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CHAPTER 1

THE ROAD TO EXTINCTION

In 1858, when John Wolley and Alfred Newton set off from Britain on their expedition to Iceland, the great auk (*Pinguinus impennis*) was reported to be in serious decline. Wolley's friend William Proctor, keeper of the bird collection at Durham University, had traveled to Iceland in 1833 and 1837, partly in order to seek out great auks. Proctor told Wolley that sightings were now rare in Iceland and that he had not seen any of the birds.[1] Wolley's fellow-student William Milner, who went to Iceland some years later, inquired about great auks on his travels and was informed that none had been seen recently, though two had been caught two years earlier, in 1844. Milner's account of his visit gave rise to a strong suspicion that the species was not only rare but vanishing.

Wolley took a keen interest in discussions of rare birds, and he resolved to go to Iceland with the same intention as his friends. He invited Alfred Newton, then making a name for himself as a zoologist at Cambridge University, to join him. Wolley and Newton met for the first time in Cambridge one October day in 1851, although they had corresponded for several years. Wolley had recently passed his final examinations in medicine at the University of Edinburgh, with excellent results,

but he had decided not to pursue a career as a doctor; instead, he would follow his vocation to create a great and systematic egg collection. It would eventually become one of the largest collections ever known, numbering at least ten thousand eggs. Perhaps in Iceland Wolley could acquire an egg of the rare great auk?

Newton, who was six years Wolley's junior, had also been collecting eggs since boyhood and had kept meticulous records of the comings and goings of migratory birds. The animated letters that Wolley wrote to him during a collecting expedition in northern Scandinavia captured the younger man's imagination and stimulated his interest in nature. To Newton, the north was an "ornithological paradise," where rare bird species were nevertheless still to be found and the diversity of species was immense.[2] He and Wolley agreed that they must go to Iceland as soon as possible and seek out the great auks—although for the next seven years nothing came of their plans. They were, frankly, obsessed with finding the bird they knew by the name of "gare-fowl." When they finally set off, in 1858, their ambition was to learn as much as possible about the species during a two-month stay, during which they would visit the great auk breeding grounds on Eldey, a small island off Iceland's southwest coast.

Bad weather prevented them from even attempting to row out to Eldey. Stuck ashore, with no gare-fowl to observe, they occupied themselves with identifying the crew of the latest successful great auk hunting expeditions, interviewing as many people as possible who had seen the birds. Wolley carefully preserved their accounts—along with much other information about the great auk—in the set of notebooks now known collectively as the *Gare-Fowl Books*. On the basis of what the two British naturalists learned in Iceland in 1858, Newton, who outlived his friend and preserved his legacy, would become a

leading figure in discussions of a new and politically volatile scientific concept: extinction.

Was it conceivable, Wolley and Newton wondered on their return to Britain, that this sizable bird, known to collectors around the world, was in critical decline as a result of human activities? Could it be erased from the book of life altogether? Was such a thing—unnatural extinction—possible?

In the early nineteenth century, most people, both lay and learned, believed that all the species of the living world had been created once and for all, that existing organisms could not vanish, and that new species could not appear. The Creation was seen as perfect; the principal role of the natural scientist was to document, describe, and classify the species created.

Today, the concept of species is essential to our understanding of extinction, but nobody, not even scholars, talked about extinction in those terms in the early nineteenth century. Species did not disappear. There was no name for the loss of a species—particularly not for a loss that might be detected and studied in the here and now. The English noun *extinction* (from Latin *extinctionem*) had, of course, been in use since at least the fifteenth century; it meant "annihilation." The related verb *to extinguish* meant (and still means) to quench, in the context of fires, or, figuratively, to wipe out a material thing, such as a debt. Yet in the early nineteenth century, as Cambridge scholar Gillian Beer points out, the word *extinction* was primarily "linked to the history of landed families: a line becomes extinct and with it the family name and the succession of property and practices."[3]

Not until the late 1880s were *extinction* and *species* paired, and extinction became a matter of biology and governance.[4] The species that instigated this pairing was the great auk, and it was Wolley and Newton's 1858 expedition to Iceland that sparked

this important conceptual development, adding the concept of unnatural extinction to modern language and thought.

