Near the close of the eighth century A.D., Nordic pirates, traders, and settlers began the expansion from their Scandinavian homelands that gave the Viking Age its name and permanently changed the development and history of Europe. In the North Atlantic, Viking Age settlers colonized the islands of the eastern North Atlantic (Faeroes, Shetland, Orkney, Hebrides, Man, Ireland) by c. A.D. 800. Iceland was traditionally settled c. 874, Greenland c. 985, and the short-lived Vinland colony survived a few years around A.D. 1000 in the Newfoundland–Gulf of St. Lawrence region. Around A.D. 1000 a common language and culture stretched from Bergen to the St. Lawrence, and colonists drawn from both Scandinavia and the British Isles were attempting the dangerous business of \textit{landnám} (land taking, or first settlement) over a diverse range of island ecosystems.

In some of these island groups (Ireland, Shetland, Orkney, Hebrides, Man) the Nordic voyagers found well-established Iron Age maritime communities similar in many ways to their own, with enough cultural and linguistic overlap to allow widespread intermarriage and political alliance as well as feuding and mutual raiding. In other island groups (Faeroes, Iceland) humanity was either entirely absent or represented by a few (soon departing) heretical monks, and the Viking Age settlers encountered an essentially virgin landscape. In Greenland and Vinland, contact was with indigenous maritime hunter-gatherers rather than agriculturalists. The Vinland contact rapidly resulted in victory for the local population—hostility of the local \textit{Skraeling} is the only negative factor reported about Vinland in the later saga literature, but it was clearly enough to abort the European \textit{landnám} of continental North America for another half millennium. In Greenland, a still poorly understood contact between Norse settlers and Dorset Paleo-Eskimo hunters resulted in a distribution of Norse farming settlements along the southwest coast and Dorset settlements far to the north in the Thule district. As they had in Iceland and the Faeroes, in Greenland the Norse again took over ecosystems unexploited by large-scale farming and again set up a new cultural and economic landscape.

After the demise of the Vinland settlement shortly after A.D. 1000, Iceland and Greenland were the westernmost outposts of Scandinavian culture in the North Atlantic. As Viking Scandinavia became integrated into European Christendom in the later eleventh century, many new options opened for would-be chieftains and ambitious younger sons in Normandy, England, and even Sicily, and the wind went out of the sails of the Viking Age Atlantic voyages. Greenland survived for another five hundred years before becoming extinct. Iceland, by contrast, remains today a very lively modern descendant of the age of settlement.

**DOCUMENTARY SOURCES**

Prior to the 1970s most scholars of the Viking period in the North Atlantic were philologists, medieval archaeologists, and documentary historians, and the uneven written record for Viking depredations in Europe and the colorful and diverse saga literature of Iceland tended to dominate discussion of the period (see Adolf Friðriksson, 1994). All of the saga literature of Iceland postdates the events of the \textit{landnám} period in Iceland and Greenland by several hundred years. The rich documentary sources do not begin to become contemporary with the events they describe until the mid-twelfth century, and accounts of earlier times may very well have been heavily shaped by later political and dynastic agendas. Greenland certainly had its own set of sagas, annals, and written historical records,
but these were all lost when the settlements became extinct and only a few tantalizing fragments remain. The surviving medieval documentary sources are thus rich and by no means completely analyzed, but it is unlikely that more will be discovered and they are thus essentially a closed body of data.

Since the mid-1970s research focus has shifted, as multiple field projects combining archaeology, paleoecology, and history have been carried out all across the region, producing new troves of data of different kinds not wholly dependent upon later documentary sources. The North Atlantic has become a very active center for field and laboratory research, so that every year new finds are made and new analyses carried out that change and enrich our picture of society of the settlement age and the historical ecology of landnám. Rapid expansion of both radiocarbon dating and the use of tephra (ash) from Icelandic volcanoes is providing an increasingly detailed chronology for early settlement in both Greenland and Iceland, and several long-term field projects are concentrating their efforts on early settlement. Thus although archaeology and paleoenvironmental studies increasingly are coming to dominate new research into the essentially prehistoric period of first landnám, the written accounts can be reinterpreted in light of fresh evidence to make a renewed contribution.

Both later documentary references and modern genetic studies indicate that many of the participants in each successive westward movement were drawn from previously settled islands—modern Icelanders have a strong British Isles genetic heritage and saga accounts suggest considerable ethnic diversity aboard the landnám vessels. Long open-water voyages were always dangerous, and of the twenty-four ships that set out from Iceland to colonize Greenland, only fourteen apparently completed the journey. First settlers had their pick of the best land, but in Iceland and Greenland they also faced a true wilderness without established farms, fields, roads, bridges, or local farming expertise. Domestic animals and human labor would both be desperately scarce in the early years, and saga accounts mention failed landnám attempts in Iceland.

