

The Viking Prelude and Fugues

Experiments in the Atlantic ■ The Viking explosion *m* Autocatalysis ■
 Viking agriculture ■ Iron ■ Viking chiefs ■ Viking religion ■
 Orkneys, Shetlands, Faeroes a Iceland's environment ■
 Iceland's history ■ Iceland in context ■ Vinland ■

When moviegoers of my generation hear the word "Vikings," we picture chieftain Kirk Douglas, star of the unforgettable 1958 epic film *The Vikings*, clad in his nail-studded leather shirt as he leads his bearded barbarians on voyages of raiding, raping, and killing. Nearly half a century after watching that film on a date with a college girlfriend, I can still replay in my imagination the opening scene in which Viking warriors batter down a castle gate while its unsuspecting occupants carouse inside, the occupants scream as the Vikings burst in and slaughter them, and Kirk Douglas begs his beautiful captive Janet Leigh to heighten his pleasure by vainly attempting to resist him. There is much truth to those gory images: the Vikings did indeed terrorize medieval Europe for several centuries. In their own language (Old Norse), even the word *vikingar* meant "raiders." But other parts of the Viking story are equally romantic and more relevant to this book. Besides being feared pirates, the Vikings were farmers, traders, colonizers, and the first European explorers of the North Atlantic. The settlements that they founded met very different fates. Viking settlers of Continental Europe and the British Isles eventually merged with local populations and played a role in forming several nation-states, notably Russia, England, and France. The Vinland colony, representing Europeans' first attempt to settle North America, was quickly abandoned; the Greenland colony, for 450 years the most remote outpost of European society, finally vanished; the Iceland colony struggled for many centuries through poverty and political difficulties, to emerge in recent times as one of the world's most affluent societies; and the Orkney, Shetland, and Faeroe colonies survived with little difficulty. All of those Viking colonies were derived from the same ancestral society: their differing fates were transparently related to the different environments in which the colonists found themselves.

Thus, the Viking expansion westwards across the North Atlantic offers us an instructive natural experiment, just as does the Polynesian expansion eastwards across the Pacific (map, pp. 182-183). Nested within this large natural experiment, Greenland offers us a smaller one: the Vikings met another people there, the Inuit, whose solutions to Greenland's environmental problems were very different from those of the Vikings. When that smaller experiment ended five centuries later, Greenland's Vikings had all perished, leaving Greenland uncontested in the hands of the Inuit. The tragedy of the Greenland Norse (Greenland Scandinavians) thus carries a hopeful message: even in difficult environments, collapses of human societies are not inevitable; it depends on how people respond.

The environmentally triggered collapse of Viking Greenland and the struggles of Iceland have parallels with the environmentally triggered collapses of Easter Island, Mangareva, the Anasazi, the Maya, and many other pre-industrial societies. However, we enjoy advantages in understanding Greenland's collapse and Iceland's troubles. For Greenland's and especially Iceland's history, we possess contemporary written accounts from those societies as well as from their trade partners—accounts that are frustratingly fragmentary, but still much better than our complete lack of written eyewitness records for those other pre-industrial societies. The Anasazi died or scattered, and the society of the few surviving Easter Islanders became transformed by outsiders, but most modern Icelanders are still the direct descendants of the Viking men and their Celtic wives who were Iceland's first settlers. In particular, medieval European Christian societies, such as those of Iceland and Norse Greenland, that evolved directly into modern European Christian societies. Hence we know what the church ruins, preserved art, and archaeologically excavated tools meant, whereas much guesswork is required to interpret archaeological remains of those other societies. For instance, when I stood within an opening in the west wall of the well-preserved stone building erected around A.D. 1300 at Hvalsey in Greenland, I knew by comparison with Christian churches elsewhere that this building too was a Christian church, that this particular one was an almost exact replica of a church at Eidfjord in Norway, and that the opening in the west wall was the main entrance as in other Christian churches (Plate 15). In contrast, we can't hope to understand the significance of Easter Island's stone statues in such detail.

The fates of Viking Iceland and Greenland tell an even more complex, hence more richly instructive, story than do the fates of Easter Island, Mangareva's neighbors, the Anasazi, and the Maya. All five sets of factors that I

discussed in the Prologue played a role. The Vikings did damage their environment, they did suffer from climate changes, and their own responses and cultural values did affect the outcome. The first and third of those three factors also operated in the histories of Easter and Mangareva's neighbors, and all three operated for the Anasazi and the Maya, but in addition trade with friendly outsiders played an essential role in the histories of Iceland and Greenland as of Mangareva's neighbors and the Anasazi, although not in Easter Island and Maya history. Finally, among these societies, only in Viking Greenland did hostile outsiders (the Inuit) intervene crucially. Thus, if the histories of Easter Island and Mangareva's neighbors are fugues weaving together two and three themes respectively, as do some fugues by Johann Sebastian Bach, Iceland's troubles are a quadruple fugue, like the mighty unfinished fugue with which the dying Bach meant to complete his last great composition, the *Art of the Fugue*. Only Greenland's demise gives us what Bach himself never attempted, a full quintuple fugue. For all these reasons, Viking societies will be presented in this chapter and the next two as the most detailed example in this book: the second and larger of the two sheep inside our boa constrictor.

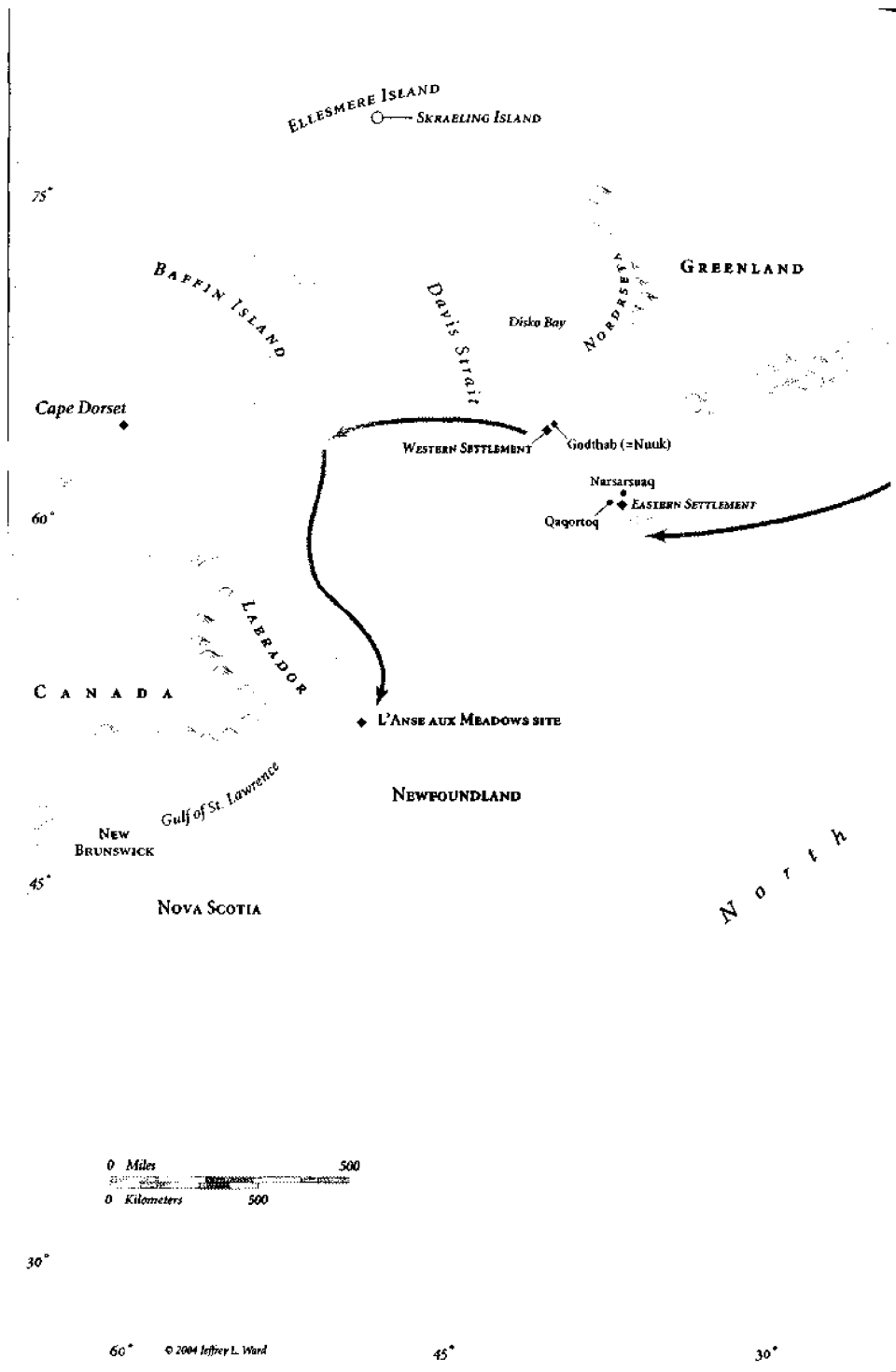
The prelude to the Iceland and Greenland fugues was the Viking explosion that burst upon medieval Europe after A.D. 793, from Ireland and the Baltic to the Mediterranean and Constantinople. Recall that all the basic elements of medieval European civilization arose over the previous 10,000 years in or near the Fertile Crescent, that crescent-shaped area of Southwest Asia from Jordan north to southeastern Turkey and then east to Iran. From that region came the world's first crops and domestic animals and wheeled transport, the mastery of copper and then of bronze and iron, and the rise of towns and cities, chiefdoms and kingdoms, and organized religions. All of those elements gradually spread to and transformed Europe from southeast to northwest, beginning with the arrival of agriculture in Greece from Anatolia around 7000 B.C. Scandinavia, the corner of Europe farthest from the Fertile Crescent, was the last part of Europe to be so transformed, being reached by agriculture only around 2500 B.C. It was also the corner farthest from the influence of Roman civilization: unlike the area of modern Germany, Roman traders never reached it, nor did it share any boundary with the Roman Empire. Hence, until the Middle Ages, Scandinavia remained Europe's backwater.

