CHAPTER 3

The Last People Alive: Pitcairn and Henderson Islands

Pitcairn before the *Bounty* ■ Three dissimilar islands ■ Trade ■ The movie's ending ■

Many centuries ago, immigrants came to a fertile land blessed with apparently inexhaustible natural resources. While the land lacked a few raw materials useful for industry, those materials were readily obtained by overseas trade with poorer lands that happened to have deposits of them. For a time, all the lands prospered, and their populations multiplied.

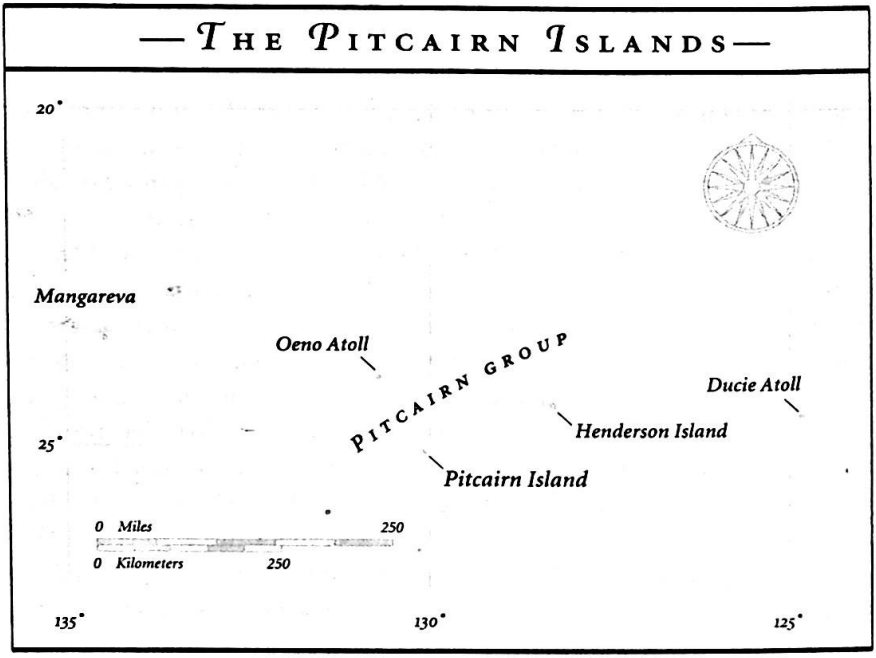
But the population of the rich land eventually multiplied beyond the numbers that even its abundant resources could support. As its forests were felled and its soils eroded, its agricultural productivity was no longer sufficient to generate export surpluses, build ships, or even to nourish its own population. With that decline of trade, shortages of the imported raw materials developed. Civil war spread, as established political institutions were overthrown by a kaleidoscopically changing succession of local military leaders. The starving populace of the rich land survived by turning to cannibalism. Their former overseas trade partners met an even worse fate: deprived of the imports on which they had depended, they in turn ravaged their own environments until no one was left alive.

Does this grim scenario represent the future of the United States and our trade partners? We don't know yet, but the scenario has already played itself out on three tropical Pacific islands. One of them, Pitcairn Island, is famous as the "uninhabited" island to which the mutineers from the H.M.S. *Bounty* fled in 1790. They chose Pitcairn because it was indeed uninhabited at that time, remote, and hence offered a hiding place from the vengeful British navy searching for them. But the mutineers did find temple platforms, petroglyphs, and stone tools giving mute evidence that Pitcairn had formerly supported an ancient Polynesian population. East of Pitcairn, an even more remote island named Henderson remains uninhabited to this

day. Even now, Pitcairn and Henderson are among the most inaccessible islands in the world, without any air or scheduled sea traffic, and visited only by the occasional yacht or cruise ship. Yet Henderson, too, bears abundant marks of a former Polynesian population. What happened to those original Pitcairn Islanders, and to their vanished cousins on Henderson?

