

INTRODUCTION

Constructing an Age of Mammals

OVER THE NINETEENTH CENTURY VISITORS TO METROPOLITAN MUSEUMS AND READERS of popular science books became familiar with a menagerie of extinct beasts. These included the mammoths, mastodons, dinotheres, and other ancient proboscideans, ancestors and relatives of modern elephants. The giant “toothless” edentates of South America, including the ground sloths and armadillo-like glyptodons, were known since the early nineteenth century. From North America came the horned herbivores like the dinocerata and titanotheres, and carnivores like the short-faced bear and saber-toothed cat. Fossil remains showed Europe had recently been inhabited by cave bears, hyenas, lions, woolly mammoths, aurochs, and hippopotamuses. More creatures were excavated in colonial territories, including great giraffids from India, and fossil marsupials from Australia. Evolutionary displays showed the step-by-step development of familiar creatures, such as horses and camels, from small early forms to the modern animals. The diversity of past life formed a narrative of the Tertiary and Quaternary periods—enshrined as “the Age of Mammals”—moving across the lush jungles of the Eocene, the bountiful forests and plains of the Miocene and Pliocene, the harsh Pleistocene glacial epoch, and the current “Age of Man,” when most of the great beasts were lost.

Building this history for the mammals required diverse knowledge and expertise. Fossils were excavated in places connected to expanding nineteenth-century economies, including mines, quarries, agricultural fields, urban building sites, and territories surveyed for settlement and exploitation. Interpreting the remains required imagination and debate, as scholars compared ancient bones with modern animals and fashioned fragmentary fossils into workable specimens. Prehistoric animals were imagined by scholars, publics, and artists, and elaborated in novels, poems, and popular science works. These genres brought an unknown past to life and constructed a history for the animal world. The ancient history of the mammals could provoke wonder at the spectacles of creation, horror at fearsome beasts and their terrible relations (and their imagined terrible deaths), evocations of transcendent or perplexing mysteries, calls to action for research or preservation, or humorous musings on creatures that seemed strange and comical. The lost beasts of prehistory were discussed in various registers, building their relevance to the present. The mammals showed life and the earth had a history with moral messages. Like human history, this could be conceptualized as a story of confident progress, or of decline and fall and fears for the future. The sedimentary eras of the Age of Mammals undergirded understandings of nature and humanity, where faith in progress was tempered by uncertainty and trepidation.

This book is about how the deep history of the mammals was constructed across the nineteenth century, and its implications for the current world. Its starting point is that—contrary to current interest in dinosaurs—nineteenth-century scholars and public audiences seeking dramatic lessons on the history of life focused inordinately on mammals. Mammals were thought to represent the pinnacle of animal life and were crucial for understanding the natural world. Yet the assumed dominance of mammals combined with troubling notions: promising creatures had been swept aside in the “struggle for life,” and modern nature was “impoverished” compared to previous eras. Why some ancient animals, such as the saber-toothed cat and ground sloth, became extinct, while others seemed to be precursors of familiar creatures like elephants and horses, were problems loaded with cultural assumptions and ambiguity. How humans related to deep developmental processes, and how the Age of Man differed from the Age of Mammals, provoked reflections on humanity’s relationship to the natural world. Ancient mammals became crucial for engaging with nature and the environment, and the past, present and future of the world.

The Age of Mammals was constructed as the last era of earth's history, setting the foundation for the modern world. But this former world was not conceived as entirely lost. Sedimentary views of time and globalized visions of the natural world meant that remnants of ancient life were thought to still be present in places considered removed from progress. The "denial of coevalness" was a defining technique within nineteenth-century anthropology, colonial rule, and racial and cultural othering, as people and places around the world were defined by Western scholars as relics of past stages of development.¹ The modernity of many humans was denied, as was the modernity of many landscapes, animals, and plants. Debates over fossils, and reconstructions of organisms and ancient environments, marked particular creatures and locations as "progressive" or "primitive," "developing" or "decadent," "general" or "specialized," terms with strong ideological resonances. Studies of fossil mammals naturalized ideas of how familiar animals like the horse and the elephant came to be, how the life of South America and Australia was distinct from that of other places, and why Africa seemed to be the one place in the world where some great beasts survived. Fossil mammals linked nature with social, cultural, and economic values. The construction of hierarchy and order in the history of the mammals was inseparable from the construction of hierarchy and order in the modern world.

