



Lovesick Grass, Foreign Tubers, and Jade Rice (Silk for Silver, Part Two)

HIDDEN PASSENGERS

Trade brought more than silver across the Pacific. Tobacco may have led the parade. Somehow Portuguese ships brought the species across oceans and borders to Guangxi, in southern China, where archaeologists have unearthed locally made tobacco pipes dating back to 1549.* Little more than two decades later, the plant arrived in the southeast, aboard a silver ship from Manila. Not long after that, it filtered into the northeast, probably from Korea.

* The reader will have noted that I barely mention Dutch and Portuguese trade in Asia, which centered on spices, and focus on Spain and the galleon trade. This is partly to simplify a complex narrative, but mainly because the Spanish empire, the first truly global enterprise, is more germane to this book. In addition, the Netherlands and Portugal were entangled with that empire: the former not wresting full independence from it until 1648; the latter, long independent, forced by dynastic mishaps to accept a Spanish king from 1580 to 1640.

Nicotiana tabacum was as much an object of fascination in Yuegang as in London and Madrid. “You take fire and light one end [of the pipe] and put the other end in your mouth,” explained the seventeenth-century Fujianese poet Yao Lü. “The smoke goes down your throat through the pipe. It can make one tipsy.” Writing not long after the smoking weed arrived in Fujian, Yao was amazed by its rapid spread across the province. “Now there is more here than in the Philippines,” he marveled, “and it is exported and sold to that country.”

Then as now, smoking was made to order for the boredom and inertia of army life. Tobacco was embraced by Ming soldiers, who disseminated it as they marched around the empire. In the southwestern province of Yunnan, one physician reported, Chinese soldiers “entered miasma-ridden [malarial] lands, and none of them were spared disease except for a single unit, whose members were in perfect health. When asked the reason, the answer was that they all smoked.” (Mosquitoes dislike smoke, so smoking actually may have provided some protective effect against malaria-carrying insects.) From that point, the account continued, “smoking spread . . . and now in the southwest, whether old or young, they cannot stop smoking from morning until night.” As a child in the 1630s, the writer Wang Pu had never heard of tobacco. When he grew to adulthood, he later recalled, “customs suddenly changed, and all the people, even boys not four feet tall, were smoking.”

“Tobacco is everywhere,” announced what was apparently China’s first smoking how-to book. Calling the plant “golden-thread smoke” and “lovesick grass”—the latter a nod to its penchant for hooking the user—the Qing dynasty’s legions of smokers may have been the planet’s most enthusiastic nicotine slaves. An ostentatious addiction to tobacco became the hallmark of the fashionable rich. Men boasted of their inability to eat, converse, and even think without a lighted pipe. Women carried special silk tobacco purses with elaborate jeweled fastenings; to protect their delicate feminine essences from the harsh spirit of

tobacco, they smoked extra-long pipes, some so big that they had to be lugged around by servants. A new poetic sub-genre emerged among China's wealthy aesthetes: the hymn to tobacco.

*Puffing fragrance, exhaling the Sage's vapor;
Bluish tendrils born from the subtle Smoke.
The Gentleman's Companion, it warms my heart
And leaves my mouth feeling like a divine furnace.*

Late-waking aristocratic women slept with their heads elevated on special blocks so that attendants could do their hair and makeup while they were unconscious—it shortened the time between waking and the first tobacco of the day. "The scene is a little hard to imagine," remarked Timothy Brook, the Canadian historian whose studies of Chinese tobacco I am drawing upon here.

Brook found the tale of the sleeping smokers in Chen Cong's *Yancao pu* (Tobacco Manual), a learned collection of tobacco-related poetry and prose from 1805. An even more recondite compendium, Lu Yao's *Yan pu* (Smoking Manual), appeared around 1774. Lu, a former provincial governor, laid down the rules for nicotine consumption in aristocratic circles. Like a modern etiquette handbook, the manual provided a set of smoking do's and don'ts:

Do smoke: after waking up; after a meal; with guests; while writing; when growing tired from reading; while waiting for a good friend who hasn't shown up yet.

Don't smoke: while listening to a zither; feeding cranes; appreciating orchids; observing plum blossoms; making ancestral offerings; attending the morning court assembly; sleeping with a beautiful woman.

From today's perspective, the Chinese courtier's ornate surrender to tobacco seems absurd, but it had many equally odd

counterparts abroad. At the same time that Lu Yao was laying out smoking etiquette, wealthy English were taking snuff (finely ground tobacco stems) in public sessions heavy with ritual. Opening their silver or ivory snuffboxes—"a fetish of the eighteenth century," as the anthropologist Berthold Laufer put it—fashionable young blades scooped out measures of fresh-ground snuff with finger-length ladles made of bone. Parties fell quiet as groups of men in embroidered waistcoats simultaneously inserted tiny pucks of ground tobacco into their noses, then whipped out lace handkerchiefs to muffle the ensuing volley of sneezes. Mastering the arcana of snuff was, for the addict, worth the bother: snorted tobacco delivers nicotine to the bloodstream faster than cigarette smoke. Few were more enraptured by the ritual than the celebrated London dandy Beau Brummell, who claimed to have a different snuffbox for every day of the year. Brummell instructed his fellow gallants in the subtle art of using only one hand to open the box, extract a pinch of snuff, and stick it in a nostril. The injection had to be accomplished with a rakish tilt of the head to avoid unsightly brown drips.

Snuff mania had few consequences in England other than interrupted party chatter, high laundry bills, and nasopharyngeal cancer. China's tobacco addiction occurred in an entirely different context, and thus had an entirely different impact. *N. tabacum* was part of an unplanned ecological invasion that shaped, for better and worse, modern China.

At the time, China had roughly a quarter of the world's population, which had to provide for itself on roughly a twelfth of the world's arable land. Both figures are imprecise at best, but there is little dispute that the nation has long had a lot of people and that it always has had relatively little land to grow crops to feed them. In practical terms, China had to harvest huge amounts of food—half or more of the national diet—from areas with enough water to grow rice and wheat. Unluckily, those areas are relatively small. The nation has many deserts, few big lakes, irregular rainfall, and just two major rivers, the Yangzi and the Huang He

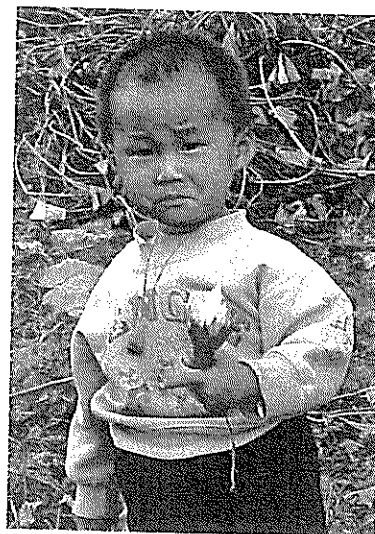
(Yellow). Both rivers run long, looping courses from the western mountains to the Pacific coast, emptying into the sea scarcely 150 miles from each other. The Yangzi carries mountain runoff into the rice-growing flats near the end of its course. The Huang He takes it into the North China Plain, then as now the center of Chinese wheat production. Both areas are vital to feeding the nation; there are no other places in China like them. And both are prone to catastrophic floods.

Song and Yuan, Ming and Qing—every dynasty understood both this vulnerability and the concomitant necessity of maintaining China's agricultural base by controlling the Yangzi and Huang He. So important was water management that European savants like Karl Marx and Max Weber identified it as China's most important institution. Creating and operating huge, complex irrigation systems, Weber claimed, required organizing masses of laborers, which inevitably created a powerful state bureaucracy and subjugated the individual. In an influential book from 1957, the historian Karl Wittfogel built on Marx to describe China and places with similar water-control needs as "hydraulic societies." Wittfogel's view of these societies can be gathered from the title of his book: *Oriental Despotism*. Europe, to his mind, avoided despotism because farmers didn't need irrigation. They fended for themselves, which created traditions of individualism, entrepreneurship, and technological progress that China never had. In recent years this thesis has fallen out of favor. Most Sinologists today believe that hydraulic Asia was just as diverse, individualistic, and market oriented as anywhere else, including non-hydraulic Europe. But this image still remains influential, at least in the West, where China is all too often viewed as an undifferentiated mass of workers, moving ant-wise to the directives of the state.