The romance and mystery of the H.M.S. *Bounty* mutineers on Pitcairn, retold in many books and films, are matched by the mysterious earlier ends of these two populations. Basic information about them has at last emerged from recent excavations by Marshall Weisler, an archaeologist at the University of Otago in New Zealand, who spent eight months on those lonely outposts. The fates of the first Pitcairners and the Henderson Islanders prove to have been linked to a slowly unfolding environmental catastrophe hundreds of miles overseas on their more populous island trading partner, Mangareva, whose population survived at the cost of a drastically lowered standard of living. Thus, just as Easter Island offered us our clearest example of a collapse due to human environmental impacts with a minimum of other complicating factors, Pitcairn and Henderson Islands furnish our clearest examples of collapses triggered by the breakdown of an environmentally damaged trade partner: a preview of risks already developing today in association with modern globalization. Environmental damage on Pitcairn and Henderson themselves also contributed to the collapses there, but there is no evidence for roles of climate change or of enemies.

Mangareva, Pitcairn, and Henderson are the sole habitable islands in the area known as Southeast Polynesia, which otherwise includes just a few low atolls supporting only temporary populations or visitors but no permanent populations. These three habitable islands were settled sometime around A.D. 800, as part of the eastwards Polynesian expansion explained in the preceding chapter. Even Mangareva, the westernmost of the three islands and hence the one closest to previously settled parts of Polynesia, lies about a thousand miles beyond the nearest large high islands, such as the Societies (including Tahiti) to the west and the Marquesas to the northwest. The Societies and Marquesas in turn, which are the largest and most populous islands in East Polynesia, lie more than a thousand miles east of the nearest high islands of West Polynesia and may not have been colonized until perhaps nearly 2,000 years after West Polynesia's settlement. Thus, Mangareva and its neighbors were isolated outliers even within Polynesia's more remote eastern half. They were probably occupied from the Marquesas or



Societies during the same colonizing push that reached the even more remote Hawaiian Islands and Easter, and that completed the settlement of Polynesia (maps, pp. 84–85 and this page).

Of those three habitable islands of Southeast Polynesia, the one capable of supporting by far the largest human population, and most abundantly endowed with natural resources important to humans, was Mangareva. It consists of a large lagoon 15 miles in diameter, sheltered by an outer reef, and containing two dozen extinct volcanic islands and a few coral atolls with a total land area of 10 square miles. The lagoon, its reefs, and the ocean outside the lagoon teem with fish and shellfish. Especially valuable among the species of shellfish is the black-lipped pearl oyster, a very large oyster of which the lagoon offered virtually inexhaustible quantities to Polynesian settlers, and which is the species used today to raise the famous black cultured pearls. In addition to the oyster itself being edible, its thick shell, up to eight inches long, was an ideal raw material that Polynesians carved into fishhooks, vegetable peelers and graters, and ornaments.

The higher islands of Mangareva's lagoon received enough rain to have springs and intermittent streams, and were originally forested. In the narrow band of flat land around the coasts, the Polynesian colonists built their

settlements. On the slopes behind the villages they grew crops such as sweet potato and yams; terraced slopes and flats below the springs were planted in taro, irrigated by spring water; and higher elevations were planted in tree crops such as breadfruit and bananas. In this way, farming and fishing and gathering of shellfish would have been able to support a human population of several thousand on Mangareva, more than 10 times the likely combined populations of Pitcairn and Henderson in ancient Polynesian times.

From a Polynesian perspective, Mangareva's most significant drawback was its lack of high-quality stone for making adzes and other stone tools. (That's as if the United States contained all important natural resources except high-grade iron deposits.) The coral atolls in Mangareva lagoon had no good raw stone at all, and even the volcanic islands offered only relatively coarse-grained basalt. That was adequate for building houses and garden walls, using as oven stones, and fashioning into canoe anchors and food pounders and other crude tools, but coarse-grained basalt yielded only inferior adzes.

Fortunately, that deficiency was spectacularly remedied on Pitcairn, the much smaller (2½ square miles) and steeper extinct volcanic island lying 300 miles southeast of Mangareva. Imagine the excitement when the first canoeload of Mangarevans discovered Pitcairn after several days' travel on open ocean, landed at its only feasible beach, scrambled up the steep slopes, and came upon Down Rope Quarry, Southeast Polynesia's sole useable lode of volcanic glass, whose flakes could serve as sharp tools for fine cutting tasks—the Polynesian equivalent of scissors and scalpels. Their excitement would have turned to ecstasy when, barely a mile farther west along the cost, they discovered the Tautama lode of fine-grained basalt, which became Southeast Polynesia's biggest quarry for making adzes.