The Fossil Hunters

Before unnatural extinction—the loss of a species as a result of human activities—could be understood, the idea that creatures could become extinct by any means at all needed to be accepted. Taxonomer Carl von Linné was among those to protest that such a thing was flatly impossible. "We will never believe that a species could totally vanish from the earth," he said, and his was the prevailing viewpoint.[5]

One of the key quotes from Linnaeus's work is from his *Genera plantarum* (§ 5):

> There are as many species as there were different forms produced by the Infinite Being in the beginning. Which forms afterwards produce more, but always similar forms according to inherent laws of generation; so that there are no more species now than came into being in the beginning. Hence there are as many species as there are different forms or structures of plants occurring today, setting aside those which place or accident exhibit to be a little different (varieties).[6]

It's a heavy paragraph, and Linnaeus doesn't quite say that species do not disappear, only that there are "no more species now" than originally. He allows for the role of "place or accident" in exhibiting "varieties" (an interesting nod to evolutionary theory), but the possibility of progressively fewer species—of what we now call "extinction"—was unthinkable at the time (in 1737); life-forms, it was implied, somehow remained intact since the theological big bang.

The concept of species itself had been first developed around 1680 by British naturalist John Ray (1627–1705); about half a century later, Linnaeus proposed a taxonomic system of species in his treatise *Systema Naturæ*.[7] But Linnaeus was interested solely in species that existed in his own time; the prior history of the planet was of no importance to him and had no place in his taxonomy.

Well after Linnaeus's death, German anatomist Johann Christian Rosenmüller (1771–1820) examined a set of mysterious bones that had been discovered in a cave in southern Germany in 1748. Rosenmüller concluded that the bones represented a bear unknown to science; it had once lived, he said, but then totally disappeared.[8] This was a stunning inference at a time when the idea of what now counts as extinction hardly existed.

It was, however, George Cuvier (1769–1832) at Paris's Museum of Natural History who established extinction as a historical fact through his broader study of fossilized bones. During the mayhem of the French Revolution, which questioned just about everything, he pointed out that historical animal remains discovered by geologists and collectors in rock strata at several places in the world exposed species that had disappeared. At first, his opinions were disputed. The evidence was scant, and Cuvier's conclusions irritated people who believed that the earth had a shallow history; according to the Bible, it was only about 6,000 years old.[9]

In 1812, Cuvier published a four-volume compendium in which he presented evidence of forty-nine extinct vertebrates that he had accumulated. Cuvier—a flamboyant character with a passion for history, honored by Napoleon and invited for talks in Britain—wasn't sure how to make sense of his fossils and the vanished creatures they represented; he had no faith in what

would soon come to be called "evolution." But Cuvier assumed that there was a lot to be learned from fossils. Like Alfred Newton, he was more interested in the disappearance of species than in their origins. Cuvier carefully studied the anatomy of the monstrous species accessible to him, and was eager to collect more samples for his expanding museum.

For this, Cuvier, like his male peers, was dependent on fossil hunters, who did most of the dirty work of finding and digging up fossilized bones. Also, he and his colleagues often drew upon skillful women within their domestic contexts; Sophie Cuvier sketched birds for her father.[10] Arguably, the fossil hunters and the artists deserve no less credit than the collectors and museum lecturers for launching the discovery of the origins and disappearance of species. Without their skills and painstaking work, based on their practical touch and deep understanding of context and terrain, we would have no concepts of speciation: no extinction, no evolution.

One of the key fossil hunters at the time of Cuvier was Mary Anning (1799–1847). Anning lived in Lyme, near what is now known as the Jurassic Coast in Dorset in the west of England. She has been dubbed "the greatest fossilist the world ever knew."[11] Anning came from a poor family; her father was a carpenter, and the Annings lived largely by selling fossils to scientists from museums and to keepers of private cabinets of curiosities. Mary Anning went out for walks, armed with rock hammers and carrying a sack on her back, most days. Although she did not know the mechanism, ancient sedimentary rock from the seabed, with layers containing fossils, had been lifted to the surface as the tectonic plates moved, and the fossils were brought to light, eroding out of the cliff faces of the coast of Lyme Regis.