None of the challenges to past thinkers dispute that China had a relative dearth of land suitable for rice and wheat. From this perspective, the Columbian Exchange was a boon, and China raced to embrace it. "No large group of the human race in the

Old World was quicker to adopt American food plants than the Chinese," Alfred W. Crosby wrote in *The Columbian Exchange*. Sweet potatoes, maize, peanuts, tobacco, chili peppers, pineapple, cashew, manioc (cassava)—all poured into Fujian (via the galleon trade), Guangdong (the province southwest of Fujian, via Portuguese ships in Macao), and Korea (via Japan, which took them from the Dutch). All became part of the furniture of Chinese life—who can imagine Sichuan (Szechuan) food today without heaps of hot peppers? "While men who stormed Tenochtitlan with Cortés still lived," Crosby said, "peanuts were swelling in the sandy loams near Shanghai; maize was turning fields green in south China; and the sweet potato was on its way to becoming the poor man's staple in Fujian." Today China is the world's biggest sweet potato grower, producing more than three-quarters of the global harvest; it is also the world's second-biggest maize producer.

Epitomizing China's readiness to experiment was the Yuegang merchant Chen Zhenlong, who came across sweet potatoes (*Ipomoea batatas*) during a visit to Manila in the early 1590s. Prob-



Sweet potatoes in China are often eaten raw, the skin whittled off in a fashion that makes them somewhat resemble ice cream cones.

ably native to Central America, *I. batatas* had been encountered by Colón on his first voyage; Spaniards had brought the species to the Philippines, where it was quickly adopted by Malays, who already grew the tuber crop taro. Liking the taste, Chen decided to take sweet potatoes home with him. "He bribed the barbarians to get segments of their vines several feet in length," reported his great-great-great-grandson in *True Account of the Story of Planting Sweet Potatoes in Qinghai, Henan, and Other Provinces* (1768), a book-length essay devoted to bragging about the sweet potato feats of the author's ancestors. Chen hid the vines by twisting them around ropes and tossing the ropes into a basket. Spanish customs agents noticed nothing. (They weren't trying to stop the export of sweet potatoes per se, so much as trying to prevent the Chinese from getting their hands on *anything* from which they might derive commercial advantage.) In this way Chen smuggled sweet potatoes into China. "Even though the vines were withered," his great-great-great-grandson wrote later, "they flourished after he stuck cuttings in infertile ground."

The 1580s and 1590s, an intense point in the Little Ice Age, were two decades of hard cold rains that flooded Fujianese valleys, washing away rice paddies and drowning the crop. Famine shadowed the rains. Poor families were reduced to eating bark, grass, insects, and even the seeds found in wild-goose excrement. Chen Zhenlong and his friends seem initially to have thought of the *fanshu*—foreign tubers—as an amusing novelty; they gave them away as presents, a slice or two at a time, neatly wrapped in a box. (Botanically speaking, *fanshu* is a misnomer; *I. batatas* actually has a modified root, rather than a proper tuber.) As hunger tightened its grip, Chen's son, Chen Jinglun, showed the *fanshu* to the provincial governor, to whom he was an adviser. The younger Chen was asked to conduct a trial planting near his home. Successful results persuaded the governor to distribute cuttings to farmers and instruct farmers how to grow and store them. "It was a great fall harvest; both near and far food was abundant and disaster was no longer a threat," exulted the great-great-great-grandson. Near

Yuegang, as much as 80 percent of the locals were living on sweet potatoes.*

Governmental promotion of foreign crops was nothing new in Fujian. Sometime before 1000 A.D., Fujianese merchants brought in a novel type of rice—early-ripening Champa rice—from Southeast Asia. Because the new rice matured quickly, it could be planted in areas with shorter growing seasons. After intensive breeding, farmers created varieties that grew quickly enough to let them plant two crops a year in the same field—one of rice, then a second of wheat or millet. Harvesting twice as much from the same amount of land, Chinese farms became more productive than farms elsewhere in the world. The then-ruling Song dynasty actively promoted the new rice, distributing free seeds, publishing illustrated how-to brochures, sending out agents to explain cultivation techniques, and even providing some low-interest loans to help smallholders adapt. This aggressive adaptation and promotion of a new technology was a key reason for the nation's subsequent prosperity, and its preeminence.

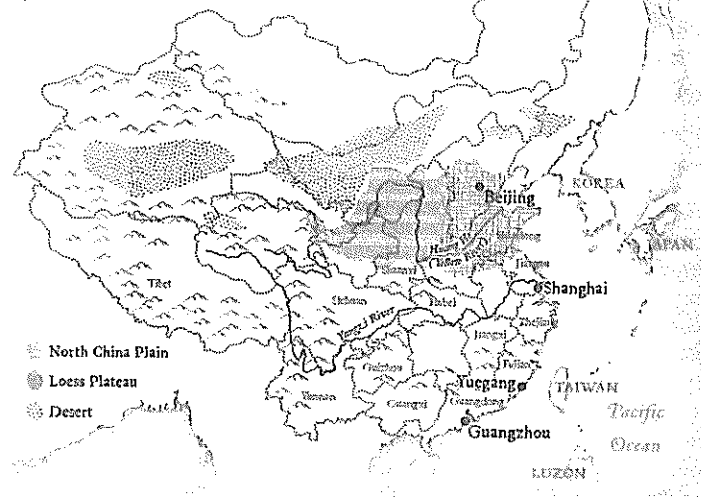
Still, Fujian was lucky that sweet potatoes arrived when they did. The crop spread through the province just in time for the fall of the Ming dynasty, which ushered in decades of violent chaos. Incoming Manchu forces seized Beijing in 1644, beginning a new dynasty: the Qing. The last Ming emperor hanged himself, and pretenders emerged to lead a rump state. Initially it was based in Fujian. In a disordered interlude, pieces of the Ming mil-

* Chen was not the only sweet-potato smuggler. According to a nineteenth-century gazetteer, the Chinese doctor Lin Huailan successfully treated a sick Vietnamese princess in 1581. At a banquet in his honor, he was served sweet potatoes. Vietnam had banned exporting the tuber to China "on penalty of death," the gazetteer recounted, but Lin decided to take some anyway. "While crossing the border, he was questioned by a [Vietnamese] border official. Lin answered truthfully, and requested that the officer secretly let him through. The officer said: 'As for what happens today, being a servant of the country, it would be disloyal of me to let you pass; however, being grateful for your virtues, to deny you would be unrighteous.' He then drowned himself. Lin returned, and the tuber spread across Guangdong."

itary splintered away and became, in effect, *wokou*. Meanwhile actual *wokou* took advantage of the confusion. To deny supplies to the Ming/*wokou*, the Qing army forced the coastal population from Guangdong to Shandong—the entire eastern “bulge” of China, a 2,500-mile stretch of coastline—to move en masse into the interior.

Beginning in 1652, soldiers marched into seaside villages and burned houses, knocked down walls, and smashed ancestral shrines; families, often given only a few days’ warning, evacuated with nothing but their clothes. All privately owned ships were set afire or sunk. Anyone who stayed behind was slain. “We became vagrants, fleeing and scattering,” one Fujianese family history recalled. People “simply went in one direction until they halted,” another said. “Those who did not die scattered over distant and nearby localities.” For three decades the shoreline was emptied to a distance inland of as much as fifty miles. It was a scorched-earth policy, except that the Qing scorched the enemy’s earth, not their own.