In other respects, Pitcairn offered much more limited opportunities than did Mangareva. It did have intermittent streams, and its forests included trees large enough to fashion into hulls of outrigger canoes. But Pitcairn's steepness and small total area meant that the area of level plateau suitable for agriculture was very small. An equally serious drawback is that Pitcairn's coastline lacks a reef, and the surrounding sea bottom falls off steeply, with the result that fishing and the search for shellfish are much less rewarding than on Mangareva. In particular, Pitcairn has no beds of those black-lipped pearl oysters so useful for eating and tool-making. Hence the total population of Pitcairn in Polynesian times was probably not much greater than a hundred people. The descendants of the *Bounty* mutineers and their Polynesian companions living on Pitcairn today number only 52.

When their number climbed from the original band of 27 settlers in 1790 to 194 descendants in the year 1856, that population overtaxed Pitcairn's agricultural potential, and much of the population had to be evacuated by the British government to distant Norfolk Island.

The remaining habitable island of Southeast Polynesia, Henderson, is the largest (14 square miles) but is also the most remote (100 miles northeast of Pitcairn, 400 miles east of Mangareva) and the most marginal for human existence. Unlike Mangareva or Pitcairn, Henderson is not volcanic but is in effect a coral reef that geological processes thrust up 100 feet above sea level. Hence Henderson is devoid of basalt or other rocks suitable for tool-making. That's a severe limitation for a society of stone tool makers. An additional severe limitation for any humans is that Henderson has no streams or reliable freshwater sources, because the island consists of porous limestone. At best, for a few days after the unpredictable arrivals of rain, water drips from the roofs of caves, and puddles of water can be found on the ground. There is also a freshwater spring that bubbles up in the ocean about 20 feet offshore. During Marshall Weisler's months on Henderson, he found obtaining drinking water even with modern tarpaulins to catch the rain a constant effort, and most of his cooking and all of his washing and bathing had to be carried out with saltwater.

Even soil on Henderson is confined to small pockets between the limestone. The island's tallest trees are only about 50 feet high and not big enough to fashion into canoe hulls. The resulting stunted forest and thick undergrowth are so dense that they require a machete to penetrate them. Henderson's beaches are narrow and confined to the north end; its south coast consists of vertical cliffs where it is impossible to land a boat; and the south end of the island is a makatea landscape thrown into alternating rows of razor-sharp limestone ridges and fissures. That south end has been reached only three times by groups of Europeans, one of them Weisler's group. It took Weisler, wearing hiking boots, five hours to cover the five miles from Henderson's north coast to its south coast—where he promptly discovered a rock shelter formerly occupied by barefoot Polynesians.

Offsetting these fearsome disadvantages, Henderson does have attractions. In the reef and shallow waters nearby live lobsters, crabs, octopus, and a limited variety of fish and shellfish—unfortunately, not including black-lipped pearl oyster. On Henderson is Southeast Polynesia's sole known turtle nesting beach, where green turtles come ashore to lay eggs between January and March of each year. Henderson formerly supported at least 17 species of breeding seabirds, including petrel colonies possibly as large as

millions of birds, whose adults and chicks would have been easy to catch on the nest—enough for a population of a hundred people each to eat one bird every day of the year without endangering the colonies' survival. The island was also home to nine species of resident land birds, five of them flightless or weak fliers and hence easy to catch, including three species of large pigeons that would have been especially delectable.

All those features would have made Henderson a great place for an afternoon picnic ashore, or for a short vacation to glut yourself on seafood and birds and turtles—but a risky and marginal home in which to try to eke out a permanent existence. Weisler's excavations nevertheless showed, to the surprise of anyone who has seen or heard of Henderson, that the island did evidently support a permanent tiny population, possibly comprising a few dozen people who went to extreme effort in order to survive. Proof of their former presence is provided by 98 human bones and teeth representing at least 10 adults (both men and women, some of them over 40 years old), six teenaged boys and girls, and four children in the age range of 5 to 10 years. The children's bones in particular suggest a resident population; modern Pitcairn Islanders usually don't take young children when they visit Henderson to collect wood or seafood.