Paleontology across Boundaries and Borders

The growth of the concept of "deep time" is now regarded as one of the most significant shifts in human understandings of their place in the universe. Indeed, Martin Rudwick argues that the establishment of "the earth's deep history" should be regarded as one of the great conceptual revolutions, along with the Copernican, Darwinian, and Freudian.² Partly this was because of the tremendously long chronologies promoted by geology and paleontology, which constructed an earth history far beyond the time spans deduced from the Bible or the chronologies of India, China, and Pharaonic Egypt. Interest also derived from the sense of change and unfamiliarity. The earth and nature were reevaluated through ideas that landscapes had, in former ages, been radically different: covered in jungles filled with giant reptiles, or glaciated landmasses home to mammoths and great bears. How far back did this history go? How could it be made known? What forces drove change in the natural world? Was there a plan or order behind it? And what was the

relationship between fossil organisms and the modern world? Behind these questions were sedimentary ideas of time and development. Geology and paleontology showed successions of environments layered on one another. There was no single timeless past or original state of nature, but a series of eras which stretched through the layers of the earth. Fossils and geological landscapes were gateways into these former worlds.

More recently Pratik Chakrabarti and others associated with a drive for “new earth histories” have examined the conceptual power of deep time obliterating other means of understanding the world and its pasts.³ These studies argue that the establishment of deep time was intrinsically connected with structures of economic and political power. While recognition of connections between political ideology and evolutionary sciences is not new,⁴ this more recent literature has taken a material and institutional focus, arguing that the construction of deep history was inseparable from control over territories and extraction of mineral resources. Katrin Yusoff has drawn attention to how “the sleight of hand of the Janus-faced discipline of geology (as extractive economy and deep-time paleontology of life-forms) is to naturalize (and thus neutralize) the theft of extraction through its grammars of extraction.”⁵ The extraction of fossils, the extraction of mineral resources, and the establishment of systems of authority are not separate stories, but deeply entwined. Similar observations have been made in the history of paleontology. Lukas Rieppel has argued that the paleontology of “the long Gilded Age” in the United States was predicated on the changing capitalist economy, drawing in people and techniques from mining, industry, corporate administration, and philanthropy, often in politicized and socially controlling ways.⁶ The study of fossils was inscribed with power and linked with empire and economic dominance.

We therefore have a strong literature showing the conceptual importance of deep time, and how it was conditioned by power and control over the natural and human worlds. This book seeks to develop these perspectives, further linking nineteenth-century histories of the earth with the workings of cultural, political, and economic authority. The elaboration of the history of the mammals shows the connections between ideologies of progress and hierarchy, and how the natural world was inscribed with moral values. It also shows the wide ranges of people and places involved in these processes. In some respects it is a story of power and control. Mammal paleontology was connected with expanding nineteenth-century economies and was often

furthered through empires and nationalizing states. Intellectually too the history of the mammals was constructed around ideas that living things could be arranged in scales of worth. However, the elaboration of the Age of Mammals also shows unevenness in both these areas. The geographic framing of the Age of Mammals reinforced the power and hierarchy of established centers, but could also displace them, by making areas regarded as strange, primitive, or unique essential for research. Similarly, these researches often raised more questions than they answered, reinforcing idioms of cyclical development, or doubts over the nature of “progress.” In the construction of the Age of Mammals, valuations of progress and power were beset by uncertainty and threat.