Qing-era China



For Fujian, the coastal evacuation amounted to a spectacularly harsh version of the Ming dynasty’s ban on overseas trade. In the 1630s, before the political convulsions and the trade bans, twenty or more big junks went to Manila every year, each carrying hundreds of traders. During the evacuation, the number fell to as low as two or three, all illicit. Like the Ming trade bans, the Qing coastal clearance effectively turned over the silver trade to *wokou*.

As it happened, the trade was turned-over to one pirate in particular: Zheng Chenggong, known in the West as Koxinga (the name is a corruption of a Chinese honorific). Born in Japan to a Japanese mother and a Fujianese Christian father who was a prominent pirate, Zheng had spent his life flouting Ming law. When the Qing came in, he realized that *wokou* were better off with the lackadaisical, corrupt Ming. He became an admiral in the rump Ming state and led an enormous sea-based assault on the Qing that came close to toppling the new regime. Afterward, he returned to piracy, amassing a fleet that one eyewitness, a Dominican missionary in Fujian, estimated at fifteen to twenty thousand vessels and an army of “a hundred thousand men at arms, all the necessary sailors, and eight thousand horses.” Based in a palace in Amoy (now called Xiamen), a city across the river from Yuegang, Zheng controlled the entire southeast coast—a true pirate king.

Manila’s traders, having no alternative, begged Zheng in 1657 to buy their silver. When his ships appeared in the harbor, the galleon trade resumed. Perhaps distracted by his running battle with the Qing, Zheng took longer than one would expect to realize that a) the Spaniards in the Philippines had no source but him for silk and porcelain; and b) he, Zheng, was a pirate with a large army. Not until 1662 did he dispatch the Dominican missionary—dressed in the rich robes of an imperial emissary—to Manila with a proposal to change the terms of trade. The Spaniards would give him all their silver, as before. In return, Zheng would not kill them. Panicked, the Spanish governor decided to

expel the Chinese in the Philippines. Refusing to be ejected, they barricaded themselves in the Parián. As was by that point customary, Spanish troops forcibly rounded up the Chinese, slaughtering many and forcing the rest to leave Manila on jam-packed ships. The precaution turned out to be needless; just two months later, Zheng died unexpectedly, probably of malaria. His sons fought over their inheritance, and the Manila trade was left alone.

The Qing had ordered the coastal evacuation, but it had disastrous consequences for them, too. As the treasury official Mu Tianyan complained, closing down the silver trade effectively froze the money supply. Because silver was always being wasted, lost, and buried, the pool of Chinese money was actually shrinking. "Every day there is less and less to meet the demand, with no way to restore it," Mu wrote to the emperor. When the money supply falls, each unit becomes more valuable; prices fall in a classic deflationary spiral. To stop the importation of silver "yet desire the wealth of fortune and convenience of use," Mu asked, "how is this different from blocking a source of water while expecting to benefit from its flow?" Reluctantly agreeing, the Qing lifted the ban in 1681.

Meanwhile, though, coastal people had flooded into the mountains of Fujian, Guangdong, and Zhejiang. Inconveniently, these areas were already inhabited. Most of the inhabitants belonged to a different ethnic group, the Hakka, famed for their *tulou*—fortress-like complexes, usually but not always circular, whose earthen outer walls contain scores of apartments, all facing onto a central courtyard. (Today these amazing structures are a tourist attraction.) Decades before the expulsion, the Fujianese scholar Xie Zhaozhe had observed that the Hakka in the hills were packed into every scrap of available real estate:

There is not an inch of open ground. . . . Truly as someone once said, "Not a drop of water goes unused, and as much as possible even the most rugged parts of mountains



Thousands of *toulou*, clan dwellings of the Hakka, still dot the mountains of Fujian. Made from rammed earth mixed with rice stalks, they had no windows on lower floors as a defensive measure.

are cultivated." One could say that there isn't a bit of land left.

Unable to support themselves, poor Hakka and other mountain peoples had been emigrating north and west for a century, renting uninhabited highland areas—terrain too steep and dry for rice—in neighboring provinces. They cut and burned the tree cover and planted cash crops, mainly indigo, in the exposed earth. After a few years of this slash-and-burn the thin mountain soil was exhausted and the Hakka moved on. ("When they finish with one mountain, they simply move on to the next," the geographer Gu Yanwu complained.) As coastal refugees poured into the mountains, the highland exodus accelerated.

Landless and poor, the Hakka refugees were mocked as *pengmin*—shack people. Strictly speaking, shack people were not vagabonds; they rented land in the heights that was owned but not used by farmers in the more fertile valleys. Shifting from one temporary home to the next, *pengmin* eventually occupied a crooked, 1,500-mile stretch of montane China from the sawtooth hills of Fujian in the southeast to the silt cliffs around the Huang He in the northwest.

Neither rice nor wheat, China's two most important staples, would grow in the shack people's marginal land. The soil was too thin for wheat; on steep slopes, the irrigation for rice paddies requires building terraces, the sort of costly, hugely laborious capital improvement project unlikely to be undertaken by renters.

Almost inevitably, they turned to American crops: maize, sweet potato, and tobacco. Maize (*Zea mays*) can thrive in amazingly bad land and grows quickly, maturing in less time than barley, wheat, and millet. Brought in from the Portuguese at Macao, it was known as "tribute wheat," "wrapped grain," and "jade rice." Sweet potatoes will grow where even maize cannot, tolerating strongly acid soils with little organic matter and few nutrients. *I. batatas* doesn't even need much light, as one agricultural reformer noted in 1628. "Even in low, narrow, damp alleys,

where there is only a few feet of ground, if you can look up and see the sky, you can plant them there."

In the south, many farmers' diets revolved around the sweet potato: sweet potatoes baked and boiled, sweet potatoes ground into flour for noodles, sweet potatoes mashed with pickles or deep-fried with honey or chopped into stew with turnips and soybean milk, even sweet potatoes fermented into a kind of wine. In the west, China was a land of maize and another American import: potatoes, originally bred in the Andes Mountains. When the wandering French missionary Armand David lived in a hut in remote, scraggy Shaanxi, his meal plan would not have been out of place, except for a few garnishes, in the Inka empire. "The only plant cultivated near our cabin is the potato," he noted in 1872. "Maize flour, along with potatoes, is the mountain peoples' daily diet; it's usually eaten boiled and mixed with the tubers."

Nobody knew how many shack people were in the hills. Hoping, perhaps, that hiding the problem would avoid the need to solve it, Qing bureaucrats left them out of census reports. But all evidence suggests that the number was not small. In Jiangxi, Fujian's western neighbor, the rigid, nit-picking provincial treasurer insisted in 1773 that the shack people, many of whom had lived in Jiangxi for decades, counted as actual inhabitants of the province and therefore should be included in the reports sent to Beijing. He dispatched field workers to enumerate every Hakka head and every Hakka shack. In rugged Ganxian County, they tallied 58,340 settled inhabitants, most in the main town of Ganzhou—and 274,280 shack people in the surrounding slopes. In county after county the story was repeated, sometimes with a few thousand wanderers, other times a hundred thousand or more. Hidden from the government, more than a million shack people had been slashing and burning their way across Jiangxi. And that, as the Qing court must have realized, was only one medium-sized province.

Coupled with the outflow of shack people was a second, parallel, even bigger wave of migration into the parched, moun-

tainous, thinly settled west. In their quest for social stability, the Ming had prohibited people from leaving their home regions. Reversing course, the Qing actively promoted a westward movement. Much as the United States encouraged its citizens to move west in the nineteenth century and Brazil provided incentives to occupy the Amazon in the twentieth, China's new Qing masters believed that filling up empty spaces was essential to the national destiny. ("Empty," that is, from the Qing point of view; dozens of non-Chinese peoples—Tibetans, Yao, Uighurs, Miao—lived in them. By sending in people from the center, the Qing were forcibly incorporating these previously autonomous cultures into the nation.)* Lured by tax subsidies and cheap land, migrants from the east swarmed into the western hills. Most of the newcomers were, like the shack people, poor, politically luckless, and scorned by urban elites. They looked at the weathered, craggy landscape, so unwelcoming to rice—and they, too, planted American crops.