At the early age of ten or twelve (accounts vary), Anning found the fossilized remains of a marine creature that was later

named *Ichthyosaur* ("Fish Lizard"). Her discovery, a collaboration with her brother Joseph, was widely discussed: *Ichthyosaur* raised new questions about the story and fate of animals. In 1823, Anning discovered a nearly intact plesiosaur (*Plesiosaurus dolichodeirus*). Cuvier famously invalidated this discovery at first, claiming the animal to be an impossibility, but when a well-known British geologist presented the evidence and defended Anning's work, Cuvier was forced to pronounce Anning's fossil a major discovery.

It later transpired that the geological relics that Anning retrieved, reconstructed, and sold to collectors were 200 million years old. Their existence confirmed that Cuvier was right.[12] Now he was able to establish that species had truly disappeared off the face of the earth, not simply moved or gone into hiding. Some creatures, it appeared, had originated in the sea and later emerged on dry land, or even took flight. This notion threw taxonomists into confusion. What did it mean to be a bird? Feathers were not exclusively a property of "birds" or an indication of "birdness": palaeontology would reveal that some dinosaur species had been feathered.[13] And some birds, including the great auk, couldn't fly. The science of life needed to be rethought.

Anning never published a scientific paper; all that remains of her writing is a number of letters, including her correspondence with scientists. She was deeply religious and struggled to reconcile her groundbreaking discoveries with her Christian faith, resisting ideas of birth and extinction. It seems, however, that in the end she accepted the idea of change. In 1833, when visited by tourists, she is reported to have said that because her fossils were found at different levels in the cliffs, the animals in question had been created and lived at different times. Later, she remarked that, judging from her observations of fossils, there

was a "connection of analogy between the Creatures of the former and present World."[14]

While Anning became a public figure and the tourist attraction of Lyme, placing her community on the radar, few scholars made any reference to her in their writings; until recently she received little credit for her contributions to science. Stratified by gender and social class, science had no space for her name. "The world has used me so unkindly," she said. "These men of learning have sucked my brains." As American palaeontologist Stephen Jay Gould has remarked, Anning was "probably the most important unsung (or inadequately sung) collecting force in the history of paleontology."[15] She paved the way for Charles Darwin, Alfred Wallace, Alfred Newton, and many others.

It was due to the work of Anning that naturalists in the mid-nineteenth century became accustomed to the idea that prehistoric "species" could be wiped off the face of the earth; that they could become "extinct"—at least, in the context of fossil discoveries. Fossils were understood to represent animals that no longer existed. Yet while the people of the time debated the reasons for the disappearance of these strange prehistoric creatures, most assumed that the causes were "natural," in the common sense. People referred to myths of floods and chaos, or to the collaborative efforts of gods and humans.

Biology Is Invented

One of the successes of the nineteenth century was the discovery and calibration of deep time in 1859—only a year after Wolley and Newton's Iceland expedition.[16] This was the "time revolution," based on the discovery by two British amateurs of hand-held stone tools among the bones of ancient animals at Somme in France. Humans, it was now established, had lived in deep

geologic time, much longer than the 6,000 years postulated in biblical accounts. History had begun. Charles Darwin (1809–82) and Alfred Russel Wallace (1823–1913) went on to demonstrate that the story of life itself on earth was far longer than had been believed. (A solid estimate of the age of the earth, however, was achieved only at the very end of the nineteenth century, with the discovery of radioactivity.)

Darwin and Wallace reasoned that life was a constant process of change, in which natural selection played a crucial role. Only the variants of a certain species that were "fittest" for the prevailing conditions would survive to give rise to new species, while others would decline or disappear. Darwin's first manuscripts about his theory of natural selection date from 1842 and 1844—years during which the great auk was pushed to extinction. When a species became uncommon or rare, Darwin argued, it was an indication of impending extinction. The fossils spoke for themselves. Darwin, however, decided not to publish in the 1840s, fearing that his theory would spark controversy.

Wallace developed his theory of evolution in Borneo in 1855, as he waited for the end of the monsoon season. He had observed a simple rule: each species "had for immediate antetype a closely allied species existing at time of its origin."[17] One species must follow on from another.

