"People Said Extinction Was Not Possible:" 2,000 Years of Environmental Change in South China

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-By-

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THE IDEA

The idea of species extinction emerged early in the nineteenth century, not only in Europe, but in China as well. In France, George Cuvier studied the anatomy of fossil remains, and, concluding that some species had indeed become extinct, in 1812 published his findings in *Discours sur les révolutions de la surface du globe*. Rejecting J. B. Lamarck's theory of "transmutation" which purported to explain fossil remains as old forms of existing species, Cuvier argued that great geological catastrophes accounted for extinctions.[1]

In China, one year before the publication of Curvier's book, an official by the name of Deng Bi'nan also wrote about extinctions. While posted in Leizhou prefecture in the south China province of Guangdong, Deng wrote in the "local products" section of the prefectural gazetteer: "Northerners record that Leizhou produced teeth and ivory from black

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[1]Peter J. Bowler, *The Norton History of the Environmental Sciences* (New York and London: W. W. Norton and Co., 1993): 216-17.

elephants, and noted that in Xuwen there were *bao niu* (a kind of buffalo). *The Records of Jiaozhou* [a fourth-century text] say that Xuwen had the giant centipede…[An earlier] provincial gazetteer records that in the wilds of Leizhou deer were plentiful, and that the 'fragrant navel of the civet' could substitute for musk-deer…Today these do not exist [*wu zhe*]."[2]

Although both Cuvier and Deng had come to understand that entire species could vanish, they had come to that understanding in rather different ways, and they had quite different explanations for extinctions too. Like other European naturalists, Cuvier had been examining the stratifications in fossil records, in his case, from areas around Paris, and was seeking explanations for the observed changes. His "catastrophic" explanation soon gave way, via Charles Lyell in England, to a more gradualist explanation that located the processes of species extinction as "part of the normal operation of Nature."[3] Although Lyell did not posit a mechanism by which species became extinct, in 1859 Charles Darwin did with the publication of *On the Origin of Species*: evolution as a product of natural selection brought upon by competition and the struggle for existence. Influenced by Malthus' *Essay on Population*, Darwin arrived at "a theory of evolution by ecological replacement. As he put it, he had arrived at 'the absolute knowledge that species die and others replace them.'"[4]

Despite the differences among nineteenth-century European scientists, they all tended to assign "natural" causes to the extinction of species.[5] Not so Deng Bi'nan. Deng articulated a relationship of living things to "the land:" "Because local products come from the land [and

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[2]*Leizhou fuzhi* (1811 ed.): juan 2: 67a-b. The modern concept of "species extinction" was not available to Deng, so he used what was available to him in Chinese: the term "*wu zhe*." "*Wu*" used alone means "without, apart from, none," but its antonym is "*you*," meaning "to have, to exist." As the opposite of "to exist," "*wu*" thus meant "to not exist." And by adding the suffix "*zhe*" to "*wu*," forming "*wu zhe*," Deng created the term "those that do not exist." Whether Deng also had available to him a Chinese taxonomical concept of "species" is an open question.

[3]Bowler, 283.

[4]Donald Worster, *Nature's Economy*, second edition (Cambridge and New York: Cambridge University Press, 1994): 159.

[5] Lyell did acknowledge the role of humans as disturbers of nature, but as "compared to the environmental changes caused by geological forces, the impact of man on the earth's ecology has been negligible, he maintained." Worster, 142. The most forceful early statement on the human impact on the environment came in 1864 with George Perkins Marsh's groundbreaking book, *Man and Nature*. Bowler, 318.

because there are changes in the land], the local products too change over time. Of the common ones mentioned in the ancient texts, just 80-90% exist today; of the rare ones, just 20-30% survive. [Today], there is no land that has not changed, so the times are no longer the same either."[6] The various plants and animals in Leizhou, Deng was saying, are connected with "the land," and as there were changes in the land, Deng reasoned, so too were there changes in the plant and animal community, sometimes leading to extinction.

Darwin too offered an ecological explanation for the origin (and disappearance) of species: those that adapted better to the environment flourished. But Dawrin seemed to have a view of a more or less static environment: what changed was the rise of new species competing for existing environmental niches. "As these new forms continued to arise," the historian Donald Worster summarized, "some old species and most of the new ones become extinct, for the number of places in the polity of nature is not indefinitely great."[7]

Deng Bi'nan, on the other hand, saw environmental change, or as he put it, "changes in the land," as the force driving species extinction. The question, of course, is what caused those "changes in the land"? Deng did not have to state it explicitly, for the world in which he was living provided ample evidence for the cause of the changes: human activity. What this paper will explore is the 2,000 year history of human changes to South China, revealing a history in which virtually every inch of the landscape had been worked and reworked by human hands, a history that was palpable to Deng Bi'nan: "Today, there is no land that has not changed." Significantly, Deng's evidence for extinctions came from the written record, not the fossil record. Unlike Europeans, whose connection with their past was discontinuous and marred by the "dark ages," literate Chinese of the Qing dynasty (1644-1911) were connected to their three-millenia past via written records. And it was Deng's reading of these written records regarding the area of his posting that led him to conclude, contrary to what others believed, that anthropogenic changes in the land had led to extinctions.

THE LAND

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[6] *Leizhou fuzhi* (1811 ed.): juan 2: 67a-b.

[7] Worster, 158.

This paper deals with environmental changes in that part of China known historically as "Lingnan." Lingnan is the region of South China stretching from Hainan Island in the south to the Nanling mountain range in the north; Lingnan means "south of the mountain range," which it is. Roughly speaking it is the area within a two hundred mile radius of Hong Kong (see Figures 1 and 2), and is nearly coterminous with Guangdong and Guangxi provinces.[8]

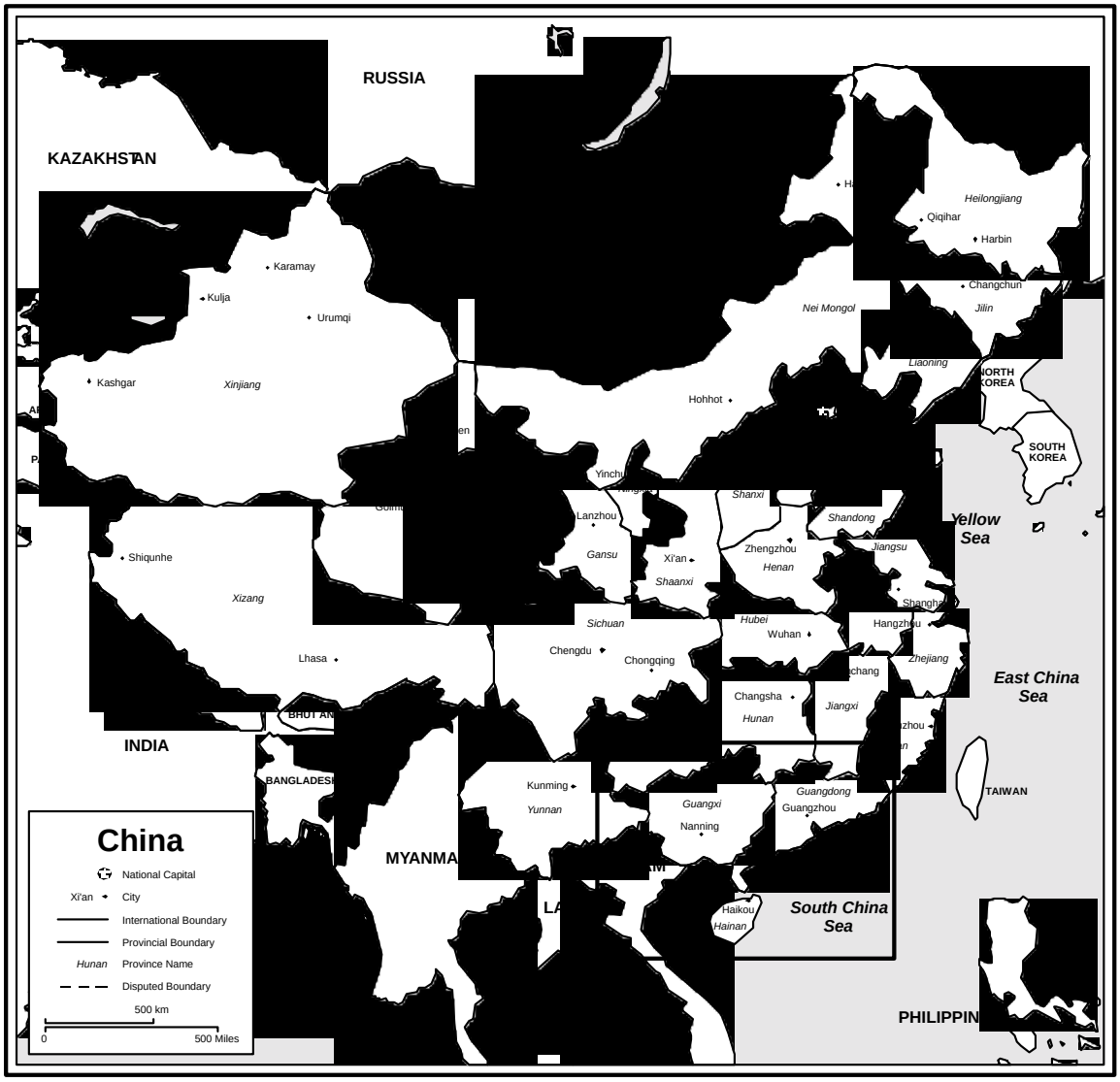

Fig. 1 South China ca. 2000

[8]Although small parts of these provinces lie outside of the Lingnan macroregion as defined by Skinner, for our purposes here the areas are basically the same.