Further evidence of human use is a huge buried midden, one of the largest known from Southeast Polynesia, running for 300 yards in length and 30 yards in width along the north-coast beach facing the only passage through Henderson's fringing reef. Among the midden's garbage left behind from generations of people feasting, and identified in small test pits excavated by Weisler and his colleagues, are enormous quantities of fish bones (14,751 fish bones in just two-thirds of a cubic yard of sand tested!), plus 42,213 bird bones comprising tens of thousands of bones of seabirds (especially petrels, terns, and tropicbirds) and thousands of bones of land birds (especially the flightless pigeons, rail, and sandpiper). When one extrapolates from the number of bones in Weisler's small test pits to the likely number in the whole midden, one calculates that Henderson Islanders must have disposed of the remains of tens of millions of fish and birds over the centuries. The oldest human-associated radiocarbon date on Henderson is from that midden, and the next-oldest date is from the turtle nesting beach on the northeast coast, implying that people settled first in those areas where they could glut themselves on wild-caught food.

Where could people live on an island that is nothing more than an uplifted coral reef covered with low trees? Henderson is unique among islands inhabited or formerly inhabited by Polynesians in its almost-complete lack

of evidence for buildings, such as the usual houses and temples. There are only three signs of any construction: a stone pavement and post holes in the midden, suggesting the foundations of a house or shelter; one small low wall for protection against the wind; and a few slabs of beach rock for a burial vault. Instead, literally every cave and rock shelter near the coast and with a flat floor and accessible opening—even small recesses only three yards wide and two yards deep, barely large enough for a few people to seek protection from the sun—contained debris testifying to former human habitation. Weisler found 18 such shelters, of which 15 were on the heavily used north, northeast, and northwest coasts near the only beaches, and the other three (all of them very cramped) were on the eastern or southern cliffs. Because Henderson is small enough that Weisler was able to survey essentially the entire coast, the 18 caves and rock shelters, plus one shelter on the north beach, probably constitute all the "dwellings" of Henderson's population.

Charcoal, piles of stones, and relict stands of crop plants showed that the northeast part of the island had been burned and laboriously converted to garden patches where crops could be planted in natural pockets of soil, extended by piling surface stones into mounds. Among the Polynesian crops and useful plants that were introduced intentionally by the settlers, and that have been identified in Henderson archaeological sites or that still grow wild on Henderson today, are coconuts, bananas, swamp taro, possibly taro itself, several species of timber trees, candlenut trees whose nut husks are burned for illumination, hibiscus trees yielding fiber for making rope, and the ti shrub. The latter's sugary roots serve usually just as an emergency food supply elsewhere in Polynesia but were evidently a staple vegetable food on Henderson. Ti leaves could be used to make clothing, house thatching, and food wrappings. All of those sugary and starchy crops add up to a high-carbohydrate diet, which may explain why the teeth and jaws of Henderson Islanders that Weisler found exhibit enough signs of periodontal disease, tooth wear, and tooth loss to give nightmares to a dentist. Most of the islanders' protein would have come from the wild birds and seafood, but finds of a couple of pig bones show that they kept or brought pigs at least occasionally.

Thus, Southeast Polynesia presented colonists with only a few potentially habitable islands. Mangareva, the one capable of supporting the largest population, was largely self-sufficient in the necessities for Polynesian life,

except for lacking high-quality stone. Of the other two islands, Pitcairn was so small, Henderson so ecologically marginal, that each could support only a tiny population unable to constitute a viable human society in the long run. Both were also deficient in important resources—Henderson so much so that we moderns, who wouldn't dream of going there even for a weekend without a full tool chest, drinking water, and food other than seafood, find it mind-boggling that Polynesians managed to survive there as residents. But both Pitcairn and Henderson offered compensating attractions to Polynesians: high-quality stone on the former, abundant seafood and birds on the latter.

Weisler's archaeological excavations uncovered extensive evidence of trade among all three islands, whereby each island's deficiencies were filled by the other islands' surpluses. Trade objects, even those (such as ones of stone) lacking organic carbon suitable for radiocarbon dating, can still be dated by radiocarbon measurements on charcoal excavated from the same archaeological layer. In that way, Weisler established that trade began at least by the year A.D. 1000, probably simultaneously with the first settlement by humans, and continued for many centuries. Numerous objects excavated at Weisler's sites on Henderson could immediately be identified as imports because they were made from materials foreign to Henderson: oyster shell fishhooks and vegetable peelers, volcanic glass cutting tools, and basalt adzes and oven stones.