When Darwin received a letter from Wallace, indicating that he had reached theoretical conclusions like his own, he knew he could no longer delay the announcement of the theory of natural selection. Remarkably, he offered Wallace an opportunity to share with him the honor. The announcement of their theory was a historic moment—although few of those present at the meeting of the Linnean Society of London on 1 July 1858 realized its significance. Newton, who was then in Iceland along with his friend Wolley, frustrated by their inability to find a

great auk, was among the many natural scientists who only much later realized that biology would never be the same again. Or perhaps it is more accurate to say that biology was invented on that day.

It was extinction that had put Darwin on the track of natural selection. In his early manuscripts, he doesn't hesitate to use terms such as "extirpation" and "annihilation." Yet, rather than dwelling on extinction, he almost seems to avoid it in his magnum opus, *On the Origin of Species*, published in November of 1859. For Darwin, extinction was inevitable, taken for granted. Natural selection would inexorably thrust some species aside: "As new species in the course of time are formed through natural selection, others will become rarer and rarer, and finally extinct. The forms which stand in closest competition with those undergoing modification and improvement, will naturally suffer most."[18]

When Darwin refers to such change, he is speaking in terms of geological time, of prehistoric eras that lasted millions of years, leaving their traces in the form of fossils. Major influences upon Darwin include his friend Charles Lyell (1797–1875), a Scottish geologist who opposed the idea of sudden and catastrophic change; Lyell maintained that the earth changed only very gradually.[19] While phenomena such as volcanic eruptions and earthquakes were sudden and dramatic, they were exceptional (at least in Britain, although certainly not in Iceland) and were themselves the culmination of long processes. Geological history and the story of life went hand in hand and moved slowly. Species had evolved and then died out, Darwin writes, in the distant past, long before the arrival of modern man:

> The species of the less vigorous groups, from their inferiority inherited from a common progenitor, tend to become extinct together, and to leave no modified offspring on the face

> of the earth. But the utter extinction of a whole group of species may often be a very slow process, from the survival of a few descendants, lingering in protected and isolated situations.[20]

Darwin took little interest in the extinction of species, real or hypothetical, in his own time. For him, geological time and the unfolding of life-forms had little to do with bird-hunting off Iceland. Dinosaurs were one thing; great auks quite another.

For that reason, Darwin has less to say to us today than we might expect, as we foresee the extinction of many species, at the hands of humans, in the coming years. Darwin's conception of the world was static—as was remarked after his time—and not relevant to a world of rapid change generated by human activities.[21]

Extinction Observed

The great auk was one of the first species pushed "off the cliff" by humanity, its extinction observed by scientists more-or-less in real time. It is no surprise, then, that the great auk has come to stand for the concept of extinction in museums and in the public mind around the world, often with a heavy dose of loss and guilt: lost species remind us uneasily of humanity's predatory behavior—and of lessons that we may not yet have learned.

Arguably, the extinction of the great auk was inevitable, in view of massive European hunting of the birds for their meat, feathers, and oil in the 1700s and 1800s. By the time the international entourage of collectors became seriously interested in the species, its population was small and barely viable; collectors like Wolley and Newton did not kill off the great auk.[22] It has been suggested that environmental changes may have

played a part—for instance, a drop in sea temperature affecting the bird's food sources.[23] Genetic research published by Jessica E. Thomas and her colleagues in 2019, however, provides no indication that any environmental factors played a crucial role. Their sequencing of DNA from great auks from all over their historical habitats points to considerable genetic diversity; only if genetic diversity had been low would it have been difficult for the species to adapt to environmental change. The authors conclude that hunting pressure by humans alone was sufficient to lead to the extinction of the great auk.[24]

When Wolley and Newton set off for Iceland in 1858, such an idea was unheard of. Species that were no longer seen where they were expected to be found were assumed to be hiding. When hunters in Europe, North America, and Greenland found the traditional breeding grounds of the great auk deserted, they assumed that the bird had simply gone elsewhere to breed that year. In the mid-nineteenth century, the consensus among ornithologists and amateur bird enthusiasts seems to have been that the great auks were hiding in Iceland. In 1854, for example, a paper was published in a Scottish journal under the heading, "The Great Auk Still Found in Iceland." The author, writing about great auk hunting off Iceland between 1813 and 1844, remarks that "there can be little question as to the great auk still existing in some numbers in Iceland; . . . we shall one day hear of some of our enterprising countrymen having overcome all difficulties, and returning home with a rich booty."[25] Discussions of this kind, about where species believed to be at risk of extinction may still be found hiding "in some numbers," have a familiar ring in our own times.