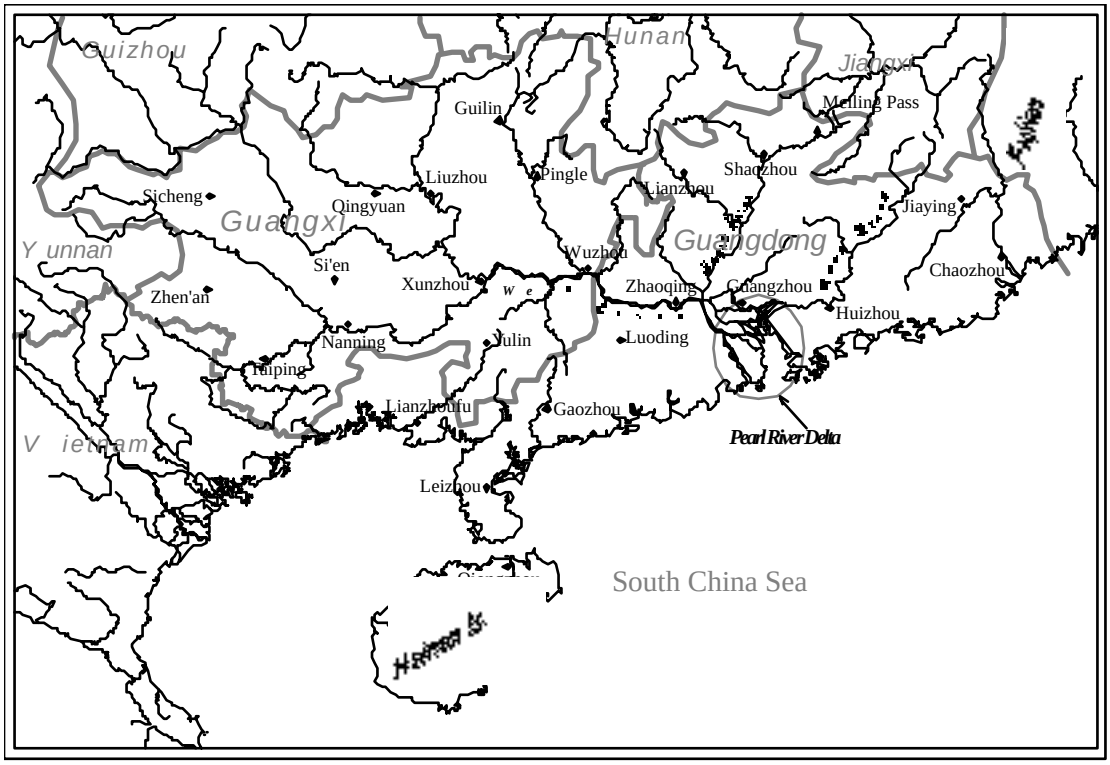

Fig. 2 South China ca. 1820

Climate. The present climate of Lingnan is classified broadly as subtropical to tropical; Guangdong and Guangxi provinces straddle the Tropic of Cancer, while the more southerly positioned Leizhou peninsula and Hainan Island have a tropical climate.[9] Current monthly mean temperatures range from about 10˚C to 30˚C, and plentiful rainfall (about 1600 mm annually) falls mostly during the agricultural growing season. Although the region is not frost free, the growing season ranges from 250 to 320 days (10˚C is the minimum temperature for growing rice).[10]

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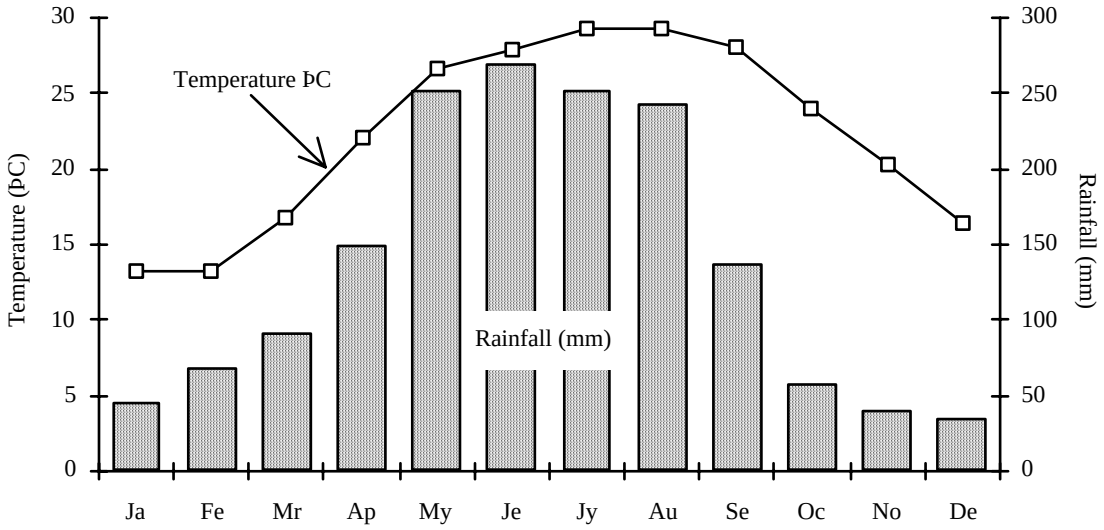
[9]The climate of south China has changed over the past two thousand years, but that story is not immediately relevant to the issues being discussed here. For those interested in climate change and its impact upon south China, see my book, *Tigers, Rice, Silk, and Silt: Environment and Economy in Late Imperial South China* (New York, Cambridge, and Melbourne: Cambridge University Press, 1998), especially chapters 2, 4 and 6.

[10]In northern Guangdong province, because of higher altitudes and exposure to cold currents in the winter, there are only about 225 frost-free days, and the growing season is hence shorter. See International Rice Research Institute, *Rice Research and Production in China* (Los Banos, Philippines: IRRI, 1979): 25.

Fig. 3 Mean Monthly Temperature and Rainfall at Guangzhou



Source: International Rice Research Institute, *Rice Research and Production in China* (Los Banos, Philippines: IRRI, 1979): 25.

The monsoon brings considerable amounts of rain to Lingnan, ranging from over 2,000 mm in Hong Kong on the coast to 1,300 mm in Wuzhou and 1,700 mm in Guangzhou. By any standards, that is a lot of precipitation. Not only is there a lot of rain, it is concentrated in just five or six months of the year, from April through October. Since neither evaporation nor soil permeability or retention could contain the vast quantities of water that falls upon Lingnan, it runs off the folded surface of the land and fills the natural lines of drainage. As Fenzel succinctly and aptly concluded, "consequently, extended river systems had to develop themselves in order to ensure the removal of the water."[11]

River Systems. Lingnan's "extended river systems" consist primarily of three rivers—the East, the North, and the West—which converge in the Pearl River delta and then empty into the South China Sea (see Fig. 2). The West River drainage basin is the largest and most important, followed by the North and the East Rivers. The catchment basins and the structure of these major river systems conform to the topography of Lingnan, with most of the river systems contributing to the flow of water into the Pearl River. Shorter, smaller rivers in southwest Lingnan flow directly into either the South

[11]G. Fenzel, "On the Natural Conditions Affecting the Introduction of Forestry as a Branch of Rural Economy in the Province of Kwangtung, Especially in North Kwangtung," *Lingnan Science Journal* 7 (1929): 72.

China Sea or the Gulf of Tonkin. While the West River system constitutes the largest drainage in Lingnan, in comparison with other drainage systems in the rest of China, it ranks third behind the Yellow and Yangzi River systems.

Linkages to the Yangzi River System. The Lingnan river system was such an important part of the transportation system of the entire Chinese empire that from very early times links were established between it and the Yangzi River valley. The earliest was the construction of the Ling Qu canal connecting the upper reaches of the southward-flowing Li river above Guilin with the Xiang River, which flowed north through Hunan province and into the Yangzi River. Built initially around 230 BCE by Shi Lu, an engineer in Qin Shi Huangdi's army, the Ling Qu was (and remains) a masterpiece of ingenuity. Even an extended description of the Ling Qu canal cannot do justice to the way in which the Xiang and Li Rivers were connected, so suffice it to say that Joseph Needham translated the character in its name (*ling*) as "magic," rather than the less grandiose but still apt "ingenious." Used first to transport troops and warships into Lingnan, the Ling Qu was later used to transport goods to and from Lingnan from north China via the Yangzi River.[12]

Another important linkage to the Yangzi River valley was the Meiling Pass in northern Guangdong, connecting with the Gan River to the north in Jiangxi. The Meiling Pass in fact had been "chiseled" (*zao*) by human labor during the Tang dynasty (in 716 CE) under the leadership of the engineer and state minister, Zhang Jiuling. A native of Shaozhou in northern Lingnan, a place some 90 miles southwest of the pass, Zhang ascended the ranks of the Tang bureaucracy and ultimately found himself positioned to be able to "improve" the pass, the main link between the Yangzi River valley and Lingnan. As might be imagined, the path over the Meiling Pass originally had been a single, rugged mountain trail winding over steep precipices. As Zhang Jiuling described it, Meiling was

> Formerly, an abandoned road in the east of the pass,
> Forbidding in the extreme, a hardship for men.
> An unswerving course; you clambered aloft
> On the outskirts of several miles of heavy forest,

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[12] Joseph Needham, *Science and Civlization in China*, vol. 4 part III, *Physics and Physical Technology: Civil Engineering and Nautics* (Cambridge: Cambridge University Press, 1971): 299-306.