Yet Scandinavia possessed two sets of natural advantages awaiting ex-

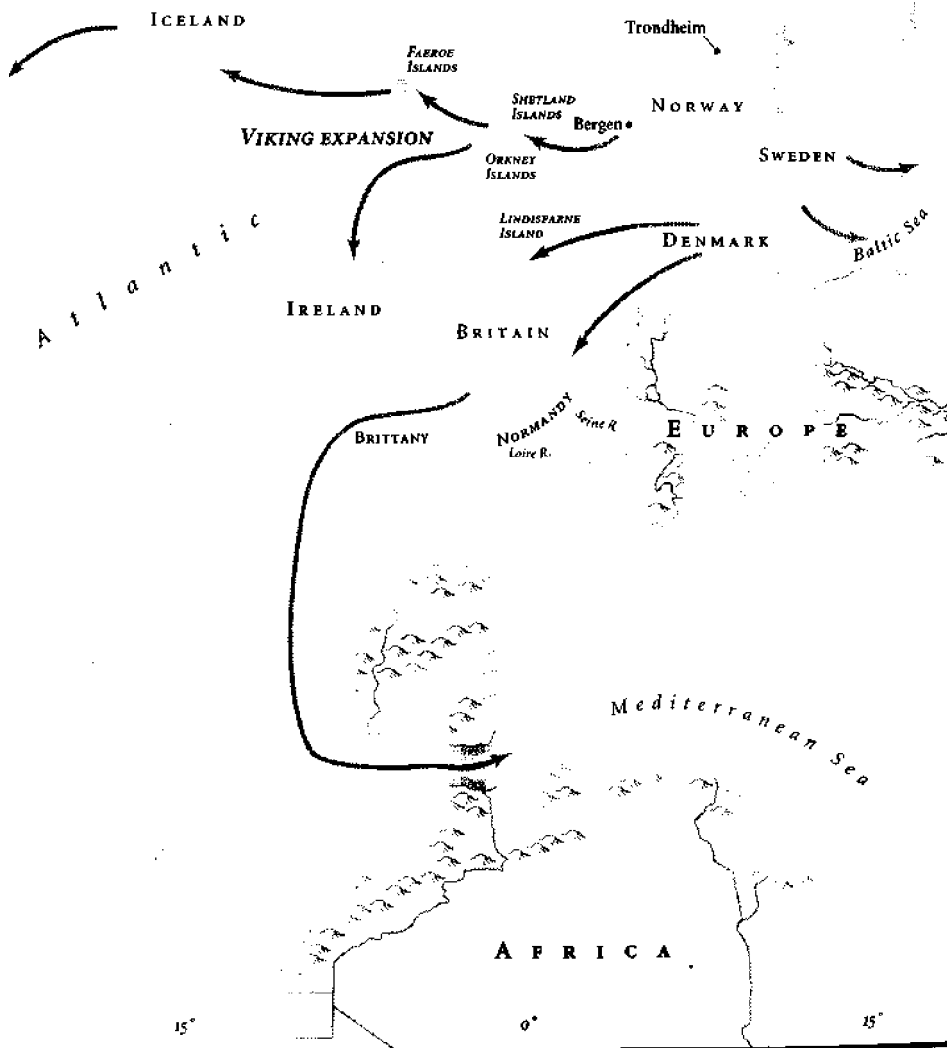
plotation: the furs of northern forest animals, seal skins, and beeswax prized as luxury imports in the rest of Europe; and (in Norway as in Greece) a highly indented coastline, making travel by sea potentially faster than travel by land, and offering rewards to those who could develop seafaring techniques. Until the Middle Ages, Scandinavians had only oar-propelled rowboats without sails. Sailboat technology from the Mediterranean finally reached Scandinavia around A.D. 600, at a time when climatic warming and the arrival of improved plows happened to be stimulating food production and a human population explosion in Scandinavia. Because most of Norway is steep and mountainous, only 3% of its land area can be used for agriculture, and that arable land was coming under increasing population pressure by A.D. 700, especially in western Norway. With decreasing opportunities to establish new farms back at home, Scandinavia's growing population began expanding overseas. Upon the arrival of sails, Scandinavians quickly developed fast, shallow-draft, highly maneuverable, sailed-and-rowed ships that were ideal for carrying their luxury exports to eager buyers in Europe and Britain. Those ships let them cross the ocean but then also pull up on any shallow beach or row far up rivers, without being confined to the few deepwater harbors.

But for medieval Scandinavians, as for other seafarers throughout history, trading paved the way for raiding. Once some Scandinavian traders had discovered sea routes to rich peoples who could pay for furs with silver and gold, ambitious younger brothers of those traders realized that they could acquire that same silver and gold without paying for it. Those ships used for trade could also be sailed and rowed over those same sea routes to arrive by surprise at coastal and riverside towns, including ones far inland on rivers. Scandinavians became Vikings, i.e., raiders. Viking ships and sailors were fast enough compared to those elsewhere in Europe that they could escape before being overtaken by the locals' slower ships, and Europeans never attempted counterraids on the Viking homelands to destroy their bases. The lands that are now Norway and Sweden were then not yet united under single kings, but were still fragmented among chiefs or petty-kings eager to compete for overseas booty with which to attract and reward followers. Chiefs who lost in the struggle against other chiefs at home were especially motivated to try their luck overseas.

The Viking raids began abruptly on June 8, A.D. 793, with an attack on the rich but defenseless monastery of Lindisfarne Island off the northeast English coast. Thereafter, the raids continued each summer, when the seas were calmer and more conducive to sailing, until after some years the



—THE VIKING EXPANSION—



Vikings stopped bothering to return home in the autumn but instead made winter settlements on the targeted coast so that they could begin raiding earlier in the next spring. From those beginnings arose a flexible mixed strategy of alternative methods to acquire wealth, depending on the relative strengths of the Viking fleets and the targeted peoples. As the strength or number of Vikings relative to locals increased, the methods progressed from peaceful trading, through extorting tribute in return for a promise not to raid, to plundering and retreating, and culminated in conquest and the establishment of overseas Viking states.

Vikings from different parts of Scandinavia went raiding in different directions. Those from the area of modern Sweden, termed Varangians, sailed east into the Baltic Sea, navigated up rivers flowing from Russia into the Baltic, continued south to reach the heads of the Volga and other rivers flowing into the Black Sea and Caspian Sea, traded with the rich Byzantine Empire, and founded the principality of Kiev that became the forerunner of the modern Russian state. Vikings from modern Denmark sailed west to the coast of northwest Europe and the east coast of England, found their way up the Rhine and Loire rivers, settled at their mouths and in Normandy and Brittany, established the Danelaw state in eastern England and the Duchy of Normandy in France, and rounded the Atlantic coast of Spain to enter the Mediterranean at the Straits of Gibraltar and raid Italy. Vikings from modern Norway sailed to Ireland and the north and west coast of Britain and set up a major trading center at Dublin. In each area of Europe the Vikings settled, intermarried, and gradually became assimilated into the local population, with the result that Scandinavian languages and distinct Scandinavian settlements eventually disappeared outside of Scandinavia. Swedish Vikings merged into the Russian population, Danish Vikings into the English population, while the Vikings who settled in Normandy eventually abandoned their Norse language and began speaking French. In that process of assimilation, Scandinavian words as well as genes were absorbed. For instance, the modern English language owes "awkward," "die," "egg," "skirt," and dozens of other everyday words to the Scandinavian invaders.

In the course of these voyages to inhabited European lands, many Viking ships were blown off-course into the North Atlantic Ocean, which at those times of warm climate was free of the sea ice that later became a barrier to ship navigation, contributing to the fate of the Norse Greenland colony and of the *Titanic*. Those off-course ships thereby discovered and settled other lands previously unknown either to Europeans or to any peoples: the uninhabited Faeroe Islands some time after A.D. 800 and Iceland around 870;

around A.D. 980 Greenland, at that time occupied only in the far north by Native American predecessors of the Inuit known as the Dorset people; and in A.D. 1000 Vinland, an exploration zone encompassing Newfoundland, the Gulf of St. Lawrence, and possibly some other coastal areas of north-eastern North America teeming with Native Americans whose presence forced the Vikings to depart after only a decade.