We now know that, while the great auk population suffered its greatest devastation at the hands of European hunters off Newfoundland in the early nineteenth century, the species

fought its rear-guard action for survival off the coast of Iceland in the 1840s. Thanks to Wolley's *Gare-Fowl Books* and Newton's writings after the two returned from Iceland in 1858, the bird's losing battle was fought under the observant eyes of scientists.

Not that Wolley and Newton fully understood what they were chronicling. During their stay in Iceland, they pondered the meaning of "species," but "extinction" was not seriously on their minds. Not yet.

In 1855, John Wolley had visited Oslo, Norway (or Kristiania as it was called at the time), a town no less preoccupied with birds than Victorian Britain.[26] There, he met Johannes Japetus Steenstrup (1813–97), professor of zoology and one of Denmark's leading naturalists. Steenstrup had recently completed an important treatise on the great auk.[27] It was published later that year, throwing light on the bird's history on both sides of the Atlantic Ocean. Steenstrup had made his reputation by excavating historical garbage pits in which great auks featured. The origins of the great auk as a species and as a subject of study may be said to lie in Steenstrup's book. Wolley clearly listened to what Steenstrup told him about the great auk colonies in Iceland. As written in his soon-to-be-published book, Steenstrup believed that while "no dense colony exists any more; . . . the bird may possibly still live . . . off the west of Iceland, but that colony must surely be very small."[28]

As early as 1838, an article in a Danish journal—"The Great Auk in Iceland?"—had maintained that these once-common seabirds were "likely to become obliterated [*udslettede*]."[29] Significantly, while this reference to "obliteration" represents one of the earliest warnings about the rapid decline of the great auk in Iceland, the Danish word *udslettede* projected an image of erasing or flattening out, not quite what we think of as extinction. Again, the birds could have just gone elsewhere to breed.

For a while, several English terms signifying the end of a species were in circulation, including "extinction," "extermination," and "extirpation"; Newton used them interchangeably at times, as did many others during the Victorian period. As his work on the fate of the great auk progressed, however, Newton would become the "chief proponent" of the term "extinction."[30] Since then, "extinction" has become petrified in scientific discourse, as a fossil is in rock strata. No other term seems to offer a serious challenge. Search for "extinction" on the web today, and the Google search engine will quickly locate five billion hits. As far as can be ascertained, the definition used is the one that Newton established: Despite its long and nuanced history, the term "extinction" seems to have been colonized by concerns over loss of habitat as a result of human activities. Indeed, it is not far off to speak of "Newtonian extinction."

It is important, Newton insisted, to distinguish the prehistoric extinctions established by Anning and Cuvier from human-caused extinctions. Newton's breakthrough, in the wake of the Iceland expedition, was to move beyond the then-current notion of extinction as being the slow, long-durée consequence of natural forces—the notion highlighted in the works of Charles Darwin. Extinction, Newton reasoned, was not confined to deep time, to geological history or forces of nature, in the conventional meaning of the words. Extinction implicated humans, making them both complicit and responsible. Drawing upon the case of the great auk, Newton worked hard to publicize contemporary environmental problems. He helped to put bird protection on the political agenda in Britain and elsewhere. He was a founding member of the British Ornithologists' Union, one of the world's oldest and most respected organizations of its kind, in 1858, and of its journal, *Ibis*, the following year.[31] He wrote extensively about laws and other protective measures to avoid

bird decline and habitat destruction, emphasizing both individual and professional responsibility.