With flying bridges, clinging to the brink
Halfway up a thousand fathoms of layered cliffs…[13]

As trade between Lingnan and areas to the north picked up after the Tang re-established political unity and stability in the seventh century, the amount of silk and porcelain flowing into Lingnan increased, as did exports of furs, pelts, incense, and medicinal herbs. With more trade, the need to improve the route over the Meiling Pass arose, and in 716 CE state minister Zhang Jiuling began to cut a less steep, broader gradient over the Meiling Pass, lowering the solid rock by some twenty yards to create a pass about three yards wide. Not only did Zhang "chisel" the pass through solid rock, he paved the road on either side with small stones. Although the pass was not a waterway, it did effectively link the Gan River in Jiangxi with the North River in Lingnan. According to Ye Xian'en, the Tang "opening" of the Meiling Pass reoriented shipping routes in Lingnan: the North River became increasingly busy, while the former route through the Ling Qu canal in Guangxi fell into disuse.[14]

Land Cover. Given the virtual absence by the twentieth century of any natural forest, reconstructing what kind of forests originally (i.e. some 2,000 years ago, before human populations dramatically altered the environment) might have covered Lingnan is not easy, requiring botanists to examine climatic conditions, compare conditions in Lingnan with regions elsewhere in the world, investigate the few, inaccessible mountain areas where forest still stood, consult historical records, and conduct field experiments. While much uncertainty remains, to date the most extensive considerations of the issue have been conducted by Wang Chi-wu[15] and by Chinese scientists whose synthesized findings were published in 1982.[16] According to these studies, the original forests of Lingnan included three main types: (1) an evergreen broad-leafed forest composed mainly of evergreen oaks (and associated trees like the laurel), which grew on the inland hills of northern Guangdong and throughout much of Guangxi ; (2) a tropical rain forest, growing in the lower elevations (below 100 m.) in the

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[13]Translated and quoted in Schafer, *The Vermilion Bird*, 22.

[14]Ye Xian'en et al., *Guangdong hang yun shi* (Beijing: Renmin jiaotong chuban she, 1989): 51-53.

[15]Wang Chi-wu, *The Forests of China* (Cambridge: Harvard University, 1961). See also the summary of Wang's work in S. D. Richardson, *Forests and Forestry in China* (Washington DC: Island Press, 1990): chapter 2.

[16]*Zhongguo ziran dili*, vol. 10., *Lishi ziran dili* (Beijing: Kexue chuban she, 1982).

southern parts of Guangdong and Guangxi, and on Hainan Island, composed of many species of straight-trunked trees forming a high canopy above the forest floor; and (3) a littoral forest on the coast, including mangrove swamps submerged in brackish water. Lingnan 2,000 years ago, in short, was covered by tropical and semi-tropical rainforests.[17]

THE PEOPLE

The Original Inhabitants. Lingnan was inhabited first not by Chinese but by other peoples. To be sure, Chinese had settled in Lingnan as early as the creation of the first Chinese empire by the Qin (ca. 221 BCE), albeit in small numbers, but even then they were invading territory inhabited for millennia by various non-Chinese groups. In the lowlands of the river valleys and along the coast were various Tai peoples, the largest group now called the Zhuang, with a smaller group called the Li in the littoral belt on the Leizhou peninsula and the coastal strip on Hainan Island.[18] Over the centuries extensive interaction between Han Chinese conquerors and settlers and the Zhuang and the Li, from intermarriage to trade and learning the Chinese language, if not actually adopting Chinese cultural practices, rendered some of the aboriginal peoples less alien than others, giving rise by the Song to the distinction between the "cooked" (*shu*) and the "raw" (*sheng*) Li or Zhuang, the former refering to those who had accepted Chinese overlordship, the latter to those still beyond the influence of Chinese culture.[19]

Where the Zhuang and the Li were aboriginal in the sense of being the original human inhabitants of Lingnan, at least as far as is now known, other peoples migrated into Lingnan in later periods and were seen by the Chinese as "barbarians" (*man*), and later historians sometimes mistook that Chinese characterization as meaning "aborigines." The most important of these other immigrants into Lingnan were the Yao. Dating their arrival in

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[17]For more detail on the natural environment, see *Tigers, Rice, Silk, and Silt: Environment and Economy in Late Imperial South China* (New York, Cambrdige, and Melbourne: Cambridge University Press, 1998): ch. 2.

[18]For a history of the Li on Hainan Island, see Anne Csete, *A Frontier Minority in the Chinese World: The Li People of Hainan Island from the Han through the High Qing* (Ph.D. dissertation: State University of New York at Buffalo, 1995).

[19]Taiwan is another case where these categories applied; see John Robert Shepherd, *Statecraft and Political Economy on the Taiwan Frontier, 1600-1800* (Stanford: Stanford University Press, 1993): 7-8.

Lingnan is controversial, some placing it in the Han and others in the Yuan or even Ming. The latest Chinese assessment is that the Yao first migrated in small numbers during the Han dynasty, but came from the north in larger numbers in the tenth century during the wars that gave birth to the Song dynasty.[20] Whenever they first arrived, by the Ming the Yao had successfully colonized the uplands of northern Lingnan. In his mid-seventeenth century work on strategic geography, Gu Yanwu lists by name each of the mountains that the Yao had occupied: 106 in Qingyuan *xian*, or 41 in Xinyi *xian*, for instance.[21]

Whenever the Yao arrived in Lingnan, their preferred habitat was the hills and mountains where they organized themselves into villages, or at best into groups of villages that might be called tribes, who practiced slash-and-burn, shifting agriculture. In contrast, the lowland Tai peoples grew wet rice,[22] cast bronze, wove silk, and by about 300 BC had organized themselves into a state called Yue. With a state system and knowledge of sericulture and metallurgy, the Tai were the only people whom the Chinese did not consider barbarians (*man*). But that did not prevent the Qin from conquering them, which they did over a period of years (234-222 BCE). The Tai ruling elite fled south to organize another state in Thailand, leaving behind the Tai agriculturists in the lowlands.

How many indigenous people inhabited Lingnan before it was brought under control of the Chinese empire, and thus before Chinese began settling there, is not known. If the average density was as low as one person per square kilometer, then there may have been about half a million people in Lingnan around 200 BCE. In the Han dynasty (220 BC-200 CE), a 2 CE count of households (adjusted for the boundaries of Lingnan) placed the total at 72,000 households, or 350-400,000 people, depending on assumptions about household size.[23] Citing earlier studies, Harold Wiens

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[20]Mo Naiqun ed., *Guangxi nonye jingji shi gao* (Nanning: Guangxi minzu chuban she, 1985): 24.

[21]Gu Yanwu, *Tianxia junguo li bing shu*, part three (xia) of the Guangdong section: 11a-17b.

[22]Indeed, among the earliest pieces of archeological evidence indicating that rice was cultivated comes from coastal Haifeng county. See *Archeological Discovery in Eastern Kwangtung: The Major Writings of Fr. Rafael Maglioni (1891-1953)* (Hong Kong: Hong Kong Archeological Society, 1975): 23-24.

[23]The population figures are given as "households" (*hu*) rather than "people" (*ren*) or "mouth" (*kou*) because the count of households is generally considered to have been

thought that the Han totals included both the few Chinese who had settled in Lingnan and the indigenous people, although the total omitted significant numbers of non-Chinese.[24] A guess at a half million thus is not unreasonable.

Predating (or concurrent with, in the case of the Yao) Chinese settlement of Lingnan, then, the half-million or so non-Chinese peoples had developed two different agricultural regimes, one for the lowlands and one for the uplands.[25] In the lowlands, the Tai planted wet rice, maybe in paddies and maybe in the same plot year after year, while in the uplands the Yao slashed and burned their way through the hills, probably waiting 20-25 years before burning them once more (swidden will be discussed more below), and on the coastal littoral and Hainan Island, Li peoples pursued a more desultory approach to growing food.

Chinese Migrants. Chinese migration into Lingnan came in three principal waves, the first a small one following the Qin subjugation of the Yue kingdom around 225 BCE when some hundred thousand or so troops occupied Lingnan and then intermarried with local Tai women. The second wave came in the early fourth century when nomadic tribesmen invaded north China and sacked the Chinese imperial capital at Loyang, bringing on the "Yongjia Panic" when inhabitants of north China fled south. The third wave began similarly in the twelfth century when central Asians—this time the Jin armies (predecesors of the Mongols)—in 1126 CE took the Song capital in Kaifeng, forcing the Song to relocate their capital south of the Yangzi River in Hangzhou; this third wave continued in the 1270s when the Mongols began their push to conquer all of China.[26] As many historians

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more accurate than *ren* or *kou*. The purpose here in any event is to gain a perspective on the movements in population, a purpose served just as well by enumerating households as people. For those interested in population estimates, it is not unreasonable to assume each household to have been comprised of 5-6 people. For a discussion, see Robert Hartwell, "Demographic, Political, and Social Transformations of China, 750-1550," *Harvard Journal of Asiatic Studies* 42:2 (Dec. 1982): 369.