The contested paleontological past rested on diverse perspectives. Indeed, rather than consider paleontology and the study of fossils as a single discipline, we should instead regard it, especially in its nineteenth-century form, as a linking field connecting many ways of knowing the natural world. While the nineteenth century has often been presented as a key period for the forging of modern disciplines, this was a difficult process.⁷ Relations between different branches of knowledge were close, and fossils linked studies of the earth and minerals with the natural history of plants and animals. Since the inception of the field, there has been a constant tension around the extent paleontological research is a geological subject, a biological or natural history one, or something *sui generis*. These debates shifted across the nineteenth and twentieth centuries. David Sepkoski has discussed the rise of the field of paleobiology in the second half of the twentieth century, defined by researchers like Jack Sepkoski and Stephen Jay Gould, and the use of statistical methods to understand fossil records.⁸ A different form of self-conscious paleobiology developed in the 1900s through figures like Henry Fairfield Osborn, Louis Dollo, and Othenio Abel, declaring (in often politicized manners) that “paleontology is the zoology of the past.”⁹ Early comparative anatomists like Georges Cuvier and scriptural geologists like William Buckland were also concerned with understanding fossil creatures as functioning organisms and communities.¹⁰ These were all distinct projects, but showed similar attempts to relate the life of the past and present. Alongside these shifts, other scholars argued that the study of fossils should be primarily concerned with stratigraphy, with the presence of particular fossils allowing discernment of the age of rock strata—a process often connected with mineralogy and the search for

resources.¹¹ These changing emphases were constantly negotiated, as fossils were used to debate the history of the earth and life.

Additionally, the study of fossils was not just an intellectual pursuit connected with what we might now call disciplines. Defining, locating, extracting, and analyzing fossils required practical knowledge and expertise. One very fruitful area of recent scholarship has examined how geology was enmeshed with the developing industrial economy and exploitation of coal, stone, metal ores, and oil, linking consciousness of deep time with economic processes.¹² Excavating fossils required skills around digging, preservation, and transportation, often relying on miners, quarry workers, and similar laborers.¹³ Once specimens were taken to collections, considerable work was required to transform them into usable specimens. Paul Brinkman and Caitlin Wylie highlighted the importance of fossil preparators, whose technical expertise refashioned fragmentary, fragile fossils into workable scientific objects.¹⁴ Knowing fossils often drew as much from the craft skills of manufacturing, casting, and preservation as it did erudite scholarly approaches to animals and nature.

The mixture of knowledge and expertise within paleontology raises a further point. As Claudine Cohen has argued, paleontological reasoning is based “not solely on observation and rationality, but sagacity and intuition, fiction and imagination, also play a necessary role in its hypotheses.”¹⁵ Partly this followed the trajectory of paleontology being entwined with literary modes of representation (as examined by Ralph O’Connor),¹⁶ and artistic work, with art and imagination becoming necessary to reconstruct fossils and represent them as living organisms and “scenes from deep time.”¹⁷ Imagination also conditioned the practice of paleontological science itself. Understanding how fragmentary remains could connect with modern animals, and presenting assemblages of fossils not as masses of bone or rock, but as the relics of lost faunas and floras, depended on imagination and conjecture. The field certainly drew from detailed typological methods and claims of “objectivity,” and some aspects showed the drive to mechanical reproduction and discipline in nineteenth-century science discussed by Daston and Galison.¹⁸ However, given the gaps in the fossil record, distance in time, and strangeness of the paleontological past, studies of fossils required imaginative and speculative leaps. While the appropriate limits of speculation were a constant controversy, the field was persistently imbued with imagination and creativity.

As well as linking disciplines, people, and ways of knowing the natural world, the study of fossils also linked places. Paleontology was a self-consciously globalizing subject, and the construction of the earth's history was exactly that: the construction of a past which could accommodate the whole world. This global focus intermixed the ideological and material aspects of paleontology. Paleontologists sought to define the history of life across time and space, accumulating fossils and geological specimens from all over the world (while comparing them with the remains of modern animals and often humans). This built a vision of earth history defined by changes in life across different eras and between different places. Sometimes Indigenous, vernacular, or traditional knowledge of fossils, earth, and landscapes were engaged with, but more often these were subordinated, instrumentalized, or erased. The deep-time sciences worked and reworked a range of pasts and traditions around the earth, and incorporated them within their concepts.