The Viking raids on Europe declined as their European targets gradually came to expect them and to defend themselves, as the power of the English and French kings and the German emperor grew, and as the rising power of the Norwegian king began to harness his uncontrolled hotbed of plundering chiefs and to channel their efforts into those of a respectable trading state. On the continent, the Franks drove the Vikings from the River Seine in A.D. 857, won a major victory at the Battle of Louvain in modern Belgium in 891, and expelled them from Brittany in 939. In the British Isles the Vikings were thrown out of Dublin in A.D. 902, and their Danelaw kingdom in England disintegrated in 954, although it was then reconstituted by further raids between 980 and 1016. The year 1066, famous for the Battle of Hastings at which William the Conqueror (William of Normandy) led French-speaking descendants of former Viking raiders to conquer England, can also be taken to mark the end of the Viking raids. The reason why William was able to defeat the English king Harold at Hastings on England's southeast coast on October 14 was that Harold and his soldiers were exhausted. They had marched 220 miles south in less than three weeks after defeating the last Viking invading army and killing their king at Stamford Bridge in central England on September 25. Thereafter, the Scandinavian kingdoms evolved into normal states trading with other European states and only occasionally indulging in wars, rather than constantly raiding. Medieval Norway became known not for its feared raiders but for its exports of dried codfish.

In light of this history that I have related, how can we explain why the Vikings left their homelands to risk their lives in battle or in such difficult environments as that of Greenland? After millennia of their remaining in Scandinavia and leaving the rest of Europe alone, why did their expansion build up so quickly to a peak after 793, and then grind to a complete halt less than three centuries later? With any historical expansion, one can ask whether it was triggered by "push" (population pressure and lack of opportunities at home), "pull" (good opportunities and empty areas to colonize overseas), or both. Many expansion waves have been driven by a

combination of push and pull, and that was also true of the Vikings: they were pushed by population growth and consolidation of royal power at home, and pulled by uninhabited new lands to settle and inhabited but defenseless rich lands to plunder overseas. Similarly, European immigration to North America reached its peak in the 1800s and early 1900s through a combination of push and pull: population growth, famines, and political oppression in Europe pushed immigrants from their homelands, while the availability of almost unlimited fertile farmland and economic opportunities in the United States and Canada pulled them.

As for why the sum of push/pull forces switched so abruptly from unattractive to attractive after A.D. 793, and then subsided so quickly towards 1066, the Viking expansion is a good example of what is termed an *autocatalytic process*. In chemistry the term *catalysis* means the speeding-up of a chemical reaction by an added ingredient, such as an enzyme. Some chemical reactions produce a product that also acts as a catalyst, so that the speed of the reaction starts from nothing and then runs away as some product is formed, catalyzing and driving the reaction faster and producing more product which drives the reaction still faster. Such a chain reaction is termed *autocatalytic*, the prime example being the explosion of an atomic bomb when neutrons in a critical mass of uranium split uranium nuclei to release energy plus more neutrons, which split still more nuclei.

Similarly, in an autocatalytic expansion of a human population, some initial advantages that a people gains (such as technological advantages) bring them profits or discoveries, which in turn stimulate more people to seek profits and discoveries, which result in even more profits and discoveries stimulating even more people to set out, until that people has filled up all the areas available to them with those advantages, at which point the autocatalytic expansion ceases to catalyze itself and runs out of steam. Two specific events set off the Viking chain reaction: the A.D. 793 raid on Lindisfarne Monastery, yielding a rich haul of booty that in the following year stimulated raids yielding more booty; and the discovery of the unpopulated Faeroe Islands suitable for raising sheep, leading to the discovery of larger and more distant Iceland and then of still larger and more distant Greenland. Vikings returning home with booty or with reports of islands ripe for settlement fired the imagination of more Vikings to set out in search of more booty and more empty islands. Other examples of autocatalytic expansions besides the Viking expansion include the expansion of ancestral Polynesians eastwards over the Pacific Ocean beginning around 1200 B.C.,

and of Portuguese and Spaniards over the world beginning in the 1400s and especially with Columbus's "discovery" of the New World in 1492.

Like those Polynesian and Portuguese/Spanish expansions, the Viking expansion began to fizzle out when all areas readily accessible to their ships had already been raided or colonized, and when Vikings returning home ceased to bring stories of uninhabited or easily raided lands overseas. Just as two specific events set off the Viking chain reaction, two other events symbolize what throttled it. One was the Battle of Stamford Bridge in 1066, capping a long series of Viking defeats and demonstrating the futility of further raids. The other was the forced abandonment of the Vikings' most remote colony of Vinland around A.D. 1000, after only a decade. The two preserved Norse sagas describing Vinland say explicitly that it was abandoned because of fighting with a dense population of Native Americans far too numerous to be defeated by the few Vikings able to cross the Atlantic in ships of those times. With the Faeroes, Iceland, and Greenland already full of Viking settlers, Vinland impossibly dangerous, and no more discoveries of uninhabited Atlantic islands being made, the Vikings got the point that there were no longer any rewards to greet pioneers risking their lives in the stormy North Atlantic.

When immigrants from overseas colonize a new homeland, the lifestyle that they establish usually incorporates features of the lifestyle that they had practiced in their land of origin—a "cultural capital" of knowledge, beliefs, subsistence methods, and social organization accumulated in their homeland. That is especially the case when, as true of the Vikings, they occupy a land that is originally either uninhabited, or else inhabited by people with whom the colonists have little contact. Even in the United States today, where new immigrants must deal with a vastly more numerous established American population, each immigrant group still retains many of its own distinctive characteristics. For instance, within my city of Los Angeles there are big differences between the cultural values, educational levels, jobs, and wealth of recent immigrant groups such as Vietnamese, Iranians, Mexicans, and Ethiopians. Different groups here have adapted with different ease to American society, depending in part on the lifestyle that they brought with them.

In the case of the Vikings, too, the societies that they created on the North Atlantic islands were modeled on the continental Viking societies that the immigrants had left behind. That legacy of cultural history was

especially important in the areas of agriculture, iron production, class structure, and religion.

While we think of Vikings as raiders and seafarers, they thought of themselves as farmers. The particular animals and crops that grew well in southern Norway became an important consideration in overseas Viking history, not only because those were the animal and plant species available for Viking colonists to carry with them to Iceland and Greenland, but also because those species were involved in the Vikings' social values. Different foods and lifestyles have different status among different peoples: for instance, cattle ranked high but goats ranked low in the values of ranchers in the western United States. Problems arise when the agricultural practices of immigrants in their land of origin prove ill-matched to their new homeland. Australians, for example, are struggling today with the question of whether the sheep that they brought with them from Britain have really done more harm than good in Australian environments. As we shall see, a similar mismatch between what was suitable in old and new landscapes had heavy consequences for the Greenland Norse.

Livestock grew better than crops in Norway's cool climate. The livestock were the same five species that had provided the basis of Fertile Crescent and European food production for thousands of years: cows, sheep, goats, pigs, and horses. Of those species, the ones considered of highest status by Vikings were pigs bred for meat, cows for milk products such as cheese, and horses used for transport and prestige. In Old Norse sagas, pork was the meat on which warriors of the Norse war god Odin feasted daily in Valhalla after their deaths. Much lower in prestige, but still useful economically, were sheep and goats, kept more for milk products and wool or hair than for meat.

Counts of bones in an archaeologically excavated garbage heap at a 9th-century chieftain's farm in southern Norway revealed the relative numbers of different animal species that the chieftain's household consumed. Nearly half of all livestock bones in the midden were of cows, and one-third were of the prized pigs, while only one-fifth belonged to sheep and goats. Presumably an ambitious Viking chief setting up a farm overseas would have aspired to that same mix of species. Indeed, a similar mix is found in garbage heaps from the earliest Viking farms in Greenland and Iceland. However, the bone proportions differed on later farms there, because some of those species proved less well adapted than others to Greenland and Iceland conditions: cow numbers decreased with time, and pigs almost vanished, but the numbers of sheep and goats increased.

The farther north that one lives in Norway, the more essential it becomes in the winter to bring livestock indoors into stalls and to provide them with food there, instead of leaving them outdoors to forage for themselves. Hence those heroic Viking warriors actually had to spend much of their time during the summer and fall at the homely tasks of cutting, drying, and gathering hay for winter livestock feed, rather than fighting the battles for which they were more famous.

In areas where the climate was mild enough to permit gardening, Vikings also grew cold-tolerant crops, especially barley. Other crops less important than barley (because they are less hardy) were the cereals oats, wheat, and rye; the vegetables cabbage, onions, peas, and beans; flax, to make linen cloth; and hops, to brew beer. At sites progressively farther north in Norway, crops receded in importance compared to livestock. Wild meat was a major supplement to domestic livestock as a source of protein—especially fish, which account for half or more of the animal bones in Norwegian Viking middens. Hunted animals included seals and other marine mammals, reindeer and moose and small land mammals, seabirds taken on their breeding colonies, and ducks and other waterfowl.