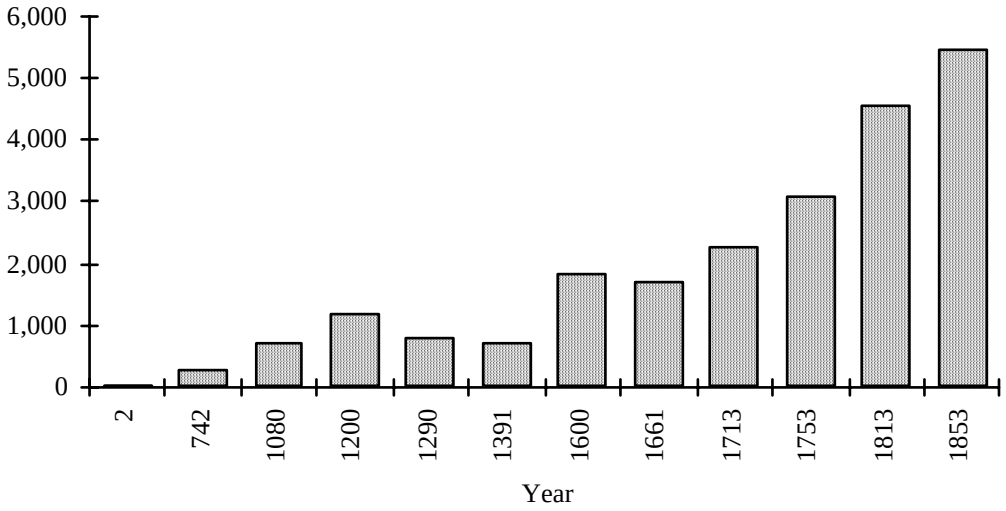
[24]Harold J. Wiens, *Han Chinese Expansion in South China* (The Shoe String Press, 1967): 180-81.

[25]This classification was first suggested by George Moseley, *The Consolidation of the South China Frontier* (Berkeley and Los Angeles: University of California Press, 1973): 12.

[26]For a brief discussion, see Li Zhuanshi et al. eds., *Lingnan wenhua* (Shaoguan: Guangdong renmin chuban she, 1993): 171-205. Li et al. also claim a fourth wave of

have noted, when northern nomadic invaders pressed south of the Great Wall, they set off a chain reaction wave of Chinese migration south.[27] Many of those fleeing the war and disorder in the north found their way through the Nanling passes and into Lingnan.

Fig. 4 Estimated Population of Lingnan, 2-1853 CE



Taking a *tour d' horizon* of Lingnan's population over the eighteen centuries from 2 to 1800 CE, we can see the impact both of the waves of in-migration and of war (see Fig. 4). From the Han (2 CE) to the Tang (742 CE), the population had fluctuated higher and lower than the Han figure of 72,000 households, probably reaching a nadir late in the third century, from which the population increased by the Tang (in the eighth century) to 319,000 households, largely as a result of in-migration from the north. The population growth over the three centuries from the Tang to the Song (742 to 1080) most likely was the result not of much in-migration but of the rate of natural increase in the base population. My estimate for the population in 1200 may well be low, given the massive influx of refugees after the 1126

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immigrants arrived in the late Ming, but cite no evidence to support the claim; I have not found any either, and so do not include it here.

[27]The Russian historian L. N. Gumilev has suggested that the movements of central Asian nomads across the steppe were caused mainly by changing patterns of rainfall in central Asia: "It is easy to understand what an enormous part such changes in steppe climate played in the history of the nomads of Eurasia. Livestock cannot live without grass, grass cannot grow without water, or nomads exist without livestock. Consequently, all these form a single system in which the key link is water." L. N. Gumilev, *Searches for the Imaginary Kingdom of Prester John*, R. E. F. Smith trans. (New York: Cambridge University Press, 1987): 23.

Song loss of their capital in Kaifeng. Whatever the population may have been at the peak of the southern Song around 1200—and it certainly was higher than it had been in 1080—it declined substantially after the Mongols subdued south China in 1278, and again a century later during the establishment of the Ming dynasty. Following the population rise and decline during the Ming dynasty, population started rising again by the late 17th century.

By 1850, the population of Lingnan had gone through three great waves. In the first, beginning from the time of the first recorded human settlement in Lingnan in 2 CE, population increased to a peak around 1200 in the Southern Song, after which the Mongol invasions sent population declining until about 1400 when peace returned to China under the Ming dynasty. Relative to the population peak in the southern Song, Lingnan in 1400 had become relatively depopulated, and had reached a low point from which population increased slowly but steadily for another 250 years. The second wave thus corresponds mostly to the Ming dynasty, with population declining by a quarter to a third in the mid-seventeenth century because of the wars, epidemics, and famines attending the transition to the Qing dynasty. The third wave began in the late seventeenth century when peace once again returned and the population started growing, by 1700 surpassing previous levels and never declining to pre-1600 levels again. Indeed, the third wave is not yet complete, with population increasing still, and probably continuing until well into the 21st century.

THE DELTA

For the first millennium after Chinese settlers moved into Lingnan, what we now call the Pearl River delta and know as one of the most agriculturally rich and productive regions of China, second only to the Yangzi River delta, was not yet a delta, but in fact still was open sea, albeit a fairly shallow bay. Residents of Guangzhou, then called Nanhai, or "the south sea," looked out onto a bay dotted with islands, probably appearing much the way the South China sea looks today from Repulse Bay on the back side of Hong Kong Island.

To be sure, silt carried downstream in the West, North, and East Rivers had been settling out in the bay, slowly creating the upper reaches of the delta. But because the silt content of these rivers was exceptionally low,

the natural processes by which the delta was being created worked extremely slowly. Then, beginning in the eleventh century (during the Song dynasty), the delta began to grow more rapidly, and in the fourteenth century (during the Yuan dynasty) accelerated even faster. The series of four maps of the Pearl River delta (see Fig. 5), chosen to correspond with the dates for which we have population data, shows the build-up of the delta. During the seven centuries from the Han to the Tang, the delta barely changed with the bay remaining filled with water. By the Song dynasty, however, enough of the delta had emerged south of Guangzhou to block the view of the ocean, and by the Yuan dynasty alluvial sand bars appeared off the coast of Dongguan where the East River emptied into the bay. Certainly, though, the largest increases in the size of the Pearl River delta occurred from the Yuan dynasty on. Where virtually no change had occurred in the nine centuries after the founding of the Han, in the 300 years from 1290 to 1582, what had been the island of Xiangshan became connected to the mainland.[28] Both the change in the shape of the delta over time, and the rate of the change itself, are interesting and significant: what accounts for both?

[28]Zhou Yuanhe, "Zhujiang sanjiaozhou de chenglu guocheng." *Lishi dili* (1987.5): 58-69.