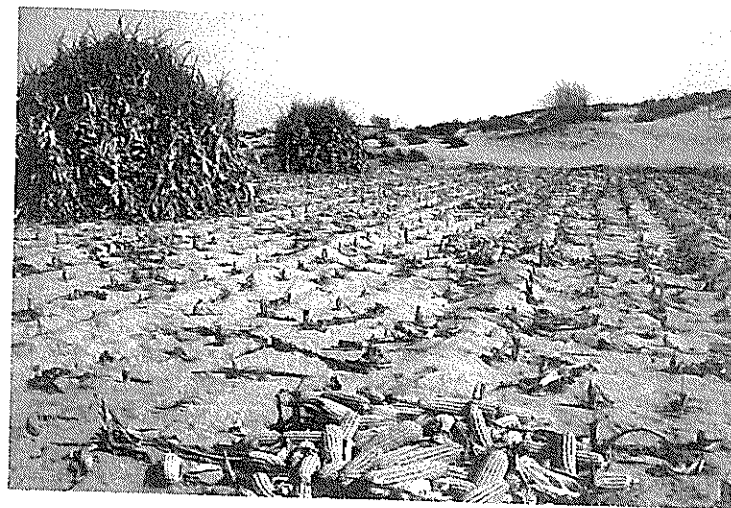
China's fifth-largest province is Sichuan, adjacent to Tibet and nearly as alpine. Back in 1795, according to Lan Yong, a historian at Sichuan's Southwest University, it was a big, roomy place: more land than California, a population as low as 9 million. Just 2,300 square miles of its surface, an area half the size of Los Angeles County, were considered arable. During the next twenty years, Lan has written, American crops moved into the ridges and highlands, increasing the pool of farmland to almost 3,700 square miles. As Sichuan's agricultural capacity increased, its population increased in tandem, to 25 million. Something similar occurred in Shaanxi Province, Sichuan's even emptier neighbor to the northeast. Migrants poured into the steep, arid hills along the border between them, knocking down the trees that clung to the slopes to make room for sweet potatoes, maize, and, later, potatoes. The amount of cropland soared, followed by the amount of food

* The ethnic group generally indicated by the word "Chinese" is the Han. The Manchu were pushing Han from the Chinese core into peripheral areas settled by other peoples.

grown on that cropland, and then the population. In some places the number of inhabitants increased a hundredfold in little more than a century.

For almost two thousand years, China's numbers had grown very slowly. That changed in the decades after the violent Qing takeover. From the arrival of American crops at the beginning of the new dynasty to the end of the eighteenth century, population soared. Historians debate the exact size of the increase; many believe the population roughly doubled, to as much as 300 million people. Whatever the precise figure, the jump in numbers had big consequences. It was the demographic surge that transformed the nation into a watchword for crowding.

China was not the only Asian nation transformed by the Columbian Exchange. Sweet potatoes became a staple in a broad swath extending from Tahiti to Papua New Guinea, and from New Zealand to Hawai'i. Surprisingly, *I. batatas* was known in much of this area before Columbus—archaeologists have found burned remains of the plant dating back as early as 1000 A.D. in Hawai'i, Easter Island, the Cook Islands, and New Zealand.



Maize at the edge of the Gobi Desert, in Inner Mongolia

(Some researchers view the species's movement across the Pacific as evidence of contact between ancient Polynesians and American Indians; others argue that the seeds, which are contained in small, buoyant, spherical capsules, must have floated across the sea.) Initially it had little impact. But about the time that the Spaniards arrived in Manila *I. batatas* was displacing native crops like yam, sago, and banana. As had the Chinese, islanders were using sweet potato's high yields and tolerance of bad soil to move into highland areas that had been lightly settled before. New Guinea was so transformed that some archaeologists speak of an "Ipomoean revolution." Still, the impact in China was bigger, if only because China is so big, and because the country had a centralized government that could enforce policies that spread sweet potato.

Were maize, potatoes, and sweet potatoes entirely responsible for China's population boom? No. American plants arrived as the Qing were transforming China. Ambitious on many fronts, the dynasty fought disease and hunger, the nation's two major killers, by enacting a program, the world's first, of smallpox inoculation; expanding a nationwide network of granaries that bought surplus grain and sold it at low, state-controlled prices during shortages; and implementing what were, for the era, sophisticated disaster-relief programs (some were as simple as a halt in the collection of grain levies in famine-struck areas). At the same time, the Qing campaigned against the nation's traditional population-control method: female infanticide. Many Chinese men had spent their days as bachelors, because infanticide removed women from the population. Now more could marry and have babies; now their babies were less likely to die from smallpox and starvation. Now, too, farm families were less likely to be driven into penury by the state: the Kangxi emperor promised in 1713 that the dynasty would never raise the basic tax on cropland, even though it was making massive investments in transportation networks so that farmers could sell their harvests, raising their incomes. Happily, those harvests were likely

to grow; the Little Ice Age was waning. Some of these policies had been first emplaced by the Ming; the Qing merely executed them efficiently. But all helped raise the number of children, and the proportion of that number who survived to adulthood.

Still, as noted by Lan, the Sichuan historian, most of the increase took place in the areas with American crops. The families that Qing policies encouraged to move west needed to eat, and what they ate, day in and day out, was maize, potatoes, and sweet potatoes. Part of the reason China is the world's most populous nation is the Columbian Exchange.

MALTHUSIAN INTERLUDE

Hong Liangji was born in 1746 near the mouth of the Yangzi, into a family that slowly went on the skids after the unexpected death of his father. Brilliant but volatile, tall and red-faced, Hong "was in his element when he was singing and drinking," one friend recalled. He was often upbraided at school for drunken antics even as he won prizes for his intellect and prose style. An intense, impatient, and easily infuriated man, he would grab his interlocutor's wrist, lean in close, and hammer his point home with febrile intensity. "His eyes would narrow and you could see his neck redden with anger," another friend said, remembering political discussions. "Then he was extremely unsociable." His friends put up with him because he was a fine poet, a lively essayist, and a noted scholar who studied waterways, reconstructed administrative boundaries, and assembled a comprehensive geography of the Qing empire. His greatest intellectual feat, though, passed almost unnoticed. Sometime in 1793 Hong Liangji thought of an idea that may never have occurred to anyone else before.

After finally winning a place in the Qing bureaucracy at the age of forty-four—Hong had failed the civil service exam four times—he was sent as an education inspector to Guizhou Province, in the southwestern hinterland. Essentially a sloping, heav-

ily eroded limestone shelf, the province is a humid jumble of steep gorges, protuberant hills, and long caverns. It was another target for Qing occupation, thronged with migrants from central China who were pushing out its original inhabitants, the Miao. The newcomers were climbing up the hills, planting maize, and beginning families. Hong wondered how long the boom could last.

"Today's population is five times as large as that of thirty years ago," he wrote, with perhaps pardonable exaggeration, "ten times as large as that of sixty years ago, and not less than twenty times as large as that of a hundred years ago." He imagined a man with "a ten-room house and 100 *mu* [about seventeen acres] of farmland." If the man married and had three adult sons, then eight people—the four men and their wives—would live on the parents' farm.

Eight people would require the help of hired servants; there would be, say, ten people in the household. With the ten-room house and the 100 *mu* of farmland, I believe they would have just enough space to live in and food to eat, although barely enough. In time, however, there will be grandsons, who, in turn, will marry. The aged members of the household will pass away, but there could still be more than twenty people in the family. With more than twenty people sharing a house and working 100 *mu* of farmland, I am sure that even if they eat very frugally and live in crowded quarters, their needs will not be met.