Iron implements discovered at Viking sites by archaeologists tell us that Vikings used iron for many purposes: for heavy agricultural tools such as plows, shovels, axes, and sickles; small household tools, including knives, scissors, and sewing needles; nails, rivets, and other construction hardware; and, of course, military tools, especially swords, spears, battle-axes, and armor. The remains of slag heaps and charcoal-producing pits at iron-processing sites let us reconstruct how Vikings obtained their iron. It was not mined on an industrial scale at centralized factories, but at small-scale mom-and-pop operations on each individual farm. The starting material was so-called bog iron widespread in Scandinavia: i.e., iron oxide that has become dissolved in water and then precipitated by acidic conditions or bacteria in bogs and lake sediments. Whereas modern iron-mining companies select ores containing between 30 and 95% iron oxide, Viking smiths accepted far poorer ores, with as little as 1% iron oxide. Once such an "iron-rich" sediment had been identified, the ore was dried, heated to melting temperature in a furnace in order to separate the iron from impurities (the slag), hammered to remove more impurities, and then forged into the desired shape.

Burning wood itself does not yield a temperature high enough for work-

ing with iron. Instead, the wood must first be burned to form charcoal, which does sustain a sufficiently hot fire. Measurements in several countries show that it takes on the average about four pounds of wood to make one pound of charcoal. Because of that requirement, plus the low iron content of bog iron, Viking iron extraction and tool production and even the repair of iron tools consumed enormous quantities of wood, which became a limiting factor in the history of Viking Greenland, where trees were in short supply.

As for the social system that Vikings brought overseas with them from the Scandinavian mainland, it was hierarchical, with classes ranging at the lowest level from slaves captured in raids, through free men, up to chiefs. Large unified kingdoms (as opposed to small local chiefdoms under chiefs who might assume a title of "king") were just emerging in Scandinavia during the Viking expansion, and overseas Viking settlers eventually had to deal with kings of Norway and (later) of Denmark. However, the settlers had emigrated in part to escape the emerging power of would-be Norwegian kings, so that neither Iceland nor Greenland societies ever developed kings of their own. Instead, the power there remained in the hands of a military aristocracy of chiefs. Only they could afford their own boat and a full set of livestock, including the prized and hard-to-maintain cows as well as the less esteemed low-maintenance sheep and goats. The chief's dependents, retainers, and supporters included slaves, free laborers, tenant farmers, and independent free farmers.

Chiefs constantly competed with one another both by peaceful means and by war. The peaceful competition involved chiefs seeking to outdo each other in giving gifts and holding feasts, so as to gain prestige, reward followers, and attract allies. Chiefs accumulated the necessary wealth through trading, raiding, and the production of their own farms. But Viking society was also a violent one, in which chiefs and their retainers fought each other at home as well as fighting other peoples overseas. The losers in those internecine struggles were the ones who had the most to gain by trying their luck overseas. For instance, in the A.D. 980s, when an Icelander named Erik the Red was defeated and exiled, he explored Greenland and led a band of followers to settle the best farm sites there.

Key decisions of Viking society were made by the chiefs, who were motivated to increase their own prestige, even in cases where that might conflict with the good of the current society as a whole and of the next generation.

We already encountered those same conflicts of interest for Easter Island chiefs and Maya kings (Chapters 2 and 5), and they also had heavy consequences for the fate of Greenland Norse society (Chapter 8).

When the Vikings began their overseas expansion in the A.D. 800s, they still were "pagans" worshipping gods traditional in Germanic religion, such as the fertility god Frey, the sky god Thor, and the war god Odin. What most horrified European societies targeted by Viking raiders was that Vikings were not Christians and did not observe the taboos of a Christian society. Quite the opposite: they seemed to take sadistic pleasure in targeting churches and monasteries for attack. For instance, when in A.D. 843 a large Viking fleet went plundering up the Loire River in France, the raiders began by capturing the cathedral of Nantes at the river's mouth and killing the bishop and all the priests. Actually, though, the Vikings had no sadistic special fondness for plundering churches, nor any prejudice against secular sources of booty. While the undefended wealth of churches and monasteries was an obvious source of easy rich pickings, the Vikings were also pleased to attack rich trading centers whenever the opportunity presented itself.

Once established overseas in Christian lands, Vikings were quite prepared to intermarry and adapt to local customs, and that included embracing Christianity. Conversions of Vikings overseas contributed to the emergence of Christianity at home in Scandinavia, as overseas Vikings returning on visits brought information about the new religion, and as chiefs and kings in Scandinavia began to recognize the political advantages that Christianity could bring them. Some Scandinavian chiefs adopted Christianity informally, even before their kings did. Decisive events in Christianity's establishment in Scandinavia were the "official" conversion of Denmark under its king Harald Bluetooth around A.D. 960, of Norway beginning around A.D. 995, and of Sweden during the following century.

When Norway began to convert, the overseas Viking colonies of Orkney, Shetland, Faeroe, Iceland, and Greenland followed suit. That was partly because the colonies had few ships of their own, depended on Norwegian shipping for trade, and had to recognize the impossibility of remaining pagan after Norway became Christian. For instance, when Norway's King Olaf I converted, he banned pagan Icelanders from trading with Norway, captured Icelanders visiting Norway (including relatives of leading Iceland pagans), and threatened to mutilate or kill those hostages unless Iceland renounced paganism. At the meeting of Iceland's national assembly in the

summer of A.D. 999, Icelanders accepted the inevitable and declared themselves Christian. Around that same year, Leif Eriksson, the son of that Erik the Red who founded the Greenland colony, supposedly introduced Christianity to Greenland.

The Christian churches that were created in Iceland and Greenland after A.D. 1000 were not independent entities owning their own land and buildings, as are modern churches. Instead, they were built and owned by a leading local farmer/chief on his own land, and the farmer was entitled to a share of the taxes collected as tithes by that church from other local people. It was as if the chief negotiated a franchise agreement with McDonald's, under which he was granted a local monopoly by McDonald's, erected a church building and supplied merchandise according to uniform McDonald's standards, and kept a part of the proceeds for himself while sending the rest of the proceeds to central management—in this case, the pope in Rome via the archbishop in Nidaros (modern Trondheim). Naturally, the Catholic Church struggled to make its churches independent of the farmers/owners. In 1297 the Church finally succeeded in forcing Iceland church owners to transfer ownership of many church farms to the bishop. No records have been preserved to show whether something similar also happened in Greenland, but Greenland's acceptance (at least nominally) of Norwegian rule in 1261 probably put some pressure on Greenland church owners. We do know that in 1341 the bishop of Bergen sent to Greenland an overseer named Ivar Bardarson, who eventually returned to Norway with a detailed list and description of all Greenland churches, suggesting that the bishopric was trying to tighten its grip on its Greenland "franchises" as it did in Iceland.

The conversion to Christianity constituted a dramatic cultural break for the Viking overseas colonies. Christianity's claims of exclusivity, as the sole true religion, meant abandoning pagan traditions. Art and architecture became Christian, based on continental models. Overseas Vikings built big churches and even cathedrals equal in size to those of much more populous mainland Scandinavia, and thus huge in relation to the size of the much smaller overseas populations supporting them. The colonies took Christianity seriously enough that they paid tithes to Rome: we have records of the crusade tithe that the Greenland bishop sent to the pope in 1282 (paid in walrus tusks and polar bear hides rather than in money), and also an official papal receipt in 1327 acknowledging the delivery of the six-years' tithe from Greenland. The Church became a major vehicle for introducing the latest European ideas to Greenland, especially because every bishop ap-

pointed to Greenland was a mainland Scandinavian rather than a native Greenlander.

Perhaps the most important consequence of the colonists' conversion to Christianity involved how they viewed themselves. The outcome reminds me of how Australians, long after the founding of Britain's Australian colonies in 1788, continued to think of themselves not as an Asian and Pacific people but as overseas British, still prepared to die in 1915 at far-off Gallipoli fighting with the British against Turks irrelevant to Australia's national interests. In the same way, Viking colonists on the North Atlantic islands thought of themselves as European Christians. They kept in step with mainland changes in church architecture, burial customs, and units of measurement. That shared identity enabled a few thousand Greenlanders to cooperate with each other, withstand hardships, and maintain their existence in a harsh environment for four centuries. As we shall see, it also prevented them from learning from the Inuit, and from modifying their identity in ways that might have permitted them to survive beyond four centuries.

The six Viking colonies on North Atlantic islands constitute six parallel experiments in establishing societies derived from the same ancestral source. As I mentioned at the beginning of this chapter, those six experiments resulted in different outcomes: the Orkney, Shetland, and Faeroe colonies have continued to exist for more than a thousand years without their survival ever being in serious doubt; the Iceland colony also persisted but had to overcome poverty and serious political difficulties; the Greenland Norse died out after about 450 years; and the Vinland colony was abandoned within the first decade. Those differing outcomes are clearly related to environmental differences among the colonies. The four main environmental variables responsible for the different outcomes appear to be: ocean distances or sailing times by ship from Norway and Britain; resistance offered by non-Viking inhabitants, if there were any; suitability for agriculture, depending especially on latitude and local climate; and environmental fragility, especially susceptibility to soil erosion and deforestation.

