed renewed power, prosperity, and population increase. This renaissance was violently halted by one of the worst environmental catastrophes in recorded history—the double blow of bubonic plague and a little ice age. Demographic shock played out in a slow motion failure of empire, culminating in the decisive territorial losses to the armies of Islam. Not only was the remnant of the Roman Empire reduced to a Byzantine rump state, but the survivors were left to inhabit a world with fewer people, less wealth, and perpetual strife among competing apocalyptic religions, including Christianity and Islam.

The rise and fall of Rome remind us that the story of human civilization is, through and through, an environmental drama. The flourishing of the empire in the halcyon days of the second century; the arrival of a new kind of virus from far beyond the Roman world; the rupture of the imperial grand bargain in the aftermath of pandemic; the meltdown of empire amid a concatenation of climate and health disasters in the third century; the empire's resurrection by a new kind of emperor; the fanning of massive people movements across Eurasia in the fourth century; the revitalization of eastern societies in late antiquity; the neutron bomb of bubonic plague; the insidious onset of a new age of ice; the final collapse of anything recognizable as the Roman Empire and the lightning conquests of the armies of *jihad*. If this book achieves its purpose, it will have become a little harder to hear these turns of the past as anything other than the contrapuntal motion of humanity and the natural environment, sometimes parallel and sometimes contrary, but as utterly inseparable as the sonorous lines of a baroque fugue.<sup>28</sup>

The pace at which our knowledge is growing is equal parts exhilarating and daunting. By the time the ink hits the pages of this book, scholarship will have sailed on. But that is a happy conundrum, and it is worth the risks if we can start to build a provisional map, inevitably to be filled in and corrected as discovery advances. It is time to reconsider the awesome, uncanny power of nature in the fate of a civilization that continues to surprise and captivate us, and we will need patience, as well as some imagination, to go back and pretend we do not know the ending. The place to begin is with Rome's greatest doctor, reared in the lap of peace and prosperity, who could little have imagined that dynamic cycles in our nearest star, or the chance mutation of a virus in a far-off forest, could rattle the foundations of the bustling empire that ruled the world where he was seeking his fortunes.