Two types of location were particularly significant within the shifting geographies of fossil work. The first were field sites—the places where fossils were extracted. In the paleontological imagination, “the field” has a special status, often associated with remote and dangerous places—the badlands of the United States, the far reaches of Patagonia, and arid regions in continental interiors. These areas were certainly important for the study of fossils, and for ideologies around the paleontologist as a masculine field-worker, part scientist and part frontiersman.¹⁹ But possibly more important were mines, agricultural fields, infrastructural cuttings, and urban digs. One core theme in this book is that exploited fossil sites tended to be in places being integrated into new industrial, commercial, and agricultural relations, rather than regions extremely remote to Western scholars. These sites could be difficult to work in, and the challenges of the modern environment were persistent features in excavation accounts. But fossil work almost invariably followed economic exploitation. Paleontology was a self-consciously “frontier science,” although it was a medium- to late-stage entrant onto frontiers, using techniques and infrastructure set up by expanding political, economic, and colonial systems to assert conceptual and scholarly dominance over territories. Paleontology entered frontiers in a self-conscious manner, but did so when the balance had definitely shifted toward extraction.

The second major sites were central collections. The study of fossils depended on accumulation of material from across time and space. This was

partly due to the rhetoric and practices around fossil work. An emphasis on analysis and comparison of specimens meant that centralization was critical to making sense of the past. As John Pickstone has argued, the museum collection, far from being secondary to laboratories and universities, developed over the eighteenth and nineteenth centuries as an important expression of new collecting and ordering modes of science.²⁰ Paleontology was a field centered on these institutions and ways of knowing. However, collections were sites of conflict and confusion as much as places of authoritarian dominance.²¹ Who within the collection had authority to own, interpret, and display specimens was not an easy question to answer. And the role of other institutions in knowing the fossil past, in particular universities, private collections, and commercial operators, was often contentious. The world of collections was fractious, both among different collections and with other sites of knowledge.

Paleontology depended on relations between field sites and collections. Yet these two places were more clusters around which relationships could be consolidated, rather than binary poles or clearly identifiable centers and peripheries. Managing fieldwork, moving between the field site and collection, and negotiating for access and material contested the power of centers and built new ones. Much of this book examines the challenges and strategies of science being worked at a distance, whether through the organization of expeditions, managing collaborators, and transporting and preserving material. Control over field sites consolidated authority in particular places, especially as new scientific institutions developed in regions regarded as significant. Authority often varied depending on access, proximity, funds, and tradition. These relations conditioned how paleontology was undertaken and the concepts underlying the field.

The deep-time sciences therefore offer almost an ideal case study to understand how different forms of knowledge and claims to authority interacted and moved across the nineteenth and early twentieth centuries, a research problem most notably expressed through James Secord's contention that knowledge is produced through communication and circulation among different social and geographic contexts.²² These transfers were not easy and depended on fierce debate and contestation. The history of paleontology allows us to get to grips with Fa-ti Fan's contention that "what is called 'circulation' may have been really a series of negotiations, pushes and pulls, struggles, and stops and starts."²³ It allows us to see movement across

“lumpy” networks of power and exchange, and the connections of scholarship with hierarchies of knowledge and authority.²⁴ Global and totalizing messages were assertions of power from particular places, but also opened space for other voices—and blockage and conflict were just as important as circulation and exchange.