With only six experimental outcomes but four variables that might explain those outcomes, we cannot hope to proceed in our search for explanations as we did in the Pacific, where we had 81 outcomes (81 islands) compared to only nine explanatory variables. For statistical correlational analysis to have any chance of succeeding, one needs many more separate experimental outcomes than there are variables to be tested. Hence, in the

Pacific, with so many islands available, statistical analysis alone sufficed to determine the relative importance of those independent variables. In the North Atlantic, there are not nearly enough separate natural experiments to achieve that aim. A statistician, presented only with that information, would declare the Viking problem to be insoluble. This will be a frequent dilemma for historians trying to apply the comparative method to problems of human history: apparently too many potentially independent variables, and far too few separate outcomes to establish those variables' importance statistically.

But historians know much more about human societies than just the initial environmental conditions and the final outcomes: they also have huge quantities of information about the sequence of steps connecting initial conditions to outcomes. Specifically, Viking scholars can test the importance of ocean sailing times by counting recorded numbers of ship sailings and reported cargos of the ships; they can test effects of indigenous resistance by historical accounts of fighting between Viking invaders and the locals; they can test suitability for agriculture by records of what plant and livestock species were actually grown; and they can test environmental fragility by historical signs of deforestation and soil erosion (such as pollen counts and fossilized pieces of plants), and by identification of wood and other building materials. Drawing on this knowledge of intervening steps as well as of outcomes, let us now briefly examine five of the six North Atlantic colonies in sequence of increasing isolation and decreasing wealth: Orkney, Shetland, Faeroe, Iceland, and Vinland. The next two chapters will discuss in detail the fate of Viking Greenland.

The Orkneys are an island archipelago just off the northern tip of Britain, wrapped around the large sheltered harbor of Scapa Flow that served as the main base for the British navy in both world wars. From John O'Groats, the northernmost point of the Scottish mainland, to the nearest Orkney Island is only 11 miles, and from the Orkneys to Norway barely a 24-hour sail in Viking ships. That made it easy for Norwegian Vikings to invade the Orkneys, to import whatever they needed from Norway or the British Isles, and to ship out their own exports cheaply. The Orkneys are so-called continental islands, really just a piece of the British mainland that became separated only when sea levels rose around the world with glacial melting at the end of the Ice Ages 14,000 years ago. Over that land bridge, many species of land mammals, including elk (alias red deer in Britain), otters, and hares, immigrated and provided good hunting. Viking invaders quickly subdued the indigenous population, known as the Picts.

As the southernmost of the Viking North Atlantic colonies except for Vinland, and lying in the Gulf Stream, the Orkneys enjoy a mild climate. Their fertile, heavy soils have been renewed by glaciation and are not at serious risk of erosion. Hence farming in the Orkneys was already being practiced by the Picts before the Vikings arrived, was continued under the Vikings, and remains highly productive to this day. Modern Orkney agricultural exports include beef and eggs, plus pork, cheese, and some crops.

The Vikings conquered the Orkneys around A.D. 800, proceeded to use the islands as a base for raiding the nearby British and Irish mainlands, and built up a rich, powerful society that remained for some time an independent Norse kingdom. One manifestation of the Orkney Vikings' wealth is a 17-pound cache of silver buried around A.D. 950, unmatched on any other North Atlantic island and equal in size to the largest silver caches of mainland Scandinavia. Another manifestation is St. Magnus Cathedral, erected in the 12th century and inspired by Britain's mighty Durham Cathedral. In A.D. 1472 ownership of the Orkneys passed without conquest from Norway (then subject to Denmark) to Scotland, for a trivial reason of dynastic politics (Scotland's King James demanded compensation for Denmark's failure to pay the dowry promised to accompany the Danish princess whom he married). Under Scottish rule, the Orkney islanders continued to speak a Norse dialect until the 1700s. Today, the Orkney descendants of indigenous Picts and Norse invaders remain prosperous farmers enriched by a terminal for North Sea oil.

Some of what I have just said about the Orkneys also applies to the next North Atlantic colony, the Shetland Islands. They too were originally occupied by Pict farmers, conquered by Vikings in the ninth century, ceded to Scotland in 1472, spoke Norse for some time thereafter, and have recently profited from North Sea oil. Differences are that they are slightly more remote and northerly (50 miles north of Orkney and 130 miles north of Scotland), windier, have poorer soils, and are less productive agriculturally. Raising sheep for wool has been an economic mainstay in the Shetlands as in the Orkneys, but raising cattle failed in the Shetlands and was replaced by increased emphasis on fishing.

Next in isolation after the Orkneys and Shetlands were the Faeroe Islands, 200 miles north of the Orkneys and 400 miles west of Norway. That made the Faeroes still readily accessible to Viking ships carrying settlers and trade goods, but beyond reach of earlier ships. Hence the Vikings found the Faeroes uninhabited except perhaps for a few Irish hermits, about whose existence there are vague stories but no firm archaeological evidence.

Lying 300 miles south of the Arctic Circle, at a latitude intermediate between that of the two largest towns on Norway's west coast (Bergen and Trondheim), the Faeroes enjoy a mild oceanic climate. However, their more northerly location than that of the Orkneys and Shetlands meant a shorter growing season for would-be farmers and herders. Salt spray from the ocean, blown onto all parts of the islands because of their small area, combined with strong winds to prevent the development of forests. The original vegetation consisted of nothing taller than low willows, birches, aspen, and junipers, which were quickly cleared by the first settlers and prevented from regenerating by browsing sheep. In a drier climate that would have been a recipe for soil erosion, but the Faeroes are very wet and foggy and "enjoy" rain on an average of 280 days each year, including several rain showers on most days. The settlers themselves also adopted policies to minimize erosion, such as building walls and terraces to prevent soil loss. Viking settlers in Greenland and especially in Iceland were much less successful in controlling erosion, not because they were more imprudent than Faeroe Islanders but because Iceland soils and Greenland climate made the risk of erosion greater.

Vikings settled the Faeroes during the ninth century. They managed to grow some barley but few or no other crops; even today, only about 6% of the land area of the Faeroes is devoted to growing potatoes and other vegetables. The cows and pigs prized in Norway, and even the low-status goats, were abandoned by the settlers within the first 200 years to prevent overgrazing. Instead, the Faeroe economy became focused on raising sheep to export wool, supplemented later by export of salt fish, and today of dried cod, halibut, and farmed salmon. In return for those wool and fish exports, the islanders imported from Norway and Britain the bulk necessities that were lacking or deficient in the Faeroe environment: especially, huge quantities of wood, because no construction timber was locally available except for driftwood; iron for tools, also completely lacking locally; and other stones and minerals, such as grindstones, whetstones, and soft soapstone out of which to carve kitchenware to replace pottery.

As for the Faeroes' history after settlement, the islanders converted to Christianity around A.D. 1000, i.e., around the same time as the other Viking North Atlantic colonies, and later they constructed a Gothic cathedral. The islands became a tributary to Norway in the 11th century, passed with Norway to Denmark in 1380 when Norway itself came under the Danish crown, and achieved self-government under Denmark in 1948. The 47,000 inhabitants today still speak a Faeroese language, directly derived from Old Norse

and very similar to modern Icelandic; Faeroese and Icelanders can understand each other's speech and Old Norse texts.

In short, the Faeroes were spared the problems that beset Norse Iceland and Greenland: the erosion-prone soils and active volcanoes of Iceland, and the shorter growing season, drier climate, much greater sailing distances, and hostile local population of Greenland. While more isolated than the Orkneys or Shetlands, and poorer in local resources compared especially to the Orkneys, Faeroe islanders survived without difficulty by importing large quantities of necessities—an option not open to the Greenlanders.

The purpose of my first visit to Iceland was to attend a NATO-sponsored conference on restoring ecologically damaged environments. It was especially appropriate that NATO had chosen Iceland as the conference's site, because Iceland is ecologically the most heavily damaged country in Europe. Since human settlement began, most of the country's original trees and vegetation have been destroyed, and about half of the original soils have eroded into the ocean. As a result of that damage, large areas of Iceland that were green at the time that Vikings landed are now lifeless brown desert without buildings, roads, or any current signs of people. When the American space agency NASA wanted to find some place on Earth resembling the surface of the moon, so that our astronauts preparing for the first moon landing could practice in an environment similar to what they would encounter, NASA picked a formerly green area of Iceland that is now utterly barren.

The four elements that form Iceland's environment are volcanic fire, ice, water, and wind. Iceland lies in the North Atlantic Ocean about 600 miles west of Norway, on what is called the Mid-Atlantic Ridge, where the American and Eurasian continental plates collide and where volcanoes periodically rise from the ocean to build up chunks of new land, of which Iceland is the largest. On the average, at least one of Iceland's many volcanoes undergoes a major eruption every decade or two. Besides the volcanoes themselves, Iceland's hot springs and geothermal areas are so numerous that much of the country (including the entire capital of Reykjavik) heats its houses not by burning fossil fuels but just by tapping volcanic heat.

The second element in Iceland's landscape is ice, which forms and remains as ice caps on much of Iceland's interior plateau because it is at high elevation (up to 6,952 feet high), just below the Arctic Circle, and hence cold. Water falling as rain and snow reaches the ocean in glaciers, in

rivers that periodically flood, and in occasional spectacular superfloods when a natural dam of lava or ice across a lake gives way, or when a volcanic eruption under an ice cap suddenly melts a lot of ice. Finally, Iceland is also a very windy place. It is the interaction between these four elements of volcanoes, cold, water, and wind that has made Iceland so susceptible to erosion.