Where did those imports come from? A reasonable guess is that the oyster shell for fishhooks came from Mangareva, because oysters are abundant there but absent on Pitcairn as well as on Henderson, and other islands with oyster beds are much more distant than Mangareva. A few oyster shell artifacts have also been found on Pitcairn and are similarly presumed to have come from Mangareva. But it is a much more difficult problem to identify origins of the volcanic stone artifacts found on Henderson, because both Mangareva and Pitcairn, as well as many other distant Polynesian islands, have volcanic sources.

Hence Weisler developed or adapted techniques for discriminating among volcanic stones from different sources. Volcanoes spew out many different types of lava, of which basalt (the category of volcanic stone occurring on Mangareva and Pitcairn) is defined by its chemical composition and color. However, basalts from different islands, and often even from different quarries on the same island, differ from each other in finer details of chemical composition, such as their relative content of major elements (like silicon and aluminum) and minor elements (like niobium and zirconium).

An even finer discriminating detail is that the element lead occurs naturally as several isotopes (i.e., several forms differing slightly in atomic weight), whose proportions also differ from one basalt source to another. To a geologist, all these details of composition constitute a fingerprint that may allow one to identify a stone tool as coming from one particular island or quarry.

Weisler analyzed the chemical composition and, with a colleague, the lead isotope ratios in dozens of stone tools and stone fragments (possibly broken off in the course of preparing or repairing stone tools) that he had excavated from dated layers of archaeological sites on Henderson. For comparison, he analyzed volcanic rocks from quarries and rock outcroppings on Mangareva and Pitcairn, the most likely sources of rock imported to Henderson. Just to be sure, he also analyzed volcanic rocks from Polynesian islands that were much more distant and hence less likely to have served as sources of Henderson imports, including Hawaii, Easter, Marquesas, Societies, and Samoa.

The conclusions emerging from these analyses were unequivocal. All analyzed pieces of volcanic glass found on Henderson originated at the Down Rope quarry on Pitcairn. That conclusion had already been suggested by visual inspection of the pieces, even before chemical analysis, because Pitcairn volcanic glass is colored so distinctively with black and gray patches. Most of Henderson's basalt adzes, and its basalt flakes likely to have resulted from adze-making, also originated from Pitcairn, but some came from Mangareva. On Mangareva itself, although far fewer searches have been made for stone artifacts than on Henderson, some adzes were also evidently made from Pitcairn basalt, imported presumably because of its superiority to Mangareva's own basalt. Conversely, of the vesicular basalt stones excavated on Henderson, most came from Mangareva, but a minority were from Pitcairn. Such stones were regularly used throughout Polynesia as oven stones, to be heated in a fire for cooking, much like the charcoal bricks used in modern barbecues. Many of those putative oven stones were found in cooking pits on Henderson and showed signs of having been heated, confirming their surmised function.

In short, archaeological studies have now documented a former flourishing trade in raw materials and possibly also in finished tools: in oyster shell, from Mangareva to Pitcairn and Henderson; in volcanic glass, from Pitcairn to Henderson; and in basalt, from Pitcairn to Mangareva and Henderson, and from Mangareva to Henderson. In addition, Polynesia's pigs and its bananas, taro, and other main crops are species that did not occur on Polynesian islands before humans arrived. If Mangareva was settled be-

fore Pitcairn and Henderson, as seems likely because Mangareva is the closest of the three to other Polynesian islands, then trade from Mangareva probably also brought the indispensable crops and pigs to Pitcairn and Henderson. Especially at the time when Mangareva's colonies on Pitcairn and Henderson were being founded, the canoes bringing imports from Mangareva represented an umbilical cord essential for populating and stocking the new colonies, in addition to their later role as a permanent lifeline.

As for what products Henderson exported to Pitcairn and Mangareva in return, we can only guess. They must have been perishable items unlikely to survive in Pitcairn and Mangareva archaeological sites, since Henderson lacks stones or shells worth exporting. One plausible candidate is live sea turtles, which today breed in Southeast Polynesia only on Henderson, and which throughout Polynesia were prized as a prestigious luxury food consumed mainly by chiefs—like truffles and caviar nowadays. A second candidate is red feathers from Henderson's parrot, fruit dove, and red-tailed tropicbird, red feathers being another prestigious luxury item used for ornaments and feather cloaks in Polynesia, analogous to gold and sable fur today.