Understanding the Mammal Emphasis

My focus on the history of research on fossil mammals sets this book apart from most works on the history of nineteenth-century paleontology. Apart from broad studies examining the overall establishment and implications of geological time, most histories have taken dinosaur paleontology as the core focus of the field. A range of works have shown—in excellent detail—how dinosaurs and other Mesozoic reptiles captured public imaginations across American and European societies. For example, Paul Brinkman’s *Second Jurassic Dinosaur Rush* discusses how dinosaur fossils were key to building scientific institutions in the United States, Ilja Nieuwland’s *American Dinosaur Abroad* examines the transfer of dinosaur fossils across varied political and cultural contexts in Europe and the United States, Lukas Rieppel’s *Assembling the Dinosaur* draws out the connections between dinosaur paleontology and Gilded Age American capitalism, and Richard Fallon’s *Reimagining Dinosaurs* has shown how relations between science and literature were key to constructing the dinosaur as a transatlantic icon.²⁵ Meanwhile, the Dinosaurs in Berlin project has examined the early twentieth-century German-led excavations at Tendaguru in modern Tanzania to consider the links among paleontology, colonialism, and international politics.²⁶ We therefore have a large literature showing how dinosaurs became important icons of prehistory, especially in Anglo-American contexts in the late nineteenth and early twentieth centuries. This work emphasizes the relations between science and popular culture; transfer across national, local, and colonial contexts; and political and economic power.

While a great deal has been written about the impact of dinosaur paleontology, the equally prominent nineteenth-century focus on fossil mammals has been much less studied. The few exceptions are popular works²⁷ and books dealing with the reception of iconic creatures, particularly mastodons, mammoths, and giant sloths.²⁸ As well as missing a crucial focus within the history of paleontology, the relative lack of work on engagement with fossil

mammals has obscured important aspects of the impact and role of the deep-time sciences. Presentations of dinosaurs tended to emphasize their strangeness and monstrosity, with accounts of their “grotesque,” “ugly,” and “ferocious” characters.²⁹ Similar terms were used for some extinct mammals, particularly early or large forms that seemed unrelated to modern organisms. Yet other prehistoric mammals were presented as comparable or ancestral to modern animals, explaining the origins of modern faunas and landscapes. Indeed, Rieppel’s *Assembling the Dinosaur* includes an entire chapter implying that scientific interest in mammals, and valuation of “mammalian traits” of sociability and intelligence, was much greater than attention given to dinosaurs.³⁰ The history of the mammals gives us a deeper view of paleontology’s cultural role: life’s history was not just about weirdness, size, and monstrosity, but about empathy and linkages across the eras. Fossil mammals could show strange “extinct monsters,” but also held the key to understanding the modern world and the forces driving life.

A focus on fossil mammals also gives new insights into the geographies of paleontological work. That histories of dinosaur paleontology orient around Britain, the United States, and to a lesser extent Germany does not just reflect the interests of historians, but the main places where dinosaur paleontology was conducted in the nineteenth and early twentieth centuries. Richard Fallon discusses the popularization of the term *dinosaur* as a decidedly US-British phenomenon.³¹ Fossil work on dinosaurs was often unusual, requiring well-resourced collections with access to the rare sites containing well-preserved dinosaur fossils. This has therefore focused the history of paleontology around a few large museums in a few countries, which—while certainly important (and are indeed often key players within this book)—were not the only significant places. The history of other branches of paleontology—where fossils were more abundant, more easily worked, and spread more widely around the world—gives a broader vision of where and by whom paleontological work was undertaken. While dinosaur paleontology was geographically uneven, fossil mammals formed the basis for extensive collections across Europe, the Americas, Asia, Africa, and Australasia.

Studies of fossil mammals were also about recent history and made the “natural” past relevant to the present, conditioning understandings of modern environments and animals. In recent decades environmental history has become a wide-ranging project, with large historiographies examining

human entanglements with nature and the construction of new hybrid environments, both metaphorically and materially.³² As Simon Schama has influentially stated, landscapes were imbued with symbolic value and connected with variously imagined pasts, as “landscape is the work of the mind. Its scenery is built up as much from strata of memory as from layers of rock.”³³ The history of the deep-time sciences allows us to think about how these layers of rock were themselves understood as representing deep and resonant memories. The importance of the deep past to engagement with modern environments has recently been drawn out in some nineteenth-century case studies, especially by Pratik Chakrabarti in the case of India and Daniel Zizzamia for the American West.³⁴ This book argues that these were not isolated incidents, but that the deep past permeated nineteenth-century engagement with the natural world. Where scientists and officials were concerned with making land “productive” through expanding agriculture, cutting through rocks to build roads and railways, or locating mineral resources like coal, knowledge of the deep past was critical to development. Long-term geological change was invoked to argue that modern environments were not static, but the latest phase of a much deeper series of eras. Past ages of lush forests, open oceans, or bountiful grasslands either laid down mineral resources or showed what the land could be like, if environmental conditions were managed.