When the first Viking settlers reached Iceland, its volcanoes and hot springs were strange sights, unlike anything known to them in Norway or the British Isles, but otherwise the landscape looked familiar and encouraging. Almost all of the plants and birds belonged to familiar European species. The lowlands were mostly covered by low birch and willow forest that was easily cleared for pastures. In those cleared locations, in natural low-lying treeless areas such as bogs, and at higher elevations above timberline the settlers found lush pasture grass, herbs, and moss ideal for raising the livestock that they had already been raising in Norway and the British Isles. The soil was fertile, in some places up to 50 feet deep. Despite the high-altitude ice caps and the location near the Arctic Circle, the nearby Gulf Stream made the climate in the lowlands mild enough in some years to grow barley in the south. The lakes, rivers, and surrounding seas teemed with fish and with never-before-hunted and hence unafraid seabirds and ducks, while equally unafraid seals and walrus lived along the coast.

But Iceland's apparent similarity to southwestern Norway and Britain was deceptive in three crucial respects. First, Iceland's more northerly location, hundreds of miles north of southwestern Norway's main farmlands, meant a cooler climate and shorter growing season, making agriculture more marginal. Eventually, as the climate became colder in the late Middle Ages, the settlers gave up on crops to become solely herders. Second, the ash that volcanic eruptions periodically ejected over wide areas poisoned fodder for livestock. Repeatedly throughout Iceland's history, such eruptions have caused animals and people to starve, the worst such disaster being the 1783 Laki eruption after which about one-fifth of the human population starved to death.

The biggest set of problems that deceived the settlers involved differences between Iceland's fragile, unfamiliar soils and Norway's and Britain's robust, familiar soils. The settlers could not appreciate those differences partly because some of them are subtle and still not well understood by professional soil scientists, but also because one of those differences was invisible at first sight and would take years to appreciate: namely, that Iceland's soils form more slowly and erode much more quickly than those of Norway

and Britain. In effect, when the settlers saw Iceland's fertile and locally thick soils, they reacted with delight, as any of us would react to inheriting a bank account with a large positive balance, for which we would assume familiar interest rates and would expect the account to throw off large interest payments each year. Unfortunately, while Iceland's soils and dense woodlands were impressive to the eye—corresponding to the large balance of the bank account—that balance had accumulated very slowly (as if with low interest rates) since the end of the last Ice Age. The settlers eventually discovered that they were not living off of Iceland's ecological annual interest, but that they were drawing down its accumulated capital of soil and vegetation that had taken ten thousand years to build up, and much of which the settlers exhausted in a few decades or even within a year. Inadvertently, the settlers were not using the soil and vegetation sustainably, as resources that can persist indefinitely (like a well-managed fishery or forest) if harvested no faster than the resources can renew themselves. They were instead exploiting the soil and vegetation in the way that miners exploit oil and mineral deposits, which renew themselves only infinitely slowly and are mined until they are all gone.

What is it that makes Iceland's soils so fragile and slow to form? A major reason has to do with their origin. In Norway, northern Britain, and Greenland, which lack recently active volcanoes and were completely glaciated during the Ice Ages, heavy soils were generated either as uplifted marine clays or else by glaciers grinding the underlying rock and carrying the particles, which were later deposited as sediment when the glaciers melted. In Iceland, though, frequent eruptions of volcanoes throw clouds of fine ash into the air. That ash includes light particles that strong winds proceed to carry over much of the country, resulting in the formation of an ash layer (tephra) that can be as light as talcum powder. On that rich fertile ash, vegetation eventually grows up, covering the ash and protecting it from erosion. But when that vegetation is removed (by sheep grazing it or farmers burning it), the ash becomes exposed again, making it susceptible to erosion. Because the ash was light enough to be carried in by the wind in the first place, it is also light enough to be carried out by the wind again. In addition to that wind erosion, Iceland's locally heavy rains and frequent floods also remove the exposed ash by water erosion, especially on steep slopes.

The other reasons for the fragility of Iceland's soils have to do with the fragility of its vegetation. Growth of vegetation tends to protect soil against erosion by covering it, and by adding organic matter that cements it and increases its bulk. But vegetation grows slowly in Iceland because of its

northerly location, cool climate, and short growing season. Iceland's combination of fragile soils and slow plant growth creates a positive feedback cycle to erosion: after the protective cover of vegetation is stripped off by sheep or farmers, and soil erosion has then begun, it is difficult for plants to reestablish themselves and to protect the soil again, so the erosion tends to spread.

Iceland's colonization began in earnest around the year 870 and virtually ended by the year 930, when almost all land suitable for farming had been settled or claimed. Most settlers came directly from western Norway, the remainder being Vikings who had already emigrated to the British Isles and married Celtic wives. Those settlers tried to re-create a herding economy similar to the lifestyle that they had known in Norway and the British Isles, and based on the same five barnyard animals, among which sheep eventually became by far the most numerous. Sheep milk was made into and stored as butter, cheese, and an Icelandic specialty called *skyr*, which to my taste is like a delicious thick yogurt. To make up the rest of their diet, Icelanders relied on wild game and fish, as revealed again by the patient efforts of zooarchaeologists identifying 47,000 bones in garbage heaps. The breeding walrus colonies were quickly exterminated, and the breeding seabirds became depleted, leaving hunters to shift attention to seals. Eventually, the main source of wild protein became fish—both the abundant trout, salmon, and char in lakes and rivers, and the abundant cod and haddock along the coast. Those cod and haddock were crucial in enabling Icelanders to survive the hard centuries of the Little Ice Age and in driving Iceland's economy today.

At the time that settlement of Iceland began, one-quarter of the island's area was forested. The settlers proceeded to clear the trees for pastures, and for using the trees themselves as firewood, timber, and charcoal. About 80% of that original woodland was cleared within the first few decades, and 96% as of modern times, thus leaving only 1% of Iceland's area still forested (Plate 16). Big chunks of scorched wood found in the earliest archaeological sites show that—incredible as it seems today—much of the wood from that land clearance was wasted or just burned, until Icelanders realized that they would be short of wood for the indefinite future. Once the original trees had been removed, grazing by sheep, and rooting by the pigs initially present, prevented seedlings from regenerating. As one drives across Iceland today, it is striking to notice how the occasional clumps of trees still standing are mostly ones enclosed by fences to protect them from sheep.

Iceland's highlands above tree line, supporting natural grassland on fertile shallow soil, were particularly attractive to the settlers, who didn't even have to clear trees there in order to create pastures. But the highlands were more fragile than the lowlands, because they were colder and drier, hence had lower rates of plant regrowth, and were not protected by woodland cover. Once the natural carpet of grassland had been cleared or browsed off, the soil originating as windblown ash was now exposed to wind erosion. In addition, water running downhill, either as rain or as snowmelt runoff, could start to erode gullies into the now-bare soil. But as a gully developed and as the water table dropped from the level of the top of the gully to the bottom, the soil dried out and became even more subject to wind erosion. Within a short time after settlement, Iceland's soils began to be carried from the highlands down to the lowlands and out to sea. The highlands became stripped of soil as well as of vegetation, the former grasslands of Iceland's interior became the man-made (or sheep-made) desert that one sees today, and then large eroded areas started to develop in the lowlands as well.

Today we have to ask ourselves: why on Earth did those foolish settlers manage their land in ways that caused such obvious damage? Didn't they realize what would happen? Yes, they eventually did, but they couldn't at first, because they were faced with an unfamiliar and difficult problem of land management. Except for its volcanoes and hot springs, Iceland looked rather similar to areas of Norway and Britain whence the settlers had emigrated. Viking settlers had no way of knowing that Iceland's soils and vegetation were much more fragile than what they were used to. It seemed natural to the settlers to occupy the highlands and to stock many sheep there, just as they had in the Scottish highlands: how would they know that Iceland's highlands couldn't support sheep indefinitely, and that even the lowlands were being overstocked? In short, the explanation of why Iceland became the European country with the most serious ecological damage is not that cautious Norwegian and British immigrants suddenly threw caution to the winds when they landed in Iceland, but that they found themselves in an apparently lush but actually fragile environment for which their Norwegian and British experience had failed to prepare them.

When the settlers finally realized what was happening, they did take corrective action. They stopped throwing away big pieces of wood, stopped keeping ecologically destructive pigs and goats, and abandoned much of the highlands. Groups of neighboring farms cooperated in jointly making decisions critical for preventing erosion, such as the decision about when in the late spring the grass growth warranted taking the sheep up to communally

owned high-altitude mountain pastures for the summer, and when in the fall to bring the sheep back down. Farmers sought to reach agreement on the maximum number of sheep that each communal pasture could support, and how that number was to be divided among sheep quotas for the individual farmers.

That decision-making is flexible and sensitive, but it is also conservative. Even my Icelandic friends describe their society to me as conservative and rigid. The Danish government that ruled Iceland after 1397 was regularly frustrated by that attitude whenever it made genuine efforts to improve the Icelanders' condition. Among the long list of improvements that Danes tried to introduce were: growing grain; improved fishing nets; fishing from decked rather than open boats; processing fish for export with salt, rather than just drying them; a rope-making industry; a hide-tanning industry; and mining sulfur for export. To these and any other proposals involving change, the Danes (as well as innovative Icelanders themselves) found that Icelanders' routine response was "no," regardless of the potential benefits for the Icelanders.