Newton's work, in these ways, presages some of the ideas currently associated with the Anthropocene. That recent term—still contested but nevertheless rapidly catching on in both public and academic discussions—describes the geological epoch of our time, when human activities have written themselves into the geological record.[32] Often identified as starting at the beginning of plantation society, sometimes at the advent of industrialization or the dawn of the atomic age, the Anthropocene demands new perspectives and new thinking about extinction and the interdependency of species.[33]

Birds are relatively well-studied and monitored, and as a result, they are a useful barometer indicating the state of the planet. Among the many changes noted, bird populations around the world have dropped dramatically in the past half-century: in North America, their numbers have fallen by one-third.[34] The latest State of the World's Birds report (2022) shows that about half of the planet's bird species are in decline, and one in eight are threatened with extinction.[35] If we continue on in this way, the voices of birds will fall silent before long, both the beautiful melodies of swans and songbirds and the harsh squawks of seabirds, like the living relatives of the extinct great auk.[36]

Endlings

For many years after he returned from his Iceland expedition, Alfred Newton clung to the hope of someone, somewhere, seeing a great auk alive. But at last, he had to accept that neither he, nor anyone else, would ever see one again. In 1865, he wrote, still somewhat hesitantly, that the great auk should be seen as belonging to the past.[37] Among the documents inserted into the

Gare-Fowl Books is a copy of a letter acquired by Newton, written in Denmark in 1873. The writer says that she has inquired about drawings and documents relating to the great auk, and met with many influential people: "I met the Governor of Iceland . . . and asked him if there was no hope that Garefowl still might dwell within his dominion, but he said not the faintest hope was left: They are gone—extinct."[38] Was this declaration from the Icelandic authorities the equivalent of a death certificate—regarding the breeding population in Iceland at least?

In the 1990s, American physician Robert Webster launched the notion of an "endling," defined as the last person, animal, or other individual in a lineage. The idea came up because of patients who were dying and thought of themselves as the last of their family line. "Endling" seems to have stuck, outlasting competitors such as "ender," "terminarch," "lastoline," and "relict," and has seeped into popular culture.[39] When Alfred Newton's friend Charles Kingsley wrote his popular children's novel, *The Water-Babies* (1910), he did not know the word "endling." But he managed to capture its dual notion in presenting the death of the last great auk and the termination of a family line, whether a population or a species. The main character of his book, a great auk, says: "And I am the last of my family. . . . Once we were a great nation, and spread over all the Northern Isles. But men shot us so, and knocked us on the head, and took our eggs. . . . And soon I shall be gone, my little dear, and nobody will miss me."[40]

Endlings, almost by definition, drop out of sight; they are relegated to cabinets of curiosities or to the geological record. In the Darwinian perspective, they represent mere moments in the deep history of life—natural, to be expected, nothing to do with mere humans. But in the *Gare-Fowl Books*, Wolley and Newton captured the biography of two endlings—the last two great auks known to have been caught. Newton's intellectual

career, after Wolley's death, would be guided by their story. Whereas Darwin sought to draw attention to variations within and among species to shed light on slow transitions from one life-form to another in the continuous process of adaptation, Newton focused on the recent histories of groups of species (he sometimes spoke of "zoological regions"), their decline and eventual disappearance—spelling out how catastrophe may be avoided. In this, he presaged a key concern of current extinction studies within the humanities.[41]

Yet, until recently, Newton's work has been strangely silenced and undervalued.[42] As American historian of science Henry M. Cowles has argued, by expounding the idea of two kinds of extinction—one natural, the other due to human impact—Newton presented the possibility that declines in nature might be reversed and at-risk species saved.[43] In such measures, Newton thought, experts in the natural sciences would surely take the lead. Influenced by his own fruitless hunt for great auks in Iceland, Newton introduced the idea that extinction is not a single event but an ongoing process—one that can be interrupted.[44]

For these reasons, it is vital for us to attend to the historic journey of John Wolley and Alfred Newton to the Reykjanes peninsula in the southwest of Iceland in 1858. Their dialogues with their Icelandic hosts about the fate of the great auk are more pertinent than ever, revealing both the blunders of the past and the clear danger to the future. The real weight of their quest rests on something far more fundamental than simply learning the fate of a pair of large, flightless birds that produced a single, beautifully patterned egg per year. By chronicling the disappearance of the great auk from its breeding grounds off the coast of Iceland, Wolley and Newton were elucidating the perturbed relations of humans and the rest of the animal world at a time of impending mass extinction.

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