Figure 5. The Pearl River Delta, 2-1820 CE

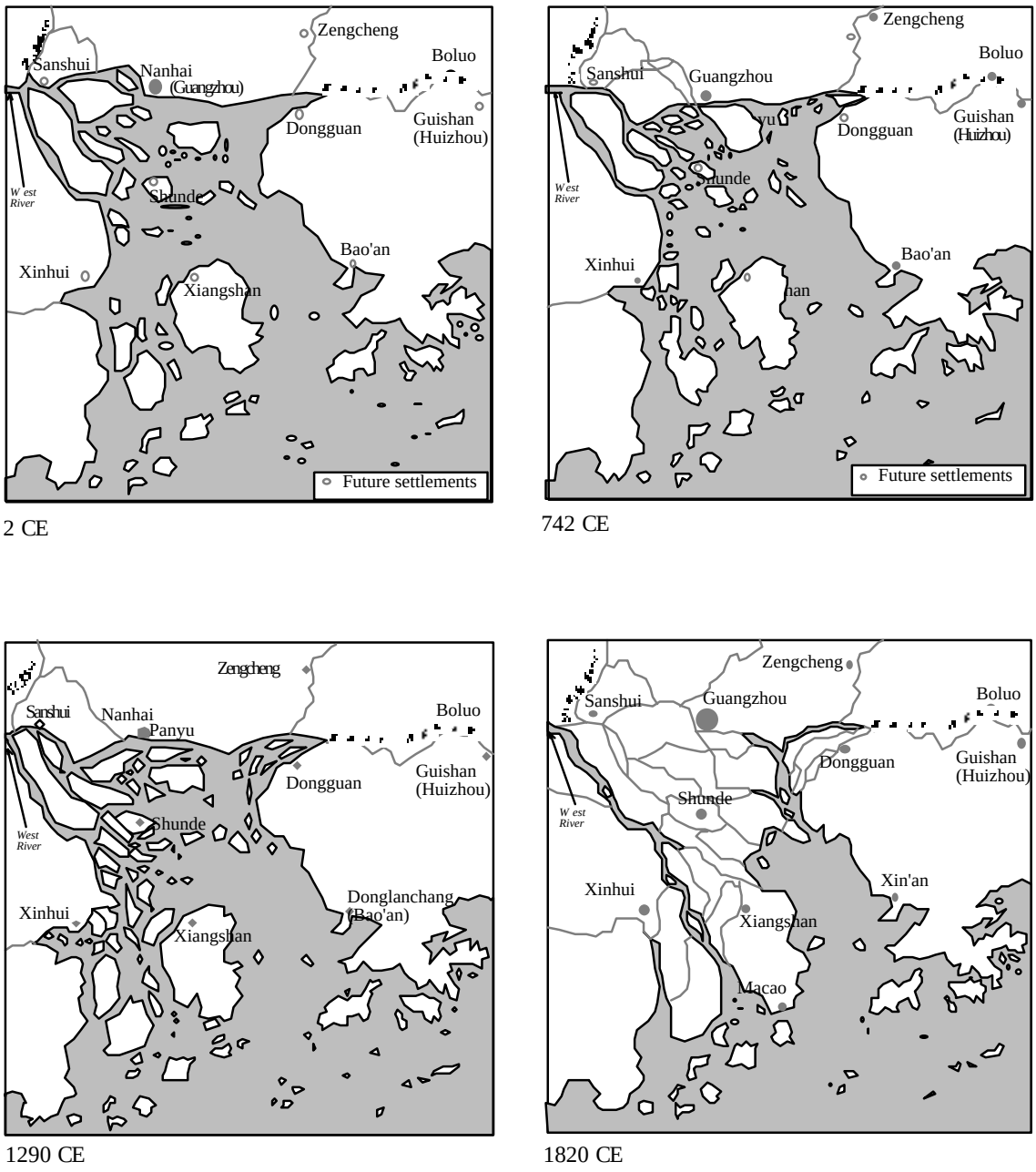

Fig. 5 The Pearl River Delta, ca. 2-1820 CE

Source: Tan Qixiang, editor in chief, *Zhongguo lishi ditu ji* (Historical maps of China) (Shanghai, Ditu chubanshe, 1975-82).

In the title to this section, I referred to the "making" of the Pearl River delta. I chose the word "making" specifically to refer to the action of human

beings, for more than anything else, people made the Pearl River delta. Involved in this story are, in chronological order: the early settlement patterns and agricultural technology of the Chinese in-migrants; the building of water control projects in the lower reaches of the West, North, and East Rivers; the Mongol invasion of south China in the 1270s and the consequent displacement of the Chinese population from northern Guangdong to islands in the Pearl River estuary; and the creation of new lands off the islands in the estuary.

Slash-and-Burn Agriculture. Slash and burn, the earliest and most rudimentary form of agriculture, was practiced in Lingnan until the techniques of wet rice agriculture spread to Lingnan in the eleventh century. When Chinese migrated into Lingnan first in Han times, and later in greater numbers in the fourth century, they settled in the upland areas around Nanxiong and Guilin, rather than near the swamps in the river valleys further south (the reaons for this will be discussed below). Burning off tracts of land, settlers broadcast millet, barley and wheat (and maybe rice) seeds onto the ash, and then harvested a crop for two or three years until the fertility of the soil was depleted. Abandoning the burned-off ground, the settlers then moved on, and a new tract was burned, the process starting over again. The fires must have been impressive, as this eighth-century poem describing the process in Lianzhou in northern Guangdong graphically illustrates:

> Wherever it may be, they like to burn off the fields,
> Round and round, creeping over the mountain's belly.
> When they bore the tortoise and get the 'rain' trigram,
> Up the mountain they go and set fire to the prostrate trees.
> Startled muntjacs run, and then stare back;
> Flocks of pheasants make *i-auk* sounds.
> The red blaze forms sunset clouds far off,
> Light coals fly into the city walls.
> The wind draws it up to the high peaks,
> It licks and laps across the blue forest.
> The blue forest, seen afar, dissolves in a flurry,
> The red light sinks—then rises again.
> A radiant tarn brings forth an old *kau*-dragon;
> Exploding bamboos frighten the forest ghosts.
> In the color of night we see no mountain,
> Just an orphan glow by the Starry Han [milky way]:

It is like a star, then like the moon,
Each after the other, until at daybreak the wind dies away.
Then first comes a light which beats on the stones,
Then follows a heat which glows up to heaven.
They drop their seeds among the warm ashes;
These, born by the "essential heat" [yang],
Burst into buds and shoots.
Verdant and vivid, after a single rain,
Spikes of trumpet vine come out like a cloud.
The snake men chant with folded hands;
Neither plowing nor hoeing involve their hearts.
From the first they have found the temper of this land,
Whose every inch holds an excess of "essential cold" [yin].[29]

Chinese settlers in the north at first adopted the slash-and-burn techniques of the non-Chinese hill peoples, the Yao and Miao, both of whom practiced various forms of slash and burn, shifting cultivation, along with hunting and gathering. Setting fire to forested hillsides during the dry winter months, groups of families then broadcast or drilled seed into the ash, and harvested crops for a few of years. They then moved on to another patch, leaving the depleted ground to return to forest, relocating their encampment as well. Remnants of this system were observed in the early twentieth century, with Yao planting seedlings and leaving the reforested area alone for 20 years after burning it off and planting it for two years.[30] The reason for such a long "fallow," as scientists later learned, is that hillsides burned off too regularly turned into grassland with dense root systems very difficult to break up and plant, unlike the soft, easily poked soils under a forest. Even for agriculture, forest was better than grassland, and the Yao seem to have discovered that.

How much of the original forest the settlers burned off is not at all clear, nor is it clear whether the forest was given sufficient time to recover its composition of broadleaf evergreens before being burned off again, or whether the scrubby *pinus massoniana* took the place of the broadleafs. What does seem to be quite certain, though, is that the slash-and-burn agriculture practiced in the upper reaches of the drainage system opened the

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[29]Liu Yuxin, translated and quoted in Schafer, *The Vermilion Bird*, 54-55.

[30]Fenzel, "On the Natural Conditions Affecting the Introduction of Forestry," 45.

hills to greater erosion and hence to a higher silt content flowing downstream in the West, North, and East Rivers.[31]

Until the eleventh century, much of this silt did not reach the Pearl River delta, but rather was deposited in the flood plains in the lower reaches of the West, North, and East rivers. Much like the end of a garden hose under high pressure, the lower courses of these rivers flopped around from one outlet to another when monsoonal rains sent water gushing through the system, filling the flood plains with silt-laden water. When the flood waters receded, the silt was left behind. Clearly, the flood plains of the lower reaches of these rivers, especially the area near the confluence of the West and North Rivers, thereby contained fertile soils with great agricultural potential. But they had two related problems: flooding and malaria. Before the upper reaches of the future Pearl River delta could become the densely populated, agriculturally rich center of the Lingnan regional economy, the Chinese would have to either change the swampy environment of the flood plains of the West, North, and East Rivers, or else adapt to that environment, for the south Cina lowlands were not hospitable to northern Chinese people.

Malaria. To Chinese from the north, all of Lingnan looked diseased. In the words of an 11th-century writer: "The mountains and rivers of Lingbiao [i.e. Lingnan] are twisted and jungly; the vapors concentrate and are not easily dispersed or diffused. Therefore there is much mist and fog to cause pestilence."[32] As is now known, of course, malaria is caused by a parasite transmitted to humans from a particular kind of mosquito, the *Anopheles*. Because of the linkages among parasite, mosquito, and human host, malaria requires a specific set of environmental conditions to exist, and cannot spread beyond those limits. Malaria thus is not a communicable disease like plague, small pox, or cholera that can spread broadly and fast through human populations regardless of where they reside, but is limited to certain environments.

Tropical forests such as those originally covering Lingnan are especially good breeding grounds for parasites of all kinds. But the particular parasites that cause malaria in humans—several species of the single-celled protozoa belonging to the genus *Plasmodium*—were not there

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[31]This conclusion is reached by Chinese hydrologists in Chen, *Zhongguo ziran dili*, vol. 4: 243.

[32]Liu Xun, *Lingbiao lu yi*, shang: 1.

just waiting for human hosts to invade, but rather arrived with their human hosts when they migrated into south China. To be sure, malaria is found in monkeys, apes, rats, birds, and reptiles, many of which inhabited Lingnan's tropical forests, but these forms are not infectious to humans. Human malaria is a very old disease, not merely evolving with humans, but even influencing the process of natural selection.[33] The disease probably originated in tropical Africa, and only later spread elsewhere with the Neolithic revolution. According to Bruce-Chwatt, the pre-eminent historian of the disease, in Neolithic times the infection established itself in Mesopotamia, India, the Nile Valley (from which it invaded the Mediterranean), and south China.[34] Whether it was brought into Lingnan by the original settlers in the area, or was spread among an indigenous population by later arrivals, is not known. But however and whenever malaria became established among the human population of south China, it was there among the indigenous Tai population long before the first Chinese migrants arrived.

Anopheles mosquitoes carry three species of plasmodium harmful to humans, and each causes a different kind of malaria. Two cause intermittent fevers and are not particularly virulent, even in non-immune populations, but one—the malignant tertian, or pernicious malaria, caused by *p. falciparum*—"is the most dangerous form of malaria."[35] Depending on the parasite, the clinical manifestations of malaria (including fever with or without paroxysm, sweating, and chills, vomiting and diarrhea, anemia, and hardening of the spleen) occur as the brood of the parasite undergo schizogony together.[36] That all three forms of malaria were found in Lingnan is clear from the classification of fevers given by Zhou Qufei in the late 12th century. In the "lighter kind (*qingzhe*), the fevers come and go."

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[33]William H. McNeill, *Plagues and Peoples* (New York: Anchor Press/Doubleday, 1976): 47-48.