EVIDENCE FROM EXCAVATIONS

In Iceland, archaeological evidence for early settlement has appeared in many areas, both along the south coast and in the northern coast and interior. The recent excavations of a nearly complete ninth-century longhouse on Aðalstræði in the center of modern Reykjavík by Howell Roberts and Mjoll Snaesdóttir and what may be the tenth-century farmstead of Erik the Red himself serve to illustrate the rich evidence for Viking Age settlement in comparatively warm southern Iceland. More surprising has been the discovery of multiple early sites in the more arctic northern interior around Lake Mývatn by a long-term project directed by Orri Vésteinsson and Adolf Friðriksson. These inland high-altitude sites appear to form part of a whole landscape of settlement involving extensive boundary walls, charcoal-burning sites, pagan burials, and what has been identified (somewhat controversially) as a pagan temple at Hofstaðir. It would appear that expansion from the initial settlements along the coast was rapid and that high inland sites were occupied in the first generation of landnám in Iceland. Barley growing (for beer as much as bread) was initially practiced in many areas but was later largely discontinued due to both climate change and soil nutrient depletion, and most Icelanders depended on milk, meat, fish, bird's eggs, and a few gathered plants for their basic diet.

By A.D. 930 the Icelanders had set up a self-governing system of local and national things (assembly places) intended to regulate competition among chieftains and adjudicate disputes among farmers. The assemblies voted to adopt Christianity as the official religion (although allowing some pagan practice) in 1000, and Icelandic churchmen soon began to contest vigorously with secular
chieftains for power, land, and followers. In the thirteenth century competition between great magnate families led to civil war and the loss of independence; in A.D. 1264 Icelanders submitted to rule under the king of Norway. After 1250 fishing played an increasing role in both subsistence economy and overseas trade, and a few fishing towns began in the eighteenth century. The Icelandic population fluctuated around fifty thousand throughout most of the Middle Ages and early modern periods, surviving epidemic disease, volcanic eruption, climate cooling, and repeated famine to regain political independence and prosperity based on commercial fishing in the twentieth century.

In Greenland, settlement took place a century after the Icelandic landnám, and settlers following Erik colonized two pockets of rich pasture at the heads of the great fjord systems of the southwest coast. The settlement was divided into a large eastern settlement in the south and the much smaller western settlement farther north in modern Nuuk district. Radiocarbon dates from both settlement areas suggest that, as in Iceland, the landscape filled rapidly, with the eastern settlement probably being settled a generation before the western settlement. Although Greenland is far larger than Iceland, the area holding plant communities rich enough to sustain European domestic stock is far smaller, and the colony seems to have stabilized at a much smaller population level, with estimates ranging from six thousand to around three thousand inhabitants. The Greenlanders were able to set up a chiefly society with assemblies as in Iceland, and they also adopted Christianity around A.D. 1000.

The Greenlandic economy was based partly on domestic stock, but with considerable supplement from hunted caribou and seals. Fishing seems to have played a minor role in Greenland, with walrus hide and ivory, polar bear and fox skins providing the key export products. In 1127 the Greenlandic chieftains traded a live polar bear to the king of Norway to get their own bishop, who appears to have rapidly taken the best land in the eastern settlement for his manor. By the fourteenth century, Greenland boasted a monastery and nunnery as well as some of the largest stone churches in the North Atlantic. Archaeological evidence also suggests a sharply stratified medieval society, with the bishop's manor providing housing for more than one hundred cattle, whereas most farms had room for only two or three head.

Around A.D. 1200 the Norse and surviving Dorset Paleo-Eskimo were contacted by the Thule Inuit people. Ancestors of the modern Inuit of Canada and Greenland, these newcomers had migrated from Alaska and employed a highly sophisticated arctic hunting technology that allowed them to take baleen whales as well as seals. The dynamics of the Norse-Thule contact is still not understood, but it seems to have been a mixture of friendly and hostile encounters that resulted in a steady migration of the Thule people into the Norse settlement areas in the southwest coast. Around A.D. 1350 the smaller Norse western settlement became extinct, and by around 1450 the larger eastern settlement followed suit. Climate change, Thule contact, and declining connections to Europe all played a role in this sad end, but it also appears that settlement decisions and environmental impacts dating back to the initial landnám period created serious vulnerabilities in later Norse Greenland.

FACTORS IN COLONIZATION

Although the perils and opportunities of culture contact, the struggle to set up households and domestic economies, and the politics of land taking probably dominated the minds of the first settlers, environmental factors were also at work in the Norse colonization of the Western North Atlantic. As Norse settlers moved from the long coast of Norway to Iceland and Greenland they cut diagonally across the great arm of the Gulf Stream, the North Atlantic Drift, which brings warm water across the Atlantic to wash the coast of northwest Europe, making grain growing possible above the arctic circle.
in Norway. As they moved into Iceland and Greenland, the colonists began to leave the main channel of the North Atlantic Drift and enter environments critically different from their homelands. The south coast of Iceland is affected by the North Atlantic drift and is wet and comparatively warm in winter, but the north coast is low arctic, experiencing deep snow and occasional drifting sea ice. West Greenland is affected by a side stream of the North Atlantic drift, but is also fundamentally arctic in climate; for example, it is afflicted by summer drift ice.