However, then as now, exchanges of raw materials, manufactured items, and luxuries would not have been the sole motive for transoceanic trade and travel. Even after Pitcairn's and Henderson's populations had grown to their maximum possible size, their numbers—about a hundred and a few dozen individuals respectively—were so low that people of marriageable age would have found few potential partners on the island, and most of those partners would have been close relatives subject to incest taboos. Hence exchanges of marriage partners would have been an additional important function of the trade with Mangareva. It would also have served to bring skilled craftspeople with technical skills from Mangareva's large population to Pitcairn and Henderson, and to reimport crops that by chance had died out in Pitcairn's and Henderson's small cultivable areas. In the same way, more recently the supply fleets from Europe were essential not only for populating and stocking but also maintaining Europe's overseas colonies in America and Australia, which required a long time to develop even rudiments of self-sufficiency.

From the perspective of Mangarevans and Pitcairn Islanders, there would have been still another likely function of the trade with Henderson. The journey from Mangareva to Henderson would take four or five days by Polynesian sailing canoes; from Pitcairn to Henderson, about one day. My

own perspective on sea journeys in Pacific native canoes is based on much briefer voyages, which left me constantly terrified of the canoe's capsizing or breaking up and in one case nearly cost me my life. That makes the thought of a several-day canoe voyage across open ocean intolerable to me, something that only a desperate need to save my life could induce me to undertake. But to modern Pacific seafaring peoples, who sail their canoes five days just to buy cigarettes, the journeys are part of normal life. For the former Polynesian inhabitants of Mangareva or Pitcairn, a visit to Henderson for a week would have been a wonderful picnic, a chance to feast on nesting turtles and their eggs and on Henderson's millions of nesting seabirds. To Pitcairn Islanders in particular, living on an island without reefs or calm inshore waters or rich shellfish beds, Henderson would also have been attractive for fish, shellfish, and just for the chance to hang out on the beach. For the same reason, the descendants of the *Bounty* mutineers today, bored with their tiny island prison, jump at the chance of a "vacation" on the beach of a coral atoll a few hundred miles distant.

Mangareva, it turns out, was the geographic hub of a much larger trade network, of which the ocean journey to Pitcairn and Henderson a few hundred miles to the southeast was the shortest spoke. The longer spokes, of about a thousand miles each, connected Mangareva to the Marquesas to the north–northwest, to the Societies to the west–northwest, and possibly to the Australs due west. The dozens of low coral atolls of the Tuamotu Archipelago offered small intermediate stepping-stones for breaking up these journeys. Just as Mangareva's population of several thousand people dwarfed that of Pitcairn and Henderson, the populations of the Societies and Marquesas (around a hundred thousand people each) dwarfed that of Mangareva.

Hard evidence for this larger trade network emerged in the course of Weisler's chemical studies of basalt, when he had the good fortune to identify two adzes of basalt originating from a Marquesas quarry and one adze from a Societies quarry among 19 analyzed adzes collected on Mangareva. Other evidence comes from tools whose styles vary from island to island, such as adzes, axes, fishhooks, octopus lures, harpoons, and files. Similarities of styles between islands, and appearances of examples of one island's type of tool on another island, attest to trade especially between the Marquesas and Mangareva, with an accumulation of Marquesas-style tools on Mangareva around A.D. 1100–1300 suggesting a peak in interisland voyaging then. Still further evidence comes from studies by the linguist Steven Fischer, who concludes that the Mangarevan language as known in recent

times is descended from the language originally brought to Mangareva by its first settlers and then heavily modified by subsequent contact with the language of the southeastern Marquesas (the portion of the Marquesas Archipelago closest to Mangareva).

As for the functions of all that trade and contact in the larger network, one was certainly economic, just as in the smaller Mangareva/Pitcairn/Henderson network, because the networks' archipelagoes complemented one another in resources. The Marquesas were the "motherland," with a big land area and human population and one good basalt quarry, but poor marine resources because there were no lagoons or fringing reefs. Mangareva, a "second motherland," boasted a huge and rich lagoon, offset by a small land area and population and inferior stone. Mangareva's daughter colonies on Pitcairn and Henderson had the drawbacks of a tiny land area and population but great stone on Pitcairn and great feasting on Henderson. Finally, the Tuamotu Archipelago offered only a small land area and no stone at all, but good seafood and a convenient stepping-stone location.