[34]From these five foci the disease spread throughout the tropics and into temperate climates. For Bruce-Chwatt's use of the term "South China" I have substituted "Lingnan." L. J. Bruce-Chwatt, "History of Malaria from Prehistory to Eradication," in Walther H. Wernsdorfer and Sir Ian McGregor, *Malaria: Principles and Practice of Malariology* (Edinburgh and London: Churchill Livingstone, 1988), vol. 1: 3. By the end of the nineteenth century, malaria covered two-thirds of the world, becoming (and remaining) what many consider to be "the most important disease in the world." Brian Maegraith, *Adams and Maegraith: Clinical Tropical Diseases* (Oxford and London: Blackwell Scientific Publications, 1989): 201.

[35]Maegraith, *Clinical Tropical Diseases*, 201.

[36]Maegraith, *Clinical Tropical Diseases*, 210-20.

In the "serious kind (*zhongzhe*), there is only fever and no chill." And in the "really serious kind (*geng zhongzhe*), fever continues without letting up."[37] Zhou may have been in error about ranking the severity based solely on the periodicity of fever, but clearly he identifies three kinds of fever, all consistent with scientific understandings of malaria. Which of the three was predominant in Lingnan can only be guess work, but given what is known about the general epidemiology of the parasites and the fact that the malaria in Lingnan was often fatal to newcomers in the region, *p. falciparum* probably was the most prevalent.

With rainfall coming in the spring and summer when temperatures were in the range considered optimal for mosquitoes to breed, with pools of water forming in depressions in the earth's surface but especially in the swamps left by the annual flooding of the river systems, and with relatively high humidity, both the parasite and the anopheles mosquito could flourish in Lingnan.[38] Since the parasite lived in both the mosquito and in humans, the environmental conditions which brought both into contact provided the environment for malaria. Human beings, as a host to the parasite, thus are a prerequisite to the existence of malaria: no humans, no malaria.[39]

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[37]Zhou Qufei, *Lingwai dai ta*, juan 4:3b-4a.

[38]For a discussion of the general conditions favorable for anopheles, see L. Molineaux, "The Epidemiology of Human Malaria as an Explanation of Its Distribution, Including Some Implications for Its Control," in Walther H. Wernsdorfer and Sir Ian McGregor, *Malaria: Principles and Practice of Malariology* (Edinburgh and London: Churchill Livingstone, 1988), vol. 2: 915.

[39]Although it seems a simple proposition that mosquitoes breed in warm, wet surroundings, and thus that malaria should exist nearly everywhere where those conditions prevail and people live, nature is not that simple. Indeed, the issue is so complex that scientists still cannot pinpoint the precise conditions which breed the anopheles mosquito. Indeed, even the particular species of anopheles responsible for malaria has been shown to be six "sibling" subspecies, only two of which carry plasmodium and infect humans. The plasmodium-carrying "siblings" are nearly indistinguishable from other *Anopheles maculipennis* except for laying their eggs separately upon the surface of water rather than in "rafts." Certainly differences in mosquito habitat—however minute—have favored one kind of reproductive strategy over the other. Variables such as whether the water is standing or moving, the amount of sunlight or shade, the presence of gases or minerals dissolved in the water, and the salinity of the water, all affect whether or not the anopheles mosquito will breed. Other factors include competition for habitat by other species of mosquitoes, such as the non-threatening *culex,* and predation by insects and fish. Those caveats aside, though, it seems that the anopheles tends to favor stagnant water: small pools of water formed after rains, or the swamps left after floods. See Marston Bates, "Ecology of Anopheline

That malaria was prevalent throughout much of Lingnan is certain, as Liu Xun's comment above makes clear. Some areas were known as being particularly virulent, such as around Qingyuan up the North River from Guangzhou. Other places mentioned malaria in the "climate" section of their gazetteers, such as Chaozhou in eastern Guangdong where malaria was prevalent in the hills.[40] But it was also apparent to Chinese observers that malaria was not found in all areas of Lingnan. In the Song dynasty toward the end of the twelfth century, for instance, Zhou Qufei could write: "Not all deep[ly forested] and wild (*shen guang*) places in Ling[nan] are necessarily malarious. For example, Qiongzhou on Hainan Island and, on the north side of the sea [i.e. on the mainland across from Hainan] are described as *shen guang*, but there is little malaria." But other *shen guang* places—Nanning, Yulin, Qinzhou, and Guiping (all in Guangxi)—all had it.[41] Although malaria had spread to Hainan Island by the nineteenth century, even in the fifteenth it was still described as a place free of malaria. The littoral belt of southwestern Guangdong (or at least part of it)—described by Gu Yanwu as an area with "very little malaria"[42]—was still free from malaria in the late nineteenth century.[43] The area around Guilin seems to have been free of malaria: according to Fan Chengda, writing in the twelfth century, "everywhere south [of Guilin] is the home of malaria."[44] Northern Guangdong province, in particular Nanxiong, Lianzhou, and Shaozhou prefectures, also was free of malaria. Local ecological factors,

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Mosquitos," in Mark Boyd ed., *Malariology* (Philadelphia and London, 1949): 302-330; Richard Fiennes, *Man, Nature and Disease* (London: Weidenfeld and Nicholson, 1964): 77; L. Molineaux, "The Epidemiology of Human Malaria as an Explanation of Its Distribution, Including Some Implications for Its Control," in Walther H. Wernsdorfer and Sir Ian McGregor, *Malaria: Principles and Practice of Malariology* (Edinburgh and London: Churchill Livingstone, 1988), vol. 2: 916.

[40]*Chaozhou fuzhi* [1762], juan 2:1b, 4b.

[41]Zhou Qufei, *Lingwai dai ta*, juan 4:2b-3a.

[42]Gu Yanwu, *Tianxia junguo li bing shu*, juan 98: 28a.

[43]"The earliest Customs Records for Pakhoi [Beihai] (1889) state that there was no malaria there and that there was not likely to be any outbreak since the Pakhoi peninsula consisted of dry sandy ground." Ernest Carrol Faust, "An Inquiry into the Prevalence of Malaria in China," *The China Medical Journal* vol. xl no. 10 (Oct 1926): 938-56. Four years later, though, there was.

[44]Fan Chengda, *Gui hai yu heng zhi*: 28a, translated and quoted in Schafer, *The Vermilion Bird*, 132.

such as elevation,[45] played the critical role in accounting for the presence of malaria in one area or its absence in another, even if we cannot now be sure exactly what those ecological differences were.

The northern Chinese fleeing the various barbarian invasions understood neither the causes of malaria, nor the environmental link to the mosquito, but they did have enough knowledge of where the disease was and where it wasn't to guide decisions about where to settle—and where to remain. Most came to Lingnan via either the Meiling Pass or the Ling Qu canal, and then settled in northern Guangdong and Guangxi provinces. This was in part because those were the first regions "south of the mountains" they encountered, and in part because those regions were free of malaria. Once settled, they tended to remain there, and the primary reason given was fear of malaria in other parts of Lingnan. According to the genealogies of several lineages that trace their roots to Nanxiong, during Song times fear of malaria kept them from migrating elsewhere in Lingnan, even in the face of mounting population pressure in northern Guangdong.[46]

In the south part of Lingnan, significant Han Chinese population densities were found not in the Guangzhou region, but along the largely malaria-free southwestern littoral, including the Leizhou peninsula and the areas to its east and west. As noted earlier, Guangzhou prefecture was not initially the most densely populated part of Lingnan, despite the fact that by the Ming dynasty it (in particular the Pearl River delta) was to become the core of the Lingnan macroregion. Certainly one possible explanation for the reticence of Chinese immigrants to settle the Pearl River delta was malaria. In terms of its original physical environment, the flood plains in the lower reaches West, North, and East rivers seem to have been nearly ideal for the anopheles mosquito. In other parts of the world where the mouths of rivers created deltas and swamps, malaria thrived, such as in the south of France and in much of Italy.[47]

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[45]J. R. McNeill has found that in the Mediterranean, malaria did not extend above 500 meters above see level. See J. R. McNeill, *The Mountains of the Mediterranean World: An Environmental History* (New York: Cambridge University Press, 1992): 350. More research needs to be conducted to determine the elevations in Lingnan above which malaria ceased.

[46]Chen Lesu, "Zhujigang shi shi," [Guangdong] *Xueshu yanjiu* 1982, no.6.

[47]Bruce-Chwatt, "History of Malaria from Prehistory to Eradication," 12-13. In a malaria epidemic in 1865 in Mauritius, according to Scott: "The sequence was similar to that which is seen to occur in other tropical regions at the present day. Low-lying,

Settlement patterns also provide indirect evidence that malaria existed in the flood plains in the lower reaches of the West and North Rivers.[48] Malaria cannot exist without human hosts to provide a "reservoir of malaria infection,"[49] so areas uninhabited by humans thus could not have been malarial. As noted above, an indigenous population of Tai peoples lived in the river valleys and along the coast,[50] providing the infectious reservoir of humans that allowed malaria to become endemic: uninfected *anopheles* mosquitoes picked up the parasite from an infected human and passed it along to a person uninfected or not recently infected. Interestingly, though, communities in which malaria is endemic also develop a certain immunity to the disease.[51]

The indigenous Tai population of Lingnan, especially those who lived in the lower reaches of the river valleys, thus would have acquired a certain

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badly drained areas near the coast became converted into swamps by the heavy rains. This condition would vary in extent and duration with the nature of the soil, the amount of slope, the drainage and the rainfall, but would usually persist for several weeks and the swamps became the home of innumerable insects. Among the first to breed would be the mosquitoes…" A medical doctor and scientist, Scott concluded that "the general principle may be summed up by saying that…the disease prevails on low-lying land, becomes less as we ascend…Hence an outbreak will decline as a damp or marshy soil dries up, as it will also when the ground is completely covered [with water], to reappear as the surface clears and puddles and ponds form." H. Harold Scott. *A History of Tropical Medicine* (Baltimore: Willliams and Wilkins, 1939), vol. 1: 131-32.