Thus it was entirely possible for a Norse colonist to journey hundreds of kilometers southward from an ancestral home in arctic Troms district to reach Iceland or west Greenland and still travel to a colder and more arctic local environment. The environmental differences may have been concealed initially by climate and biogeography. As Paul Buckland has pointed out, the flora of the North Atlantic islands is essentially like that of northwestern Europe, with the biogeographical break occurring between Greenland and Canada. Nordic and northern British settlers in Iceland and Greenland would have encountered fjords, valleys, and mountains covered with the same sort of dwarf willow, birch, grasses, sedges, and flowers so familiar from home. These plant communities formed the basis for northwest European Iron Age agriculture, providing grazing for domestic animals, construction material, fuel for heating and cooking, charcoal for iron smelting, important dietary supplements, and folk remedies for illness and injury. What was less evident to Viking Age settlers was that these familiar plants were all much closer to their biological limits in subarctic Iceland and low-arctic Greenland than they were in north temperate Britain or boreal northern Norway.

Farming practices sustainable for thousands of years in the homelands were to prove unsustainably destructive within a few generations in northern Iceland and Greenland. The deceptive similarity of the western North Atlantic islands was probably enhanced for the Viking Age settlers by the comparatively warm climate of the late ninth and early tenth centuries. Although climatologists no longer believe in a centuries-long, uniformly warm "medieval warm period," high-resolution proxy climate data from both ice and deep-sea cores do suggest that the period of initial landnám was warmer and probably more stable than the average for the region, and significantly warmer than the colder periods of the later Middle Ages. In the North Atlantic, a few degrees difference in annual temperature can have a massive impact on the viability of imported crops like barley and on the resilience of local pasture plant communities in the face of grazing pressure.

The western North Atlantic thus may have looked deceptively friendly to Norse settlement in the Viking Age and what was to prove an anomalously warm climate phase contributed to some initial errors in settlement and subsistence choices. In Iceland, rapid deforestation followed first settlement, and pollen studies suggest that 90 percent of the dwarf birch and willow forests present at landnám were removed in the first century of settlement. In some areas, rapid soil erosion took place soon after, and many settlement-age sites in Iceland are now located in heavily eroded landscapes. In Greenland, soils are generally less prone to wind erosion, but several studies have indicated a parallel pattern of deforestation and locally significant soil erosion following shortly after landnám. Something went wrong when the northwest European Iron Age economy was transplanted to Iceland and Greenland.

ANIMAL EVIDENCE

Zooarchaeology provides good proxy evidence for past economy, and a growing number of large well-excavated animal bone collections from the Viking Age North Atlantic give an impression of the changing economy of the landnám period. Domestic animals imported from Europe clearly were both a cultural and an economic necessity. Farm location in both Iceland and Greenland was determined by
concentrations of pasture vegetation, and social status seems to have been linked to cattle keeping. There was a relative abundance of domestic animal bones (cattle, horse, dog, pig and "caprine"—that is, both sheep and goats) on sites from Norway, Iceland, and Greenland. The chieftain's farm on the site of Åker in southern Norway probably represents a sort of cultural ideal for aspiring farmers, and it is characterized by a large number of cattle and pig bones and a relatively small number of sheep and goat bones. Late-ninth- to early-tenth-century collections from both northern and southern Iceland show varied success in imitating the Norwegian model, but all show considerable numbers of cattle and pigs.

The later tenth-century collections are all from northern Iceland, and these show a range of different strategies employing different mixes of cattle, pigs, sheep, and goats. By the eleventh and twelfth centuries these northern Icelandic collections began to take on the sheep-dominated character of the later Middle Ages and early modern periods: cattle bones drop in numbers, and pig and goat bones become extremely rare. This shift in farming strategy may in fact be a response to the rapid deforestation and unexpected soil erosion of the first centuries of landnám. It is possible that pigs and goats were most responsible for the rapid loss of tree cover in ninth- and tenth-century Iceland and that the loss of woodlands in turn made the keeping of these species uneconomic.

Thus the zooarchaeological record indicates that by the time Erik the Red and his followers were contemplating the landnám of Greenland, significant economic change had already taken place on many Icelandic farmsteads. However, the zooarchaeological record from early settlement period phases of Greenlandic sites indicates that the "ideal farm" of the Nordic homelands still exercised a strong hold on the first settlers. Especially at the chieftain's farm at W 51, early layers are rich in cattle and pig bones, and the overall pattern is more similar to that of landnám Iceland in the ninth century than to contemporary eleventh-century Iceland. Pigs prospered even more poorly in later Greenland than in Iceland, and the later domestic mammal samples show few or no pig bones and a general reduction in cattle. Imported domestic animals were only a part of the complete subsistence economy, and especially in the early days of landnám wild birds, fish, and mammals were critical supplements.