The fossil mammals provided a history for the animal world, which raises a further point of intersection with the rapidly growing field of animal history, which contends that integrating nonhuman animals into historical processes allows us to see important issues in new lights.³⁵ Animals have been shown as essential for nineteenth-century economies and social systems, deeply tied to urbanization, economic change, and imperialism, and highly conceptually significant, with animals becoming symbolic of environments and places or thought to embody particular moral values.³⁶ Yet, strangely, histories of human–animal relations have rarely engaged with how the deep-time sciences affected engagement with modern creatures. Works in the field frequently refer to the impact of Darwinian evolution, theories of social development, and recent extinctions on human engagement with the animal world. But the construction of the long history of animal life is usually only obliquely touched on. Indeed, it is more common for works in both animal history and environmental history to discuss modern theories of the evolution of specific organisms or the paleoclimate of particular

environments, rather than consider how many of these evolutionary and developmental narratives were themselves constructed in tandem with the nineteenth-century transformation of the environment and animal world. An underlying theme of this book is that engagement with fossils was a central means through which environments and animals were understood in the nineteenth century, and reflections on deep time were deeply entangled with changing knowledge of the current natural world.

We can see how modern creatures were defined through their assumed developmental past if we consider some of the major reasons why so much nineteenth-century attention focused on living and fossil mammals. Indeed, the originary work in the field of animal history, Harriet Ritvo's *The Animal Estate*, takes for granted that mammals were the main focus for Victorian observers, being the animals "with which people interacted most frequently and identified most readily."³⁷ More recently the excellent collection *Animalia: An Anti-Imperial Bestiary for Our Times*, examining entanglements between animals and the British Empire, devotes twenty-two of its twenty-six chapters to mammals, not only indicating historiographic emphasis, but the symbolic value of mammals.³⁸ This value was partly due to perceived utility and familiarity. An 1891 British text described mammals as "the best known and undoubtedly the most important group of the animal kingdom,"³⁹ and the French popular science writer Louis Figuier called them "the most important class of the vertebrates," who "interest us because they supply the animal auxiliaries who are most useful for our nourishment, work, and the needs of our industry."⁴⁰ As the history of human–animal relations has shown, mammals had crucial social and economic roles: cattle, pigs, and sheep were raised at increasing scales for meat, wool, and leather; horses powered cities and agriculture; dogs and cats were increasingly kept as companion animals; and exotic creatures like hippos, elephants, tigers, and bears became symbols of particular parts of the world and were hunted for commodities like ivory, hides, and fur. Mammals were pervasive, both as living creatures and as dead objects. Paleontology and the transportation of fossils were based on the same currents of global and imperial commerce as the movement of extant animals and their by-products. The life of the past was bound with the life of the present in tangible and material ways.

The prominence of mammals in the modern world was paralleled by their fossils. Mammal fossils were still rare, but considerably more common than the older remains of dinosaurs and other early reptiles and the usually

fragile fossils of birds (with the notable exception of robust flightless birds like the moa of New Zealand).⁴¹ Mammal fossils were also found throughout the world, from relatively recent geological periods. As a result, there were simply more mammal fossils in better states of preservation to be collected and studied than there were fossils of reptiles and birds. Large comparative collections were built up in numerous places. While it has been argued that this long knowledge of fossil mammals took away from their novelty and “by the end of the 1820s . . . hyaenas were old news, and a procession of bizarre extinct reptiles lurched into the limelight,”⁴² it also meant fossil mammals could be used to engage with large problems, particularly those around development, variation, and distribution, at a time when scientific authority was often based around the accumulation of large amounts of material.