[48]Anopheles mosquitoes were collected in the Pearl River delta in the early twentieth century, but that is not proof that they had been there long before. See Faust, "Mosquitoes in China and their Potential Relationship to Human Disease," 133-37.

[49]Maegraith, *Clinical Tropical Diseases,* 201.

[50]"The largest series of open-air [dwelling] sites with early pottery is in the Hsi-chiao-shan area at the delta of the Pearl River south of Canton…" Kwang-chih Chang, *The Archeology of Ancient China,* 4th edition (New Haven: Yale University Press, 1986): 106.

[51]"In the indigenous population of a malarious area the active disease is usually rare in very young infants, possibly because of a combination of the high proportion of haemoglobin F in the infant, the passive transfer of immune bodies from the mother and of the inhibitory effect of the breast or other milk diet itself on the multiplication of the malaria parasite. Malaria as a disease becomes more common and severe in the latter half of the first year of life and in the first few years of childhood, when attacks are very severe and not infrequently fatal. As the surviving children grow older, however, the attacks get milder and, provided there is continued reinfection by the same form of parasite, the overt disease eventually becomes very much modified and ameliorated in the older child and adult." Maegraith, *Clinical Tropical Diseases,* 204-05.

level of immunity to malaria before Han Chinese even appeared on the scene. But for those without acquired immunity—such as Chinese migrants from north China—the disease would have been deadly. Besides malaria, other tropical diseases too no doubt ravaged newcomers from the north, posting warning signs for later arrivals. Indeed, the Yao too settled in the hills and avoided the flood plains, perhaps as much because of their fear of tropical diseases as because of their preference for the hills. If malaria was one reason Chinese (and Yao) initially avoided the area around the Pearl River delta, then to settle there Chinese either had to acquire immunity to malaria like the indigenous Tai peoples, or change the ecological conditions so they were no longer so conducive to breeding anopheles mosquitos. The best piece of direct evidence for the gradual acquisition of immunity comes from a Ming-era author, Wang Linting, who claimed that "in the Tang and Song, malaria in Lingnan was wherever [Chinese] in-migrants (*qian ren*) lived. But by the end of the Song, when the worthies and ministers fled [in the face of the Mongol invasion], [the earlier migrants] had become more like the locals [in not contracting malaria]."[52]

Malaria by itself might have proved sufficient to keep Chinese out of the Pearl River delta, but the fact was that the lower reaches of the West, North, and East Rivers were sufficiently swampy and difficult to farm whether or not they were malaria-infested. It is not that the river valleys were unpopulated, for the non-Chinese Tai people had inhabited those regions for millenia. Also, of course, there was the Chinese city of Guangzhou, which, being set upon a hill overlooking the Pearl River estuary,[53] was probably free of malaria, as may have been the area north of the city walls. But Chinese settlement of the nearby malarial valleys required levees to control flooding and to drain swamps, opening the flood plains to Chinese-style settled agriculture. Human beings were about to alter the environment to make it more hospitable to them, and inhospitable to the anopheles mosquito as well;[54] ecological change cut both ways.

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[52]Quoted in Su Guangchang, "Song dai de Guangxi shehui jingji," *Guangxi shifan xueyuan xuebao* 1981.4: 75-84, reprinted in *Zhongguo renmin daxue shubao ziliao she fuyin basokan ziliao, jingji shi* 1982.4: 16.

[53]Zeng, "Cong lishi dimaoxue kan Guangzhou cheng fazhan wenti," 28-41.

[54]Other scholars have proposed this idea as well. Tuan Yi-fu, citing earlier studies, wrote: "New irrigation methods evolved with the spread of rice. The practice of periodic draining destroyed malarial mosquitoes. This meant that large areas which were unhealthy before, say, the year 1000, could now be settled and absorb large population." Tuan Yi-fu, *China* (London: Longman Group Ltd., 1970): 129.

Flood Control. Lingnan experienced two kinds of water control problems: too much water resulting in flooding, and too little or irregular supplies of water during the growing season; the summer monsoon rainfall pattern and the Lingnan drainage system accentuated both. When the monsoons brought the rain to Lingnan, most fell in the four summer months, swelling the oft-times nearly dry river beds. From the west, all of the rain gathered into the catchment basin that emptied into the West River, and then spilled from Wuzhou down into Guangdong province. From the north, all of the rain gathered into the North River. The West and the North River joined at Sanshui ("Three Rivers") some 10 miles west of the city of Guangzhou, forming the headwaters of the Pearl River delta. From the east, rain drained into the East River basin, pouring into the Pearl River to the east of Guangzhou.

The normal rainfall patterns thus poured huge amounts of water into the system in a very short period of time. Naturally, the flood plain from Zhaoqing (on the West River) down to Sanshui flooded every year, depositing ever greater amounts of silt eroded from the burned-off hills further up-river. As early as 809 (the Tang dynasty), levees constructed downstream from Zhaoqing prevented the West River from following the southern of two branches to the confluence with the North River, restricting the flow to the northern branch.[55] The levee not only opened a flood plain to agriculture, but also sent all of the silt-laden flood waters further downstream, thereby increasing the pressure and flooding around Sanshui. Controlling the flooding at the confluence of the West and North Rivers thus was among the first large-scale water control projects in Lingnan to be tackled.

Around 1100, work commenced on the Sang Yuan Wei (or Mulberry Garden, enclosure). When it was completed, it was about 28 miles in length and protected some 6,500 *qing* (about 100,000 acres) of land from flooding,[56] inaugurating a new era of agricultural development in that part of Lingnan. About the same time that the Sang Yuan Wei was being built, sea walls along the coast in Leizhou prefecture and in western Dongguan *xian* also were under construction. In Leizhou, nearly 25,000 *zhang* (about

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[55]Chen, *Zhongguo ziran dili*, vol. 10: 183.

[56]Wang Ping, "Qing ji zhu jiang sanjiaozhou de nongtian shui li," *Jindai Zhongguo qugan shi yantao huilun wenji* , (Taibei: Academica Sinica Institute of Modern History, 1986), pp. 569-71.

48 miles) of sea wall was constructed during the Shaoxing era (1131-62 CE), creating some 10,000 *qing* (about 160,000 acres) of arable land by protecting it from periodic inundation by tides and typhoons, and no doubt eliminating the mangrove forests there as well.[57] In Dongguan, the 12,806 *zhang* (about 24 miles) Xian Chao (Salt-Tide) dike was built in 1089, making 21,028 *qing* (about 300,000 acres) of land arable.[58]

According to statistics compiled by Ye Xian'en and Tan Dihua, in Song times 28 earthenwork dikes or embankments were built in the upper reaches of Pearl River delta, totaling 66,024 *zhang* (about 125 miles) in length and protecting 24,322 *qing* of land (nearly 400,000 acres); during the Yuan dynasty an additional 34 embankments were built, adding 50,526 *zhang* (about 96 miles) to the length and 2,320 *qing*.[59] In other words, the embankments extended for about 200 miles (or about 100 miles of river, if dikes were on both banks), and protected about 20 percent of the cultivated land in Yuan-era Guangdong. Additionally, in Chaozhou prefecture in eastern Guangdong, 22 sections of river dikes restrained the flood waters of the Han River in Haiyang and Jieyang *xian* , protecting another 88,000 *qing* of land.[60]

These flood control levees had the effect of pinning each river diked into a single course, so that rather than meandering and spilling into numerous courses during the monsoon season, rivers ran straight for the bay. The flood plains, of course, then were opened for agricultural production. But these waterworks begun in the Song had other environmental consequences as well. Draining the swampy backwaters that had remained after the flood waters receded altered the ecological conditions that had favored the malaria-carrying anopheles mosquito, rendering the areas so opened less deadly to Chinese originally from the north.

Equally importantly, though, the flood control works channeled the silt away from the former flood plains and directed it further downstream to the head waters of the Pearl River estuary. As a consequence both of the

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[57] *Guangdong tongzhi* 1822 ed.

[58] Wang Ping, "Qing ji zhu jiang sanjiaozhou de nongtian shui li," 581-82.

[59] Ye Xian'en and Tan dihua, "Ming Qing Zhu Jiang sanjiaozhou nongye shangyehua yu xushi de fazhan," *Guangdong shehui kexue*, 1984.2: 73.

[60] *Guangdong tongzhi* 1561 ed, juan 26.

slash-and-burn agriculture in the hills and of the water control works, the amount of silt pouring into the Pearl River thus increased significantly from the eleventh century on. The changes to the Pearl River delta that the increased amount of silt precipitated are evident in the maps of the delta. What is not evident, however, is that while more silt entered the upper reaches of the delta, it just might have continued to flow further into the bay had it not been "captured," as explained below, by pioneers who fled to the rocky islands in the bay in the aftermath of the Mongol invasion of the 1270s.