Hong conceded that the Qing had opened up new land to support China's population. But the amount of farmland had

only doubled or, at the most, increased three to five times, while the population has grown ten to twenty times. Thus farmland and houses are always in short supply, while there is always a surplus of households and population. . . .

Question: Do Heaven-and-earth have a way of dealing with this situation? Answer: Heaven-and-earth's way of making adjustments lies in flood, drought, and plagues.

Five years later, in England, a similar notion came to another man: Rev. Thomas Robert Malthus. A shy, kindly fellow with a slight harelip, Malthus was the first person to hold a university position in economics—that is, the first professional economist—in Britain, and probably the world. He was impelled to think about population growth after a disagreement with his father, a well-heeled eccentric in the English style. The argument was over whether the human race could transform the world into paradise. Malthus thought not, and said so at length—55,000 words, published as an unsigned broadside in 1798. Several longer versions followed. These were signed; Malthus had become more confident.

"The power of population," Malthus proclaimed, "is indefinitely greater than the power in the earth to produce subsistence for man." In textbooks today this notion is often depicted by recourse to a graph. One line on the graph represents the total food supply; it slowly rises in a line from left to right as people clear more land and farm more efficiently. Another line starts out low, quickly curves to meet the first, then soars above it; that line represents human population, growing exponentially. Eventually the gap between the two lines cannot be bridged, and the Four Horsemen of the Apocalypse pay a call. Every effort to increase the food supply, Malthus argued, will only lead to an increase in population that will more than cancel out the increase in the food supply—a state of affairs today known as a *Malthusian trap*. Forget Utopia, Malthus said. Humanity is doomed to exist, now and forever, at the edge of starvation. Forget charity, too: helping the poor only leads to more babies, which in turn produces increased hardship down the road. No matter how big the banquet grows, there will always be too many hungry people wanting a seat at the table. The Malthusian trap cannot be escaped.

The reaction was explosive. "Right from the publication of the *Essay on Population* to this day," the great economic historian Joseph Schumpeter declared, "Malthus had the good fortune—for this is good fortune—to be the subject of equally unreasonable, contradictory appraisals." John Maynard Keynes regarded Malthus as the "beginning of systematic economic thinking." Percy Bysshe Shelley, on the other hand, derided him as "a eunuch and a tyrant." John Stuart Mill viewed Malthus as a great thinker. To Karl Marx he was a "plagiarist" and a "shameless sycophant of the ruling classes." "He was a benefactor of humanity," Schumpeter wrote. "He was a fiend. He was a profound thinker. He was a dunce."

Hong, by contrast, was ignored. Unlike Malthus, he never developed his thoughts systematically, in part because he devoted his energy to criticizing the corrupt officials who he believed were looting the Qing state. Appalled at the government's brutal, incompetent reaction to a rebellion by starving peasants in Sichuan and Shaanxi, Hong quit his job in 1799. On his way out, he shot off a rambling but remarkably blunt letter to the crown prince, who passed it to the Jiaqing emperor (not to be confused with the alchemy-crazed Jiajing emperor, who ruled two centuries before). The angered emperor sentenced Hong to life in exile, silencing him.

The lack of recognition was unmerited; Hong apparently captured the workings of the Malthusian trap better than Malthus. (I use the hedge word "apparently" because he never worked out the details.) The Englishman's theory made a simple prediction: more food would lead to more mouths would lead to more misery. In fact, though, the world's farmers have more than kept pace. Between 1961 and 2007 humankind's numbers doubled, roughly speaking, while global harvests of wheat, rice, and maize tripled. As population has soared, in fact, the percentage of chronically malnourished has *fallen*—contrary to Malthus's prediction. Hunger still exists, to be sure, but the chance that any given child will be malnourished has steadily, hearteningly declined. Hong,

by contrast, pointed to a related but more complex prospect. The continual need to increase yields, Hong presciently suggested, would lead to an ecological catastrophe, which would cause social dysfunction—and with it massive human suffering.

Exactly this process is what researchers today mean when they talk about the Malthusian trap. Indeed, one way to summarize today's environmental disputes is to say that almost all boil down to the question of whether humankind will continue to accumulate wealth and knowledge, as has been the case since the Industrial Revolution, or whether the environmental impacts of that accumulation—soil degradation, loss of biodiversity, consumption of groundwater supplies, climate change—will snap shut the jaws of the Malthusian trap, returning the earth to pre-industrial wretchedness. Alarming in this context, China provides an example of the latter, at least in part. In the decades after American crops swept into the highlands, the richest society in the world was convulsed by a struggle with its own environment—a struggle it decisively lost.

"THE MOUNTAINS REVEAL
THEIR STONES"

Between the 1680s, when the Qing resumed the silver trade, and the 1780s, the price of rice in Suzhou, a rice-trading center near modern Shanghai, more than quadrupled. Incomes did not keep up—a recipe for social unrest. As if on cue, rebellions exploded across China; the convulsion that dismayed Hong is alone said to have led to several million deaths. Part of the reason for the price hike was the influx of silver to Fujian, according to Quan Hansheng, the economic historian, which drove up Chinese food prices in exactly the same way that the influx of silver to Spain had earlier driven up European prices. The population boom presumably increased demand, putting further pressure on the price. State purchases for granaries sometimes had the same effect.

But a big reason for the price rise was that many farmers simply stopped growing rice.

Qing emperors had made a priority of improving transportation networks so that farmers could sell crops profitably. The intent was to facilitate the movement of staple foods; the new roads would help merchants ship rice and wheat from places with abundant harvests to places that needed supplies. Instead smallholders discovered they could make more money by switching from rice and wheat to sugarcane, peanuts, mulberry trees, and, most of all, tobacco.

Initially the Qing court cracked down on this shift, insisting that peasant farmers practice “correct agriculture”—that is, grow rice and wheat. “Tobacco is not healthy for the people,” the Yongzheng emperor proclaimed in 1727. “Because cultivating tobacco requires using rich land, its cultivation is harmful for growing grain.” But as the court grew more insular and debased—seemingly the fate of all Chinese dynasties—it lost interest in enforcing agricultural correctness.

Farmers seized their opportunity. Tobacco required four to six times more fertilizer and twice as much labor as rice, but was more profitable; China’s growing battalions of nicotine addicts were willing to pay more for their pipes than their food. (Some were doubly addicted: they cut their tobacco with opium.) Tobacco appeared in almost every corner in China, according to Tao Weining, an agricultural historian in Guangdong. And it was a big presence in those places: in two typical hilly areas examined by Tao, “nearly half” of the total farmland was devoted to *N. tabacum*. In consequence, the local price of rice doubled, as did the price of most common vegetables and fruits. Farmers ended up spending their tobacco profits on food expensively imported from other parts of China. As in Virginia, tobacco drained the land. When farmers exhausted the soil from one former rice paddy, they went to the next. And when they ran out of rice paddies, they went into the hills.

The same phenomenon is still occurring today. When two



Even four centuries after its introduction tobacco remains so profitable in China that villagers still turn rice paddies into tobacco plots. These Fujianese farmers are drying tobacco in 2009.

friends and I visited the *tulou* houses in Fujian, we walked around the mountain hamlet of Yongding. Generations past, the villagers’ ancestors had hacked small, semicircular rice terraces out of the slopes, fertilizing the thin red earth with manure and night soil, then filling the paddies by diverting mountain streams. At the edge of the village a sign proclaimed that China Tobacco, a state monopoly, had contracted with Yongding’s farmers to convert their paddies to tobacco. The company had built a new road to facilitate harvest. From atop the terraces we looked down on horizontal arcs of splayed, fleshy green arrows: *N. tabacum*.