Of course, there were even larger collections of fossil invertebrates and fish, which were critical for forming ideas of development.⁴³ However, these never acquired the prestige of fossil mammals, for important cultural reasons. Nineteenth-century natural historians looked on mammals as the highest animals, at the summit of natural progress and exceeded only by humans (whose place within the mammals was itself debated). Histories of human–animal relations have often highlighted an overemphasis on charismatic mammals in animal studies, in contrast to the insights to be gained from studying human interaction with insects, fish, and microorganisms.⁴⁴ This book regards this mammal emphasis as an entry point rather than a problem. The privileging of the mammal derives from nineteenth-century views, where nature and human society were understood through hierarchy and progress.⁴⁵ Paleontology was crucial for this alignment, as life’s history was used to show improvement up the scale of creation. While the regularity of progress was contested, the notion that animals could be arranged into a hierarchy of invertebrate, fish, amphibian, reptile, mammal, and human (with birds being difficult to place) was consistent. And the pervasiveness of scale-thinking made mammals crucial for defining natural progress.

Ideas of hierarchy within the mammals were complicated by older notions of the “chain of being.” The idea that all creation could be ordered into a single schema, alternately called “the scale of nature” or “chain of being,” was a long-standing one in European culture (and also the history of ideas, where Arthur Lovejoy’s *The Great Chain of Being* is a founding work).⁴⁶ Nineteenth-century taxonomies had a variable relationship with this notion. The idea of a single scale was often criticized by naturalists

as a holdover from classical thinking. Yet discussions of nature constantly referred to connection, linkage, order, “high,” and “low.” Museum displays, textbooks, and encyclopedias of natural history would consistently follow chain-of-being arrangements, either starting at a notional summit with humans or primates and then moving down to the “lower” creatures, or starting with the “simplest” organisms and then ascending. Often assumed rather than overtly stated, the scale maintained a continued grip, and as Harriet Ritvo has noted, “reports of the death, or even the displacement, of the chain were greatly exaggerated.”⁴⁷

The chain was complicated because mammals were not just defined as “high,” but as incredibly diverse. Nineteenth-century scholars constantly stated how mammals had a unity of form, but varied lifestyles, including swimming whales, flying bats, burrowing rodents, large and small predators, and herd-living ungulates. The American paleontologist William Berryman Scott wrote, “It is as though a musician had taken a single theme and developed it into endless variations, preserving an unmistakable unity through all the changes.”⁴⁸ Mammals in their diversity represented the widest flowering within the natural world. They became central to debates over comparative anatomy, Darwinian evolution and its branching patterns, and how animals formed communities, either as “ecologies” or as part of the “economy of nature.” In reflections on mammals, progress and hierarchy were squared with diversity and variation.

A final point is that valuation of mammals rested on empathy and emotion. There was tremendous nineteenth-century debate over the relationships between humans and animals, but also persistent assumptions that mammals were close to humans. The notion of mammals as high in the scale of life was compounded by anthropomorphic characterizations, citing their intelligence, sociability, familial life, and complex emotions. The tremendous expansion of companion animals like dogs and cats and working connections with animals like horses, cattle, and sheep bolstered this perceived empathy.⁴⁹ Mammals seemed to presage human capacities, and were regarded as easier to understand than birds, reptiles, and other creatures. Dolly Jørgensen, in her study of valuing “lost” species, highlighted the need to pay attention to emotional engagement with animals and environments, as much as scientifically “rational” factors.⁵⁰ In the case of paleontology, the relationship between rationality and imagination, and the imposition of values on landscapes and creatures, was an emotive affair.

Mammals were therefore useful and good to think with for numerous reasons, with their assumed utility, abundance, hierarchy, diversity, and emotional resonances being particularly significant. Nineteenth-century paleontologists used mammals to create a deep history of progress and differentiation. Importantly, ancient mammals were not lost relics of a former age like the dinosaurs or trilobites. The Age of Mammals was recent enough to still be thought of as present in many parts of the world (even if often seen as under threat). Through focusing on the mammals, paleontology became not just about elaborating lost worlds, but understanding modern nature—even as it shifted, possibly into a new epoch.