My Icelandic friends explained to me that this conservative outlook is understandable when one reflects on Iceland's environmental fragility. Icelanders became conditioned by their long history of experience to conclude that, whatever change they tried to make, it was much more likely to make things worse than better. In the first years of experimentation during Iceland's early history, its settlers managed to devise an economic and social system that worked, more or less. Granted, that system left most people poor, and from time to time many people starved to death, but at least the society persisted. Other experiments that Icelanders had tried during their history had tended to end disastrously. The evidence of those disasters lay everywhere around them, in the form of the moonscape highlands, the abandoned former farms, and the eroded areas of farms that survived. From all that experience, Icelanders took away the conclusion: This is not a country in which we can enjoy the luxury of experimenting. We live in a fragile land; we know that our ways will allow at least some of us to survive; don't ask us to change.

Iceland's political history from 870 onwards can be quickly summarized. For several centuries Iceland was self-governing, until fighting between chiefs belonging to the five leading families resulted in many killings of people and burnings of farms in the first half of the 13th century. In 1262 Icelanders invited Norway's king to govern them, reasoning that a distant king was less of a danger to them, would leave them more freedom, and could

not possibly plunge their land into such disorder as their own nearby chiefs. Marriages among Scandinavian royal houses resulted in the thrones of Denmark, Sweden, and Norway becoming unified in the year 1397 under one king, who was most interested in Denmark because it was his richest province, and less interested in Norway and Iceland, which were poorer. In 1874 Iceland achieved some self-government, home rule in 1904, and full independence from Denmark in 1944.

Beginning in the late Middle Ages, Iceland's economy was stimulated by the rise of trade in stockfish (dried cod) caught in Iceland waters and exported to the European mainland's growing cities whose urban populations required food. Because Iceland itself lacked big trees for good shipbuilding, those fish were caught and exported by ships belonging to an assortment of foreigners that included especially Norwegians, English, and Germans, joined by French and Dutch. In the early 1900s Iceland at last began to develop a fleet of its own and underwent an explosion of industrial-scale fishing. By 1950, more than 90% of Iceland's total exports were marine products, dwarfing the importance of the formerly dominant agricultural sector. Already in 1923, Iceland's urban population overtook its rural population in numbers. Iceland is now the most urbanized Scandinavian country, with half its population in the capital of Reykjavik alone. The flow of population from rural to urban areas continues today, as Iceland's farmers abandon their farms or convert them to summer houses and move to the towns to find jobs, Coca-Cola, and global culture.

Today, thanks to its abundance of fish, geothermal power, and hydroelectric power from all its rivers, and relieved of the necessity to scrape up timber for making ships (now constructed of metal), Europe's former poorest country has become one of the world's richest countries on a per-capita basis, a great success story to balance the stories of societal collapse in Chapters 2-5. Iceland's Nobel Prize-winning novelist Halldor Laxness put into the mouth of the heroine of his novel *Salka Valka* the immortal sentence that only an Icelander could utter: "When all is said and done, life is first and foremost salt fish." But fish stocks pose difficult management problems, just as do forests and soil. Icelanders are working hard now to repair past damage to their forests and soils, and to prevent similar damage to their fisheries.

With this tour of Iceland history in mind, let's see where Iceland stands with respect to the other five Norse North Atlantic colonies. I had mentioned

that the differing fates of those colonies depended especially on differences in four factors: sailing distance from Europe, resistance offered by pre-Viking inhabitants, suitability for agriculture, and environmental fragility. In Iceland's case two of those factors were favorable, and the other two caused trouble. Good news for Iceland's settlers was that the island had no (or virtually no) prior inhabitants, and that its distance from Europe (much less than that of Greenland or Vinland, though greater than that of the Orkneys, Shetlands, and Faeroes) was close enough to permit bulk trade even in medieval ships. Unlike the Greenlanders, the Icelanders remained in ship contact with Norway and/or Britain every year, could receive bulk imports of essentials (especially timber, iron, and eventually pottery), and could send out bulk exports. In particular, the export of dried fish proved decisive in saving Iceland economically after 1300 but was impractical for the more remote Greenland colony, whose shipping lanes to Europe were often blocked by sea ice.

On the negative side, Iceland's northerly location gave it the second most unfavorable potential for food production, after Greenland. Barley agriculture, marginal even in the mild early years of settlement, was abandoned when the climate became cooler in the late Middle Ages. Even pastoralism based on sheep and cows was marginal on poorer farms in poorer years. Nevertheless, in most years sheep thrived sufficiently well in Iceland that wool export dominated the economy for several centuries after settlement. Iceland's biggest problem was environmental fragility: by far the most fragile soils among the Norse colonies, and the second most fragile vegetation after Greenland.

What about Icelandic history from the perspective of the five factors that provide the framework for this book: self-inflicted environmental damage, climate change, hostilities with other societies, friendly trading relations with other societies, and cultural attitudes? Four of these factors play a role in Icelandic history; only the factor of hostile outsiders was minor, except for a period of pirate raids. Iceland illustrates clearly the interaction among the other four factors. Icelanders had the misfortune to inherit an especially difficult set of environmental problems, which became exacerbated by climatic cooling in the Little Ice Age. Trade with Europe was important in enabling Iceland to survive despite those environmental problems. Icelanders' response to their environment was framed by their cultural attitudes. Some of those attitudes were ones that they imported with them from Norway: especially, their pastoral economy, their initial overfondness for cows and pigs, and their initial environmental practices appropriate to Norwegian

and British soils but inappropriate in Iceland. Attitudes that they then developed in Iceland included learning to eliminate pigs and goats and to downplay cows, learning how to take better care of the fragile Iceland environment, and adopting a conservative outlook. That outlook frustrated their Danish governors and in some cases may have harmed the Icelanders themselves, but ultimately helped them survive by not taking risks.

Iceland's government today is very concerned about Iceland's historical curses of soil erosion and sheep overgrazing, which played such a large role in their country's long impoverishment. An entire government department has as its charge to attempt to retain soil, regrow the woodlands, revegetate the interior, and regulate sheep stocking rates. In Iceland's highlands I saw lines of grass planted by this department on otherwise bare moonscapes, in an effort to establish some protective plant cover and to halt the spread of erosion. Often these replanting efforts—thin green lines on a brown panorama—struck me as a pathetic attempt to cope with an overwhelming problem. But Icelanders are making some progress.

Almost everywhere else in the world, my archaeologist friends have an uphill struggle to convince governments that what archaeologists do has any conceivable practical value. They try to get funding agencies to understand that studies of the fates of past societies may help us understand what could happen to societies living in that same area today. In particular, they reason, environmental damage that developed in the past could develop again in the present, so one might use knowledge of the past to avoid repeating the same mistakes.

Most governments ignore these pleas of archaeologists. That is not the case in Iceland, where the effects of erosion that began 1,130 years ago are obvious, where most of the vegetation and half of the soil have already been lost, and where the past is so stark and omnipresent. Many studies of medieval Icelandic settlements and erosion patterns are now under way. When one of my archaeologist friends approached the Icelandic government and began to deliver the usual lengthy justification required in other countries, the government's response was: "Yes, of course we realize that understanding medieval soil erosion will help us understand our present problem. We already know that, you don't have to spend time convincing us. Here is the money, go do your study."

The brief existence of the most remote Viking North Atlantic colony, Vinland, is a separate story fascinating in its own right. As the first European ef-

fort to colonize the Americas, nearly 500 years before Columbus, it has been the subject of romantic speculation and many books. For our purposes in this book, the most important lessons to be drawn from the Vinland venture are the reasons for its failure.

The coast of northeastern North America reached by the Vikings lies thousands of miles from Norway, across the North Atlantic, far beyond direct reach of Viking ships. Instead, all Viking ships destined for North America sailed from the westernmost established colony, Greenland. Even Greenland, though, was far from North America by Viking sailing standards. The Vikings' main camp on Newfoundland lay nearly 1,000 miles from the Greenland settlements by a direct voyage, but required a voyage of 2,000 miles and up to six weeks by the actual coast-hugging route that Vikings took for safety, given their rudimentary navigational abilities. To sail from Greenland to Vinland and then return within the summer sailing season of favorable weather would have left little time for exploring Vinland before setting sail again. Hence the Vikings established a base camp on Newfoundland, where they could remain for the winter, so as to be able to spend the entire subsequent summer exploring.

The known Vinland voyages were organized in Greenland by two sons, a daughter, and a daughter-in-law of that same Erik the Red who had founded the Greenland colony in 984. Their motive was to reconnoiter the land, in order to see what products it offered and to gauge its suitability for settlement. According to the sagas, those initial voyagers took along livestock in their boats, so that they would have the option of making a permanent settlement if the land seemed good to them. Subsequently, after the Vikings had given up on that hope of settling, they continued to visit the coast of North America for more than 300 years in order to fetch lumber (always in short supply in Greenland), and possibly in order to extract iron at sites where plenty of wood was available to make charcoal (also in short supply in Greenland) for iron-smithing.