In Yongding, the villagers had replaced some of the lost rice with maize, shoving plants into the ground everywhere they could find a scrap of plausible land: roadside ditches, backyard plots, the walls of the gullies below the houses. Somebody had stuck maize seedlings into a pickup-sized heap of dirt and gravel left by a recent landslide. During the eighteenth century, the

same kind of thing took place all over China. Jamming maize and sweet potatoes into every nook and crevice, shack people and migrants almost tripled the nation's cultivated area between 1700 and 1850. To create the necessary farmland, they knocked down centuries-old forests. Bereft of tree cover, the slopes no longer retained rainwater. Soil nutrients washed down the hills. Eventually the depleted land would not support even maize and sweet potatoes. Farmers would clear more forest, and the cycle would begin anew.*

Some of the worst devastation was in the steep, crabbed hills of eastern central China, home of the shack people. Heavy, hammering rains, common in this area, constantly flush out minerals and organic matter. The weathered soil can't hold water—"if it doesn't rain for ten days," one local writer said in 1607, "the soil becomes dry and scorched and cracks like the lines on a tortoise's back." The land was arable, in the sense that maize and sweet potatoes would grow in it. But harvesting them for more than a season or two was next to impossible without shoveling in generous amounts of lime or ashes to reduce acidity, manure to boost organic matter, and fertilizer to increase nitrogen and phosphorus. This had to be done every year, because rain kept leaching nutrients.

Shack people, one recalls, rented their farms from landowners in the valleys below. Renting for short, fixed periods, they had no incentive to fertilize, and little means to do it even should they have wanted to. Because the crop was new to their experience, they made beginners' mistakes. Maize is planted in widely spaced rows, unlike wheat and millet, which is grown across solid blocks. Many farmers did not realize for a long time that maize therefore

* Agriculture was not the only cause of deforestation. China consumed huge quantities of timber as fuel and building material. To get the wood, platoons of workers went to distant places, where they wiped out entire forests. Alas, so much lumber was lost, damaged, and stolen during shipping, reported Yang Chang, a historian in Hubei Province's Huazhong Normal University, that less than 2 percent of it was actually used by its intended recipients.

left more of the soil uncovered and hence exposed to rain. And some didn't understand that planting the maize in rows straight up and down the hills, rather than across the slope, would channel that rain down the slope, increasing erosion.

Even if one fertilized the upland soil and minimized the impact of rain, upland deforestation could still cause disaster below, according to Anne R. Osborne, a historian at Rider University, in New Jersey, whose studies of the shack people I am relying on for this account. "The narrowness of the valley plains and basins meant that human settlement and most food production were concentrated along the edges of the rivers," Osborne explained. When the uplands were covered with vegetation, they released rainwater slowly; floods were rare. Replacing stands of trees on steep slopes with temporary plots of maize and sweet potatoes reduced the mountains' water-storage capacity. Rainfall went down the hills in sheets, setting off floods. "Flood waters pouring out of the highlands met almost flat land on the neighboring basins and plains," Osborne wrote. "Slowing suddenly, they dropped their loads of silt, in the river channels or over the farmers' fields, destroying fertile fields and obstructing the channels for future drainage."

Floods were especially problematic for rice farmers, even though their livelihood depended on flooding. Paddies require a continuous trickle of incoming water. If the flow is too weak, the water evaporates; if the flow is too fast, the paddy spills over its banks, carrying away nutrients and possibly the rice itself. Farmers used upstream dikes to hold back water until needed, controlling irrigation levels by adjusting gates. In a flood, the sudden gush of water could wipe out both the dikes and the paddies they fed, bringing down the whole system. Paradoxically, the deluges drowned the rice crop—and then, later, dried out the paddies because the dikes no longer held water for them. By cutting down the forests, the shack people were not only laying waste to the land around them, they were helping to devastate the agricultural infrastructure miles downstream. Because this was occur-

ring in the lower Yangzi, the shack people were wrecking a chunk of the nation's agricultural heartland.

Some locals wholly understood the problem. When the scholar Mei Zengliang paid a nostalgic visit in 1823 to the mountain town in which he had spent his childhood, he asked his former neighbors about the shack people. No ecologist today would have much to add to their response.

On uncleared mountains [the villagers told him], the soil is firm and the rocks hold fast; grass and trees are thick, years of rotting leaves cover the ground to depths of as much as 2 to 3 *cun* [three to four inches]. Whenever it rains, the rain-water runs off the trees and onto the rotten leaves, then into the soil and rocks, before seeping through cracks in the rocks to form streams. This water flows slowly, and as it flows downward the soil does not go with it. . . . Today [shack people] strip the mountains with blades and axes, and loosen their soil with shovels and hoes, so that before even one rainfall has finished, the sand and rocks wash down with the water, quickly flowing into ravines.

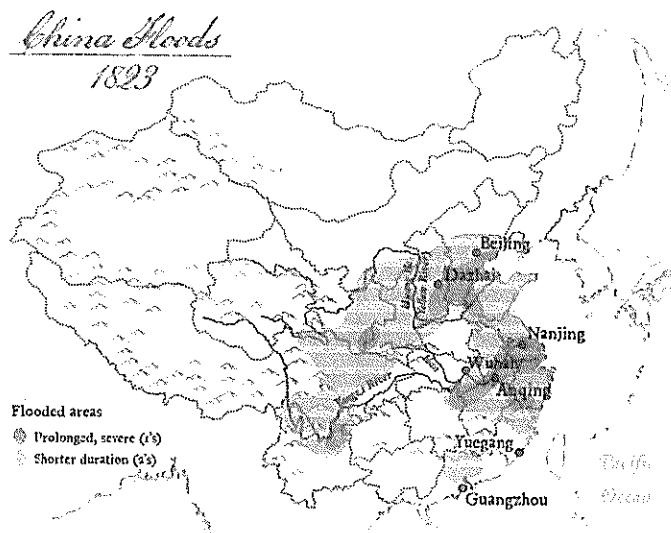
Erosion from the heights drowned the rice paddies in the lower Yangzi valleys, further driving up the price of rice, which encouraged more maize production in the heights, which drowned more rice in the valleys.

As shack people moved into the mountains, floods became ever more frequent. In the Song dynasty (960–1279 A.D.), major floods occurred somewhere in the empire at an average clip of about three every two years. Some farmers, many of them Hakka, illegally moved into the hills during the Ming dynasty (1368–1644), removing trees as they did. Predictably, the pace of deluges increased to almost two per year. The Qing (1644–1911) actively promoted moving peoples into mountain forests. As night follows day, the surge in migration led to a surge in deforestation; the flood rate more than tripled, to a little more than six

major floods a year. Worse, the floods mostly targeted China's agricultural centers. Poring through personal diaries, county gazetteers, provincial archives, and imperial disaster-relief records, the historian Li Xiangjun found that 16,384 floods had occurred during the Qing dynasty. The great majority were small. But 13,537 of them occurred in the rich farmlands in the lower Yangzi and Huang He. And the floods kept growing. Between 1841 and 1911, the Qing faced more than thirteen major floods a year—a Katrina every month, as one historian put it to me. "The government had constant disasters in the most populous parts of the realm," he said. "The areas that were most important to feeding everyone. It was not good."

In the 1970s a team of researchers at China's central meteorological bureau pored through huge numbers of local records, looking for descriptions of rainfall and temperature in past centuries. As one might expect, the researchers found few scientific measurements, but many verbal accounts. When they encountered phrases like—to use their examples—"10 consecutive days of heavy summer rain caused rivers to overflow," "spring and summer floods drowned countless people and animals," "summer and fall floods washed away the seedlings of cereal crops," "several days of heavy rains such that boats could travel over land," and "massive winds and heavy rains inundated fields and houses," the researchers concluded that the area had experienced a flood, and marked the map with a 1 in the corresponding area. Descriptions of severe drought were marked with a 5. They gave conditions in between 2, 3, or 4. Although the resultant maps were subjective, the overall course of events was clear. Flipping through the maps in the meteorological bureau book was like watching an animated movie of environmental collapse.