Structure of the Work

This book therefore traces a large topic, examining how mammalian life was given a global history during the long nineteenth century. Selections must of course be made within this canvas. Geographically, the book has a center of gravity in Europe and North America, which (as work on the history of dinosaur paleontology has shown) were key locations for the elaboration of fossil worlds, the sites of large, often self-consciously universalizing collections, and core players within economic and colonial power structures. However, an emphasis on regions where fossils were found and how these were integrated into systems of knowledge brings in a wider geography. Examples from South America, Egypt, South Asia, and Australasia will be brought in as particularly important instances (although of course it must be noted that these were not the only places involved—further case studies on the Russian Empire, southeastern Europe, and eastern and central Asia would also be of great interest, but have mainly been omitted from this book due to limitations in my own linguistic abilities). Across these different places, we can see how the fossil world was elaborated across different geographies, the contestation between different places and actors, and how the fraught building of an Age of Mammals was linked to assertions of its importance to the present.

The book traces the elaboration of the Age of Mammals across four chronologically distinct sections. The first begins with the eighteenth-century redefinition of fossils and bones in the earth as the remains of lost creatures and indicators of ancient landscapes. This carries across three chapters examining particularly important systematizations of these ideas:

the definition of the mammals themselves (and how this was connected with studies of fossils and modern life); the construction of two particularly puzzling beasts; and the elaboration of lost faunas through the expansion of European power in regions regarded as “ancient,” most notably India and Greece. These chapters see the building of a new fossil world, in which colonial and scholarly authority redefined the history and nature of life. This worked in complex ways with other means of knowing, and while new concepts of deep time were certainly important, they often reworked older mythic ideas as much as replaced them.

The second section sees how the Age of Mammals became increasingly ordered and conventionalized in the mid-nineteenth century. It first examines, across two chapters, how important institutions were founded in western Europe and North America, which were major centers of accumulation, but also field sites which reevaluated the modern territory. The remaining two chapters have a more conceptual focus, first tracing how the Age of Mammals was imagined as a series of eras, and then how paleontology became based around searches for origins and distribution. Paleontology was consolidated as a field in the years between 1850 and the 1880s, but in a contested way. Common values around progress, dominance, and links between the modern and ancient worlds were present, but often in a wary manner; uncertainty and calls to action were just as significant as confident pronouncements.

If the second section tells a story of increased consolidation of paleontological work, the third examines the heterogeneity within the field from the 1890s to the 1910s. This was certainly a period in which large institutions and particular models of the development of life were in the ascendant. The first two chapters of this section trace how institutions around the new museum movement and models of linear evolution (dramatically illustrated by the evolution of the horse) became powerful organizing principles. However, the next four chapters examine the messiness of these processes and the potential for contestation in places that could be regarded as peripheral, but that used their positions to become central to paleontological discourse. Fossil work in Argentina (especially Patagonia), Australia, Egypt, and the American West show how varied actors could claim authority within international networks and over the history of mammalian life.

The book concludes by examining a range of reflections on the natural world in the years around 1900, with the First World War being a natural

break for this book, shattering the international and colonial links that paleontologists had grown to depend on across the nineteenth century. This period, marked by fin-de-siècle anxieties over the nature of development and the expansion of Western (and more generally, human) power throughout the world, saw melancholic reflection on change, and the possibility that the current era, perhaps a new Age of Man, was defined by loss and decline as well as human dominance.

Across the century paleontology linked different places and contexts, but not evenly or equally. The accumulation of fossils was frequently centered on a few institutions and localities, and these interacted and negotiated with counterparts across the world. Hierarchies of knowledge, access, and interpretation constantly shifted. Through these shifts, paleontology became a “world-building” project, constructing the modern environment, its manifold pasts, and its varied inhabitants. The created world was based on progress and hierarchy, although in unstable, contested, and variable forms. Fossil mammals became central for understanding nature, time, and the past, but showed that development did not move in a regular or inevitable manner, but was fragmentary and uncertain. These uncertainties applied both to the ancient history of the Age of Mammals and attempted human mastery of the modern world.