Trade within Southeast Polynesia continued from about A.D.1000 to 1450, as gauged by artifacts in radiocarbon-dated archaeological layers on Henderson. But by A.D. 1500, the trade had stopped, both in Southeast Polynesia and along the other spokes radiating from Mangareva's hub. Those later archaeological layers on Henderson contain no more imported Mangareva oyster shell, no more Pitcairn volcanic glass, no more Pitcairn fine-grained basalt for cutting tools, and no more Mangareva or Pitcairn basalt oven stone. Apparently the canoes were no longer arriving from either Mangareva or Pitcairn. Because trees on Henderson itself are too small to make canoes, Henderson's population of a few dozen was now trapped on one of the most remote, most daunting islands in the world. Henderson Islanders confronted a problem that seems insoluble to us: how to survive on a raised limestone reef without any metal, without stones other than limestone, and without imports of any type.

They survived in ways that strike me as a mixture of ingenious, desperate, and pathetic. For the raw material of adzes, in place of stone, they turned to shells of giant clams. For awls to punch holes, they fell back on bird bones. For oven stones, they turned to limestone or coral or giant clamshell, all of which are inferior to basalt because they retain heat for less time, tend to crack after heating, and cannot be reused as often. They now made their fishhooks out of purse shell, which is much smaller than black-lipped

pearl oyster shell, so that it yields only one hook per shell (instead of a dozen hooks from an oyster shell) and restricts the types of hooks that can be fashioned.

Radiocarbon dates suggest that, struggling on in this way, Henderson's population of originally a few dozen people survived for several generations, possibly a century or more, after all contact with Mangareva and Pitcairn was cut. But by A.D. 1606, the year of Henderson's "discovery" by Europeans, when a boat from a passing Spanish ship landed on the island and saw no one, Henderson's population had ceased to exist. Pitcairn's own population had disappeared at least by 1790 (the year when the *Bounty* mutineers arrived to find the island uninhabited), and probably disappeared much earlier.

Why did Henderson's contact with the outside world come to a halt? That outcome stemmed from disastrous environmental changes on Mangareva and Pitcairn. All over Polynesia, human settlement on islands that had developed for millions of years in the absence of humans led to habitat damage and mass extinctions of plants and animals. Mangareva was especially susceptible to deforestation for most of the reasons that I identified for Easter Island in the preceding chapter: high latitude, low ash and dust fallout, and so on. Habitat damage was extreme in Mangareva's hilly interior, most of which the islanders proceeded to deforest in order to plant their gardens. As a result, rain carried topsoil down the steep slopes, and the forest became replaced by a savannah of ferns, which were among the few plants able to grow on the now-denuded ground. That soil erosion in the hills removed much of the area formerly available on Mangareva for gardening and tree crops. Deforestation indirectly reduced yields from fishing as well, because no trees large enough to build canoes remained: when Europeans "discovered" Mangareva in 1797, the islanders had no canoes, only rafts.

With too many people and too little food, Mangareva society slid into a nightmare of civil war and chronic hunger, whose consequences are recalled in detail by modern islanders. For protein, people turned to cannibalism, in the form not only of eating freshly dead people but also of digging up and eating buried corpses. Chronic fighting broke out over the precious remaining cultivable land; the winning side redistributed the land of the losers. Instead of an orderly political system based on hereditary chiefs, nonhereditary warriors took over. The thought of Lilliputian military dictatorships on eastern and western Mangareva, battling for control of an island only five miles long, could seem funny if it were not so tragic. All that politi-

cal chaos alone would have made it difficult to muster the manpower and supplies necessary for oceangoing canoe travel, and to go off for a month and leave one's garden undefended, even if trees for canoes themselves had not become unavailable. With the collapse of Mangareva at its hub, the whole East Polynesia trade network that had joined Mangareva to the Marquesas, Societies, Tuamotus, Pitcairn, and Henderson disintegrated, as documented by Weisler's sourcing studies of basalt adzes.