Overwhelmed by the detail on the maps, I decided to look at four rice centers on the lower Yangzi: the cities of Nanjing, Anqing, and Wuhan, and the upper Han River, an important northern tributary of the Yangzi. Between 1500 and 1550, these areas had sixteen number 1s: sixteen major floods. Between 1600 and 1650,



they had eighteen—roughly the same number. Between 1700 and 1750, at the height of the colder, wetter Little Ice Age, there were twenty-seven. Then the Little Ice Age ended, the weather became drier, and there was less rain and snow. But the number of 1s in these parts of China's agricultural core kept increasing. Between 1800 and 1850 these four places alone had thirty-two major floods. Some of the floods extended for hundreds of miles along the river, the 1s inundating city after city, each digit standing for thousands of wrecked lives.

Officials in Zhejiang Province, dismayed by the mounting problems, announced in 1802 that the government would begin sending the despised shack people "back to their native places." They also banned planting maize in the mountains. Almost nothing happened. The officials tried again in 1824, banning the species outright—Zhejiang was supposed to be a maize-free zone. Again nothing happened. The imperial government had a network of "censors" entrusted with rooting out incompetence and

corruption. Zhejiang's censors repeatedly asked Beijing to send troops to rip out maize. There was no response. In the kind of phenomenon that makes one despair of the human race's ability to govern itself, the pace of land clearing actually accelerated in the first part of the nineteenth century.

Zhejiang censor Wang Yuanfang couldn't understand it. In the past, he knew, landlords hadn't understood that renting their unused upland property would have disastrous consequences. "Now [in 1850] the waterways are filled with mud, the fields are buried under sand, the mountains reveal their stones and the officials and people know of the great disaster, but they do nothing to stop it. Why?" (Emphasis in original.)

In part, the failure was due to an inherent problem with mass illegal immigration. It is not easy to deport huge numbers of people—tearing them from homes and families built up over years—without mass suffering. Governments that seek popular support shrink from inflicting this kind of agony (unless the loss of support from one group is made up for by increased support from another). Logistically, there is also the problem of finding a destination for people who have left their original homes decades before. In the case of the shack people, Osborne argued, neither governmental queasiness nor confusion was the chief obstacle. The main problem was that the erosion represented a classic collective-action problem. A legal loophole ensured that rental income, unlike farm income, was tax free. Landowners with rentable property in the highlands thus had an easy source of untaxable income. The ensuing deforestation might ravage their own fields in the valleys, but the risks would be spread across an entire region, whereas the landowners' profits were theirs alone. Absorbing all of the gain and only a fraction of the pain, local business interests beat back every effort to rein in shack people.

In an environmentalists' nightmare, the shortsighted pursuit of small-scale profit steered a course for long-range, large-scale disaster. Constant floods led to constant famine and constant unrest; repairing the damage sapped the resources of the state.

American silver may have pushed the Ming over the edge; American crops certainly helped kick out the underpinnings of the tottering Qing dynasty.

Other factors played their part, to be sure. A rebellion led by a Hakka mystic tore apart the nation, briefly setting up a state of shack people in the Hakka hills of the southeast. A series of weak emperors allowed the bureaucracy to wallow in inanition and corruption. The empire lost two wars with Great Britain, forcing it to cede control of its borders. British forces freely disseminated the opium that the government had gone to war to exclude. And so on—catastrophe, like success, has many progenitors. Unknown to the rampaging European armies, though, their path had been smoothed by the Columbian Exchange.

UNLEARNING FROM DAZHAI

For two generations, one of the most celebrated places in China was Dazhai. A hamlet of a few hundred souls in the dry, knotted hills of north-central China, Dazhai was ravaged by floods in 1963. Standing in the wreckage with his signature sweat-absorbing towel around his head, the local Communist Party secretary refused aid from the state and instead promised that Dazhai would rebuild itself with its own resources—and create a newer, more productive village at the same time. Harvests soared, despite the flood and the area's infertile soil.

Delighted by the increase, Mao Zedong bused thousands of local officials to the village and instructed them to emulate what they saw. Mainly, they saw spade-wielding peasants working in a fury to terrace the hills from top to bottom; rest breaks occurred while reading Mao's *Little Red Book* of revolutionary proverbs. The atmosphere was cult-like: one group walked for two weeks to see the calluses on a Dazhai laborer's hands. China needed to produce grain from every scrap of land, the officials learned. Slogans, ever present in Maoist China, explained how to do it:

Move Hills, Fill Gullies and Create Plains!
Destroy Forests, Open Wastelands!
In Agriculture, Learn from Dazhai!

Filled with excitement, lashed on by local authorities, villagers fanned out across the hills, cutting the scrubby trees on the pitches, slicing the slopes into earthen terraces, and planting what they could on every newly created flat surface. Despite heat and hunger, people worked all day and then lighted lanterns and worked at night. The terraces converted unplantable steep slopes into new farmland. In one village that I visited farmers increased the area of cultivable land by about 20 percent, which seems typical.

Dazhai is in a geological anomaly called the Loess Plateau. For eon upon eon winds have swept across the deserts to the west, blowing grit and sand into central China. Millennia of dust fall have covered the region with vast heaps of packed silt—"loess," geologists call it—some of them hundreds of feet deep. The Loess Plateau is about the size of France, Belgium, and the Netherlands combined.

Loess doesn't form soil so much as pack together like wet snow. For centuries, people in the plateau have dug caves in the loess and lived in them. *Yaodong*, as these cave dwellings are called, are quite cozy—the one I stayed in had a heated platform bed cut from a block of loess. An adjacent woodstove vented through the platform, warming the bed in winter. Looking at the *yaodong* walls that night, I realized that the room, like a scientific probe, revealed the earth's workings. As a rule, soil has three layers: a thin scrim of dead leaves, bits of wood, and other organic matter on top; a band of dark topsoil, usually no more than a foot deep, shot through with humus (partly decomposed organic matter); and a stratum of subsoil below, lighter colored but rich with iron, clay, and minerals. Loess is different; my bedroom walls, carved from a giant heap of mashed-together grit, were uniform from top to bottom.

As every child who plays with mud knows, dust piles are easy to wash away. Silt grains “act like single particles,” said Zheng Fenli, a soil scientist at the Institute of Soil and Water Conservation, in the Loess Plateau city of Yangling. They don’t clump together firmly. If knocked free by flowing water, Zheng told me, silt grains “are very easy to transport.” Washed down steep hills, they can be carried great distances. The Huang He makes a big loop right through the Loess Plateau. It carries an enormous burden of silt—more than any other river in the world—into the North China Plain, China’s agricultural heartland.

Because the plain is flat, the river slows down. As the current falters, the silt in the water deposits on the river bottom and along the banks. The silt replenishes the soil—a main reason for the area’s farming primacy—but it also builds up the riverbed. In consequence, the Huang He rises one to three inches a year. Over time, it has lifted itself as much as forty feet over the surrounding land. When farmers harvesting wheat fields want to see the river, they look *up*. Moving high in the air, the river wants (so to speak) to overflow its banks, spilling into the North China Plain and creating a ruinous flood.