We have two sources of information about the Vikings' attempt to settle North America: written accounts and archaeological excavations. The written accounts consist mainly of two sagas describing the initial Vinland voyages of discovery and exploration, transmitted orally for several centuries and finally written down in Iceland during the 1200s. In the absence of independent confirming evidence, scholars tended to dismiss the sagas as fiction and to doubt that the Vikings ever reached the New World, until the debate was finally settled when archaeologists located the Vikings' Newfoundland base camp in 1961. The saga accounts of Vinland are now recog-

nized to be the oldest written descriptions of North America, although scholars still debate the accuracy of their details. They are contained in two separate manuscripts, termed the *Greenlanders' Saga* and *Erik the Red's Saga*, which are in broad agreement but have many differences of finer points. They describe up to five separate voyages from Greenland to Vinland, within the short span of barely a decade, each voyage involving only a single ship, except that the last voyage used either two or three ships.

In those two Vinland sagas, the main North American sites visited by the Vikings are described briefly and given the Norse names of Helluland, Markland, Vinland, Leifsbudir, Straumfjord, and Hop. Much effort has been poured by scholars into identifying these names and brief descriptions (e.g., "This land [Markland] was flat and forested, sloping gently seaward, and they came across many beaches of white sand.... This land will be named for what it has to offer and called Markland [Forest Land]"). It seems clear that Helluland means the east coast of Baffin Island in the Canadian Arctic, and that Markland is the Labrador coast south of Baffin Island, both Baffin Island and Labrador lying due west of Greenland across the narrow Davis Strait separating Greenland from North America. In order to remain within sight of land as much as possible, the Greenland Vikings didn't sail straight across the open North Atlantic to Newfoundland but instead crossed Davis Strait to Baffin Island and then headed south, following the coast. The remaining place names in the sagas evidently refer to coastal areas of Canada south of Labrador, including surely Newfoundland, probably the Gulf of St. Lawrence and New Brunswick and Nova Scotia (which collectively were termed Vinland), and possibly some of the New England coast. Vikings in the New World would initially have explored widely in order to find the most useful areas, just as we know that they did in Greenland before picking the two fjords with the best pastureland to settle.

Our other source of information about Vikings in the New World is archaeological. Despite much searching by archaeologists, only a single Viking camp has been identified and excavated, at L'Anse aux Meadows on the northwest coast of Newfoundland. Radiocarbon dating indicated that the camp was occupied around A.D. 1000, in agreement with saga accounts that the Vinland voyages were led by grown children of Erik the Red, who organized the settlement of Greenland around 984, and whom the sagas describe as still alive at the time of the voyages. The L'Anse aux Meadows site, whose location seems to agree with the sagas' description of a camp known as Leifsbudir, consists of the remains of eight buildings, including three residential halls large enough to hold 80 people, an iron smithy to extract

bog iron and make iron nails for boats, a carpenter's shop, and boat repair shops, but no farm buildings or farm implements.

According to the sagas, Leifsbudir was just a base camp at a location convenient for overwintering and going out on summer explorations; the resources of interest to the Vikings were instead to be found in those exploration areas termed Vinland. This is confirmed by a tiny but important discovery made during the archaeological excavation of the L'Anse aux Meadows camp: two wild walnuts known as butternuts, which do not grow in Newfoundland. Even during the centuries of warmer climate prevailing around A.D. 1000, the walnut trees closest to Newfoundland occurred south of the St. Lawrence River Valley. That was also the closest area where the wild grapes described in the sagas grew. It was probably for those grapes that the Vikings named the area Vinland, meaning "wine land."

The sagas describe Vinland as rich in prized resources lacking in Greenland. High on Vinland's list of advantages were a relatively mild climate, much lower latitude and hence longer summer growing season than Greenland, tall grass, and mild winters, making it possible for Norse cattle to graze outdoors for themselves throughout the winter, and thus sparing the Norse the effort of having to make hay in the summer for feeding their cattle in barns during the winter. Forests with good timber were everywhere. Other natural resources included lake and river salmon larger than any salmon seen in Greenland, one of the world's richest ocean fishing grounds in the seas surrounding Newfoundland, and game, including deer, caribou, and nesting birds and their eggs.

Despite the valuable shiploads of timber, grapes, and animal furs that the Vinland voyagers brought back to Greenland, the voyages were discontinued and the L'Anse aux Meadows camp was abandoned. Although the archaeological excavations of the camp were exciting in finally proving that Vikings had indeed reached the New World before Columbus, the excavations were disappointing as well, because the Norse left nothing of value. Objects recovered were confined to small items that had probably been discarded or else dropped and lost, such as 99 broken iron nails, a single whole nail, a bronze pin, a whetstone, a spindle, one glass bead, and a knitting needle. Evidently, the site was not abandoned hastily, but as part of a planned permanent evacuation in which all tools and possessions of value were taken back to Greenland. Today we know that North America was by far the largest and most valuable North Atlantic land discovered by the Norse; even the tiny fraction of it that the Norse surveyed impressed them. Why, then, did the Norse give up on Vinland, land of plenty?

The sagas offer a simple answer to that question: the large population of hostile Indians, with whom the Vikings failed to establish good relations. According to the sagas, the first Indians that the Vikings met were a group of nine, of whom they killed eight, while the ninth fled. That was not a promising start to establishing friendship. Not surprisingly, the Indians came back in a fleet of small boats, shot arrows at the Norse, and killed their leader, Erik the Red's son Thorvald. Pulling the arrow out of his intestines, the dying Thorvald is said to have lamented, "This is a rich country we have found; there is plenty of fat around my belly. We've found a land of fine resources, though we'll hardly enjoy much of them."

The next group of Norse voyagers did manage to establish a trade with local Indians (Norse cloth and cow's milk in exchange for animal furs brought by Indians), until one Viking killed an Indian trying to steal weapons. In the ensuing battle many Indians were killed before fleeing, but that was enough to convince the Norse of the chronic problems that they would face. As the unknown author of *Erik the Red's Saga* put it, "The [Viking] party then realized that, despite everything that the land had to offer there, they would be under constant threat of attack from its former inhabitants. They made ready to depart for their own country [i.e., Greenland]."

After thus abandoning Vinland to the Indians, the Greenland Norse continued to make visits farther north on the Labrador coast, where there were many fewer Indians, in order to fetch timber and iron. Tangible evidence of such visits are a handful of Norse objects (bits of smelted copper, smelted iron, and spun goat's wool) found at Native American archaeological sites scattered over the Canadian Arctic. The most notable such find is a silver penny minted in Norway between 1065 and 1080 during the reign of King Olav the Quiet, found at an Indian site on the coast of Maine hundreds of miles south of Labrador, and pierced for use as a pendant. The Maine site had been a big trading village at which archaeologists excavated stone and tools originating in Labrador as well as over much of Nova Scotia, New England, New York, and Pennsylvania. Probably the penny had been dropped or traded by a Norse visitor to Labrador, and had then reached Maine by an Indian trade network.

Other evidence of continuing Norse visits to Labrador is the mention, in Iceland's chronicle for the year 1347, of a Greenland ship with a crew of 18 that had reached Iceland after losing its anchor and being blown off course on the return voyage from "Markland." The chronicle mention is brief and matter-of-fact, as if there were nothing unusual requiring explanation—as if the chronicler were instead to have written equally matter-of-factly, "So,

the news this year is that one of those ships that visit Markland each summer lost its anchor, and also Thorunn Ketilsdottir spilled a big pitcher of milk at her Djupadalur farm, and one of Bjarni Bollason's sheep died, and that's all the news for this year, just the usual stuff."

In short, the Vinland colony failed because the Greenland colony itself was too small and poor in timber and iron to support it, too far from both Europe and from Vinland, owned too few oceangoing ships, and could not finance big fleets of exploration; and that one or two shiploads of Greenlanders were no match for hordes of Nova Scotia and Gulf of St. Lawrence Indians when they were provoked. In A.D. 1000 the Greenland colony probably numbered no more than 500 people, so that the 80 adults at the L'Anse camp would have represented a huge drain on Greenland's available manpower. When European colonizers finally returned to North America after 1500, the history of European attempts to settle then shows how long were the odds that those attempts faced, even for colonies backed by Europe's wealthiest and most populous nations, sending annual supply fleets of ships far larger than medieval Viking vessels, and equipped with guns and abundant iron tools. At the first English and French colonies in Massachusetts, Virginia, and Canada, about half of the settlers died of starvation and disease within the first year. It's no surprise, then, that 500 Greenlanders, from the most remote colonial outpost of Norway, one of Europe's poorer nations, could not succeed at conquering and colonizing North America.

For our purposes in this book, the most important thing about the failure of the Vinland colony within 10 years is that it was in part a greatly speeded-up preview of the failure that overtook the Greenland colony after 450 years. Norse Greenland survived much longer than Norse Vinland because it was closer to Norway and because hostile natives did not make their appearance for the first few centuries. But Greenland shared, albeit in less extreme form, Vinland's twin problems of isolation and Norse inability to establish good relations with Native Americans. If it had not been for Native Americans, the Greenlanders might have survived their ecological problems, and the Vinland settlers might have persisted. In that case, Vinland might have undergone a population explosion, the Norse might have spread over North America after A.D. 1000, and I as a twentieth-century American might now be writing this book in an Old Norse-based language like modern Icelandic or Faeroese, rather than in English.