While much less is known about environmental changes on Pitcairn, limited archaeological excavations there by Weisler indicate massive deforestation and soil erosion on that island as well. Henderson itself also suffered environmental damage that reduced its human carrying capacity. Five out of its nine species of land birds (including all three large pigeons), and colonies of about six of its species of breeding seabirds, were exterminated. Those extinctions probably resulted from a combination of hunting for food, habitat destruction due to parts of the island being burned for gardens, and depredations of rats that arrived as stowaways in Polynesian canoes. Today, those rats continue to prey on chicks and adults of the remaining species of seabirds, which are unable to defend themselves because they evolved in the absence of rats. Archaeological evidence for gardening appears on Henderson only after those bird disappearances, suggesting that people were being forced into reliance on gardens by the dwindling of their original food sources. The disappearance of edible horn shells and decline in turban shells in later layers of archaeological sites on Henderson's northeast coast also suggest the possibility of overexploitation of shellfish.

Thus, environmental damage, leading to social and political chaos and to loss of timber for canoes, ended Southeast Polynesia's interisland trade. That end of trade would have exacerbated problems for Mangarevans, now cut off from Pitcairn, Marquesas, and Societies sources of high-quality stone for making tools. For the inhabitants of Pitcairn and Henderson, the results were even worse: eventually, no one was left alive on those islands.

Those disappearances of Pitcairn's and Henderson's populations must have resulted somehow from the severing of the Mangarevan umbilical cord. Life on Henderson, always difficult, would have become more so with the loss of all imported volcanic stone. Did everyone die simultaneously in a mass calamity, or did the populations gradually dwindle down to a single survivor, who lived on alone with his or her memories for many years? That actually happened to the Indian population of San Nicolas Island off Los Angeles, reduced finally to one woman who survived in complete isolation for 18 years. Did the last Henderson Islanders spend much time on the

beaches, for generation after generation, staring out to sea in the hopes of sighting the canoes that had stopped coming, until even the memory of what a canoe looked like grew dim?

While the details of how human life flickered out on Pitcairn and Henderson remain unknown, I can't tear myself free of the mysterious drama. In my head, I run through alternative endings of the movie, guiding my speculation by what I know actually did happen to some other isolated societies. When people are trapped together with no possibility of emigration, enemies can no longer resolve tensions merely by moving apart. Those tensions may have exploded in mass murder, which later nearly did destroy the colony of *Bounty* mutineers on Pitcairn itself. Murder could also have been driven by food shortage and cannibalism, as happened to the Mangarevans, Easter Islanders, and—closer to home for Americans—the Donner Party in California. Perhaps people grown desperate turned to mass suicide, which was recently the choice of 39 members of the Heaven's Gate cult near San Diego, California. Desperation might instead have led to insanity, the fate of some members of the Belgian Antarctic Expedition, whose ship was trapped by ice for over a year in 1898–1899. Still another catastrophic ending could have been starvation, the fate of Japan's garrison stranded on Wake Island during World War II, and perhaps exacerbated by a drought, typhoon, tsunami, or other environmental disaster.

Then my mind turns to gentler possible endings of the movie. After a few generations of isolation on Pitcairn or Henderson, everyone in their microsociety of a hundred or a few dozen people would have been everyone else's cousin, and it would have become impossible to contract a marriage not in violation of incest taboos. Hence people may just have grown old together and stopped having children, as happened to California's last surviving Yahi Indians, the famous Ishi and his three companions. If the small population did ignore incest taboos, the resulting inbreeding may have caused congenital physical anomalies to proliferate, as exemplified by deafness on Martha's Vineyard Island off Massachusetts or on the remote Atlantic island of Tristan da Cunha.

We may never know which way the movies of Pitcairn and Henderson actually ended. Regardless of the final details, though, the main outline of the story is clear. The populations of Mangareva, Pitcairn, and Henderson all inflicted heavy damage on their environments and destroyed many of the resources necessary for their own lives. Mangareva Islanders were numerous enough to survive, albeit under chronically terrifying conditions and with a drastically reduced standard of living. But from the very begin-

ning, even before the accumulation of environmental damage, the inhabitants of Pitcairn and Henderson had remained dependent on imports of agricultural products, technology, stone, oyster shell, and people from their mother population on Mangareva. With Mangareva's decline and its inability to sustain exports, not even the most heroic efforts to adapt could save the last people alive on Pitcairn and Henderson. Lest those islands still seem to you too remote in space and time to be relevant to our modern societies, just think about the risks (as well as the benefits) of our increasing globalization and increasing worldwide economic interdependence. Many economically important but ecologically fragile areas (think of oil) already affect the rest of us, just as Mangareva affected Pitcairn and Henderson.