Such disasters have been a threat for millennia—“two breaks every three years and a channel change every century,” the Chinese used to say of the Huang He. But in the eighteenth and nineteenth centuries, erosion drove the breaks and channel changes to be more lethal. In an attempt to subdue the floods, the Qing established a corps of engineers who maintained a five-hundred-mile line of dikes, a network of spillways, locks, and dams, and an array of as many as sixteen secondary channels into which the river could be divided—a hydraulic infrastructure easily as impressive as the Great Wall, and one that was more important to the life of the nation. Not only did the system control a staggeringly complex irrigation network, it connected the river to the Grand Canal, a 1,103-mile passage between Beijing and Hangzhou (a port south of modern Shanghai) that is the longest artificial

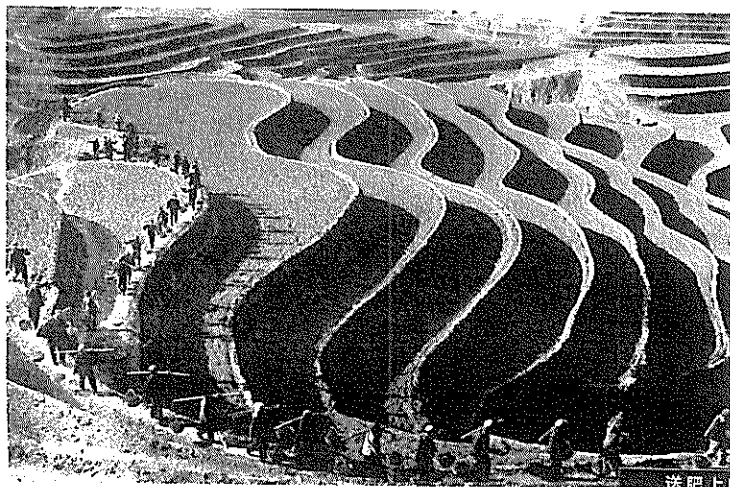
waterway in the world. Qing emperors may have spent 10 percent or more of the imperial budget on the Huang He.

Nonetheless the system was constantly overwhelmed. As the Chinese weather bureau maps show, excess silt made the Huang He spill over its banks a dozen times between 1780 and 1850—about once every six years. All of the floods were huge. One deluge in 1887 was among the deadliest ever recorded; estimates of the dead range up to a million.

The cause of the flooding—deforestation in the Loess Plateau—was well understood. But Beijing did little about it, even though much of the land clearance had its roots in Qing policies, and the floods were blows to imperial legitimacy. The court’s failure to act was not foreordained. Neither was the myopia of the landlords who rented to the shack people. Nobody will ever know whether decisive action could have resolved the nation’s ecological problems, because it wasn’t tried. Instead the floods continued until the dynasty fell, an event the floods had helped to bring about.

Which made it all the more incredible when Mao Zedong ordered *more* land clearing in the Loess Plateau. Most of the region was already deforested, but the steepest slopes—land too steep to farm—were still covered by low, scrubby growth that held back erosion. Exactly this land was targeted in the 1960s and 1970s for conversion, Dazhai style, into terraces. The terrace walls, made of nothing but packed earth, constantly fell apart; in one Loess Plateau village that I visited after a rainfall, half the population seemed to be shoring up crumbling terraces by pounding the walls flat with shovels. Even when the terraces didn’t crumble, rains sluiced away the nutrients and organic matter in the soil. Zuitou, the village, is nestled into steep hills along the Huang He. Walking along the steep paths between *yaodong*, I could almost watch the terraces sliding into the water.

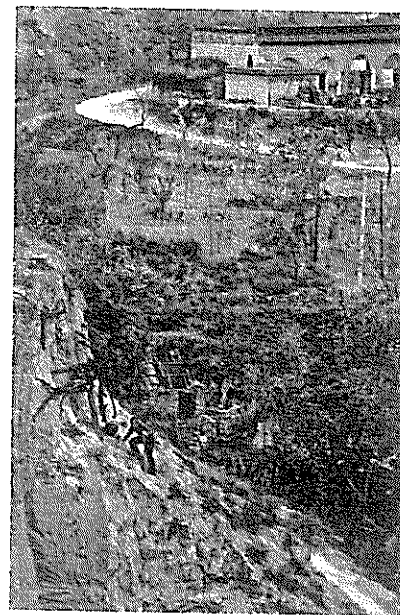
Because erosion removed nutrients, harvests in the newly planted land dropped quickly. To maintain yields, farmers cleared



and terraced new land, which washed away in turn—a perfect example of a “vicious circle,” according to Vaclav Smil, a University of Manitoba geographer who has long studied China’s environment (his first book on the subject, *The Bad Earth*, appeared in 1984). Erosion into the Huang He went up by about a third during the Dazhai era, Chinese researchers reported in 2006.

The consequences were dire and everywhere apparent. Declining harvests on worsening soil forced huge numbers of farmers to become migrants. Zuitou lost half of its population. “It must be one of the greatest wastes of human labor in history,” Smil told me. “Tens of millions of people being forced to work night and day, most of it on projects that a child could have seen were a terrible stupidity. Cutting down trees and planting grain on steep slopes—how could that be a good idea?”

In the most marginal areas farmers planted maize. North of Zuitou, at the edge of the Gobi Desert, I walked around plots of maize growing in almost pure sand. Until the 1960s the region had been covered with thorny forest scrub. Then Mao ordered aggressive planting. It was like forcing people to farm a beach. Astounding to me, the locals had actually coaxed some maize



Beginning in the 1960s, farmers throughout China’s Loess Plateau stripped the forest and carved earthen terraces out of the hills (opposite). Because the loess erodes easily, every rain caused terraces to erode (above); maintenance was a constant issue. Eventually the terraces on the steepest slopes collapsed completely (left), and farmers found themselves trying to eke out a living on hills almost too steep to stand on.

from the sand—drying cobs made little yellow heaps on rooftops and barren yards. On carts hauled by tiny Chinese motorbikes men were driving around piles of maize stalks tall as two-story buildings. In the light wind the air was intensely gritty. The Loess Plateau, which once caught dust from the desert, was now producing it.

The People's Republic had initiated plans to halt deforestation. In 1981 Beijing ordered every able-bodied citizen older than eleven to "plant 3-5 trees per year" wherever possible. Three years before, Beijing had initiated what may be the planet's biggest ecological program, the "Three Norths" project: a 2,800-mile band of trees running like a vast screen across China's north, northeast, and northwest, including the frontier of the Loess Plateau. Scheduled to be completed in 2050, this Green Wall of China will, in theory, slow down the winds that drive desertification and dust storms.

Despite their ambitious scope, these efforts did not directly address the soil degradation that was the legacy of Dazhai. Confronting the destruction was politically difficult, though: it had to be done without admitting that Mao had made mistakes. (When I asked local officials if the Great Helmsman had erred, they politely changed the subject.) Only in the last decade did Beijing chart a new course.

Today many of the terraces Zuitou's farmers hacked out of the loess are reverting to nature. In what locals call the "3-3-3" system, farmers replant one-third of their land—the steepest, most erosion-prone slopes—with grass and trees, natural barriers to erosion. They cover another third of the land with harvestable orchards. The final third, mainly plots on the gully floor that have been enriched by earlier erosion, is cropped intensively. By concentrating their limited supplies of fertilizer on that land, farmers can raise yields enough to make up for the land they have sacrificed—that's the theory, anyway. To help the transition along, farmers are compensated with an annual delivery of grain and a small cash payment for up to eight years. By 2010, the pro-

gram covered more than 56,000 square miles of gully villages, an area the size of Iowa.

At first glance, it seems that a dictatorship would be perfectly suited to accomplish this task. The government can simply order loess dwellers to stop growing millet and plant almonds without worrying about property rights or political protest. It can direct whole villages to go into the hills en masse and plant saplings, millions upon millions of them, in small pits shaped like fish scales. And when the farmers and fields are shifted around, the planners can point to their accomplishments with pride.

Things look different on the ground. Provincial, county, and village officials are rewarded if they plant the number of trees envisioned in the plan, not whether they have chosen tree species suited to local conditions (or listened to scientists who say that trees are not appropriate for grasslands to begin with). Farmers who reap no direct benefit from their work—they are installing trees that do not produce fruit, cannot be cut for firewood, and supposedly stop erosion miles from their homes—have little incentive to take care of the trees they are forced to plant. The entirely predictable result is visible on the back roads of Shaanxi: fields of dead trees, each in its fish-scale pit, lining the roads for miles. "Every year we plant trees," the farmers say, "but no trees survive."

During my visit the lines of dead trees dotted the slopes like contour marks, stretching for miles. The harvest was over, and farmers were about to be marched back in for another try. Tree by tree, the government was trying to undo the accidental legacy of the global silver trade.