The well-established Norwegian chieftain's farm at Åker may have provided a model for domestic stock raising for the early colonists of southern Iceland at Tjarnargata 4 and Herjolfsdalur, but wild sea birds (including a few of the now-extinct great auk) underwrote the initial survival of these early settlements. The landnám settlers in the greater Reykjavík area also apparently made use of now-vanished local walrus colonies, as a few bones of immature walrus have been found at Tjarnargata 4 and an impressive set of tusks were recently recovered from the early longhouse at Aðalstræði nearby. In northern Iceland, freshwater fish, preserved marine fish, birds, and bird eggs seem to have provided a major supplement on many sites. In Iceland the early reliance upon easily depleted bird and whale colonies soon shifted toward more extensive use of marine fish, especially cod and haddock, laying the basis for the large-scale commercial fishing of the later Middle Ages. In Greenland, fish bones are rare finds, but all sites (both early and later) show a massive amount of seal and some caribou bone. Smaller sites in Greenland (like W 48) show an increasing percentage of seal bones through time, a pattern probably mirrored in the 1999 results of isotopic investigation of human bones from Greenland by teams led by Jette Arneborg of the Danish National Museum showing a steady increase in the amount of marine foods consumed in the later Middle Ages.
SETTLEMENT STRATEGIES

Advances in zooarchaeology and understanding of settlement pattern and chronology have prompted some reexamination of the documentary record, and especially of retrospective passages in some of the sagas describing settlement times "long ago." An often-cited passage from Ægir's Saga (translated in The Complete Sagas of Icelanders) describes the establishment of the settlement of the chieftain Skallagrim in Borgarfjörður in southeastern Iceland (emphasis has been added):

Skallagrim was an industrious man. He always kept many men with him and gathered all the resources that were available for subsistence, since at first they had little in the way of livestock to support such a large number of people. Such livestock as there was was grazed free in the woodland all year round. . . . There was no lack of driftwood west of Myrar. He had a farmstead built on Alftanes and ran another farm there, and rowed out from it to catch fish and cull seals and gather eggs, all of which were there in great abundance. There was plenty of driftwood to take back to his farm. Whales beached there, too, in great numbers, and there was wildlife there for the taking at this hunting post: the animals were not used to man and would never flee. He owned a third farm by the sea on the western part of Myrar . . . and he planted crops there and named it Akrar (Fields). . . . Skallagrim also sent his men upriver to catch salmon. He put Odd the hermit by Gljufura to take care of the salmon fishery there . . . When Skallagrim's livestock grew in number, it was allowed to roam mountain pastures for the whole summer. Noticing how much better and fatter the animals were that ranged on the heath, and also that the sheep which could not be brought down for winter survived in the mountain valleys, he had a farmstead built up on the mountain, and ran a farm there where his sheep were kept. . . . In this way, Skallagrim put his livelihood on many footings.

The use of marine mammals, freshwater fish, and bird colonies "not used to man," exploitation of upland pastures, and the ecologically sound strategy of diversified resource use ("putting his livelihood on many footings") attributed to Skallagrim are also now clearly reflected in the archaeological record of landnám. Equally intriguing are the hints of a centralized settlement strategy involving both initially wide holdings by a single chieftain and careful arrangement of tenant farms to validate and effectively exploit the first comer's claim. The area said in the thirteenth-century saga to have been claimed in the ninth century by the industrious Skallagrim would contain the residences of four major chieftains in the thirteenth century as well as up to three hundred smaller farmsteads. The "Skallagrim strategy" would have the effect of establishing a wide scatter of settlements over a large area (intentionally including many environmental zones). It would also account for some of the unexpectedly early dates for settlements at higher elevations or less-desirable locations documented by archaeology in the late twentieth century and after, suggesting a rapid widespread population dispersal into all potentially habitable sites rather than a more gradual expansion outward from favored coastal locations. The residue of planned settlement expansion may be visible in later patterns of farm settlement in both Greenland and Iceland, which show considerable regularity in farm spacing and may reflect landnám-age allotments.

It seems likely that the politics of landnám involved the competitive interaction of a range of different strategies by chieftains, middle-ranking farmers, and the lower-ranking servants and slaves whose unsung labor was so vital to the success of the first settlements. Although the process of landnám in Iceland and Greenland is only beginning to be understood, research in many interrelated fields is making clear that the first century of settlement saw rapid change and transformation of both nature and human society that was to have profound and lasting impact on the history of the whole region.
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