The Mongol Invasion. Many of the large, powerful families that came to dominate the economic, social, and political life of the Pearl River delta by the Ming and Qing dynasties traced their origins to the Nanxiong area in northern Guangdong, in particular to the small but important village of Zhujigang, which sat astride the road to the Meiling Pass.[61] All traffic flowing between Lingnan and the Yangzi River over the Meiling Pass—and that was a considerable amount of foot traffic, carrying products made from the natural wonders of Lingnan north and bringing the porcelains from Jingdezhen south—had to pass through Zhujigang. Perhaps the village had acquired its name—"Pearl Alley"—either from pearl merchants who may have operated there, or from the small, rounded stones inlaid into the ground to form the road. Qu Dajun claims the village was named after an especially filial Tang-era man from Nanxiong who was so fat he had "a belly like a pearl."[62] However the village obtained the "pearl" part of its name, it literally straddled the road, with travelers forced to walk between the rows of houses and shops lining the "alley." Zhujigang served as a resting place for merchants and other travelers before beginning or ending the one-day journey over the pass, and, we would assume, exercising some control over who passed through and how easily they did so. Nanxiong had been the first area in Lingnan settled by Han Chinese, and the population swelled after the Jin invasion of north China in the 1120s sent refugees fleeing south; many of those who took up residence in Zhujigang, according to later chroniclers, were among the most wealthy and powerful families from north China. Resources and wealth thus concentrated in Zhujigang—until the 1270s and the Mongol invasion, at least.

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[61] For a brief discussion, see Li Zhuanshi et al. eds., *Lingnan wenhua* (Shaoguan: Guangdong renmin chuban she, 1993): 183-192.

[62] Qu Dajun, *Guangdong xin yu* juan 2: 65 (Hong Kong: Zhonghua Shuju, 1974 ed.): 59.

Perhaps because the wealthy families of Zhujigang had settled there in the first place out of fear of northern invaders, when Kubilai Khan's armies began moving south in the 1270s, many residents decided to flee in 1273-74, a couple of years before the Mongol armies pushed south to the Nanling mountains.[63] When a Mongol general crossed over the Meiling Pass in 1276, those residents of Zhujigang who could flee did so; those who failed to flee probably died in the battles that devastated much of Nanxiong and Shaozhou. According to the traditions recorded in several genealogies, ninety-seven families (*jia*) with thirty-three different surnames (*xing*) fled south into the area that would become the Pearl River delta.[64]

Fearing the Mongols more than malaria or adversity, and perhaps hoping to find additional maritime escape routes, these families settled on the small islands that dotted the Pearl River estuary; many of the large lineages in Xinhui county, for instance, trace their origins to Zhujigang.[65] Even today, the relics of that settlement pattern can be seen in the towns situated on what once were islands, but now are hills in an ocean of alluvial soil. Most expressive of this is the town of Shawan, which hugs the southern slope of the island/hill where the town of Panyu too was built; to its west was a mouth of the North River.[66] Shawan means "bay of sand," which in 1276 no doubt it was.

How much cultivable land was available to the settlers of places like Shawan in the fourteenth century is not known. No doubt some alluvium had been deposited by natural processes, perhaps speeded up a bit by the slash and burn agriculture practiced in the hill regions around places like

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63*Xinhui xiang tuzhi* (Hong Kong: Gangzhou Xuehui, 1970 reprint of late Qing edition): 84-85.

64Chen Lesu, "Zhujigang shi shi," 144-49.

65*Xinhui xiang tuzhi*, 85-87.

66Liu Zhiwei, "Zongzu yu shatian kaifa—Panyu Shawan He zu de ge'an yanjiu," *Zhongguo nongshi* 1992.4: 34-41. Professor Liu argues that the shatian of the He lineage of Shawan can reliably be traced back only to the late-16th century at the latest, not the early-fourteenth century as implied in the oral traditions of the lineage's origins. Certainly most of the shatian was added from the mid-Ming on, becoming epecially pronounced in the 18th century. But that does not obviate the point that it began to be created after the Mongol invasion disrupted the previous settlement patterns with most of Lingnan's population occupying in the northern hills. Professor Liu's work has recently been translated and published in English as "Lineages on the Sands: The Case of Shawan," in David Faure and Helen F. Siu, eds., *Down to Earth: The Territorial Bond in South China* (Stanford: Stanford University Press, 1995): 21-43.

their former home in Zhujigang. As the water from the West and North Rivers flowed into the bay and around the islands, the current slowed on the "leeward" side, allowing the silt to settle out. But the new residents in the bay were not content to let natural processes create their agricultural land.

Shatan. In what became the Pearl River delta, settlers created new fields from the sand bars that formed wherever the current slowed sufficiently for the transported sediment to settle, but mostly on the downstream side of islands, or on the outward side of river bends. Called "*shatan*," or "sand flats," these fields truly were new, having literally arisen from the water. Unlike polders or enclosed fields which had been reclaimed from swamps or coastal flats, the *shatan* "grew" in the Pearl River, adding land where none had previously existed.

The particular topographical and hydrological conditions of the Pearl River estuary and the modifications to both caused by diking contributed to the creation of *shatan*. Before the Sang Yuan Wei and other dikes had been built at the headwaters of the delta, the flood waters of the West and North Rivers spilled over the river banks, depositing the sediment in the swamps bordering the river channels. Some of the silt was carried further down into what was then a bay, creating the delta. But when the dikes were built to prevent flooding, the river course was fixed and the sediment did not settle until further downstream. In Ming and Qing times, this occurred mostly in southern Panyu, northern Xiangshan, Shunde, eastern Xinhui and western Dongguan counties, and it is in these counties where *shatan* emerged.

Certainly, some of the *shatan* emerged by natural processes, but the majority were constructed. The method of creating *shatan* was relatively simple, but did require years until the land was usable. When a sandbar arose by natural means close to the water level, rocks were thrown around its perimeter not merely to fix the existing sand in place, but also to capture more sediment. After a more substantial enclosure was built, the sediment was "transformed" by planting legumes (which fix nitrogen in the soil). After three to five years, the *shatan* would be ready for rice.[67] According to the seventeenth-century writer Qu Dajun, a three-year fallow period followed three years of growing rice.[68]

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[67]The method is described in Peng Yuxin, *Qing dai tudi kaiken shi* (Beijing: Nongye chuban she, 1990): 164.

[68]Qu, *Guangdong xinyu*, juan 2: 57.

Once one *shatan* was created, more silt would build up on its downstream side. This silt would be captured by the process described above to create more *shatan*, and so on, until a whole series of *shatan* extended the cultivated land area to several tens of thousand *mu*. These connected *shatan* were called "mother and child" (*mu zi*) *shatan*, rendering metaphorical the relationship between the original *shatan* and the one to which it had given birth. Continuing the Chinese metaphor, one could say that over time whole families or even lineages of *shatan* constituted the Pearl River Delta. But more to the point, the delta had been built by people working with natural processes, but in the unusual conditions created by the Mongol invasion of south China.

Summary. The Pearl River Delta thus was not created by purely natural processes, and had not been simply waiting for Chinese to migrate from the north and reclaim it for agriculture. Rather, the creation of the delta was the result of a complex causal chain. Chinese immigrants into Lingnan preferred to settle in the hills of northern Guangdong, fearful of the diseases in the river valleys further to the south. Their land clearing eventually increased the silt content of the rivers flowing south, but most of that alluvium never reached the bay, being deposited instead in the lower reaches of the North, East, and West river valleys. Only the construction of dikes and levees there in the Song directed the silt-laden waters into the upper reaches of the Pearl River estuary. Even then, that silt might have continued to flow further out into the bay had it not been captured by refugees from the north who had fled from the Mongols to the islands in the bay. The creation of the Pearl River delta and its later emergence as the densely populated, agriculturally rich core of Lingnan was thus a historically contingent, rather than naturally determined, outcome. One can only speculate as to whether or not the same pattern would have been followed had it not been for the "historical accident" of the Mongol invasion. Whatever the outcome may have been, by the time the Mongols were driven from China and the Chinese peasant army leader Zhu Yuanzhang succeeded in establishing the Ming dynasty in 1368, the development of the Pearl River delta had begun.

THE FARMS

If the making of the Pearl River delta, the building of the Ling Qu canal, and the "chiseling" of the Meiling Pass are all rather dramatic examples of human hands reworking the Lingnan landscape, a slower but in

the long run more pervasive alteration came through the development of agriculture to feed the millions who came to populate South China. Certainly the sheer number of people inhabiting an area drives the conversion of forest land into agriculture land, and the level of agricultural technology determines how much land needs to be cleared to feed the population. I will take a closer look at these processes in the last section of the this paper, but here I want to examine the ways another important but less immediately obvious force—commercialization—influenced the ways in which peasant farmers molded the South China landscape.

The most densely populated part of late imperial Lingnan—the Pearl River delta—became the most agriculturally rich region in Lingnan, and hence the most densely populated. Formed of alluvial soils that had been captured from the silt flowing down from the major rivers, these "sand flats" (*shatan*), as the Chinese called them, were worked and reworked, until they became very productive rice paddies producing, by the sixteenth century, two crops of rice and one of vegetables or wheat annually.[69] While peasant farmers produced much of the food the family consumed, agriculture in Lingnan could not be called "subsistence" farming, for many non-food commercial crops were grown and exchanged in markets that dotted the countryside. Besides rice, peasant farmers in the Pearl River delta grew sugar cane, hemp, cotton, and mulberries for silk worms; the most important cycle of exchange involved rice for textiles (or the raw materials to make them, hemp and cotton), and vise versa. Indigo, tea, and fruits also were important crops.

But while commerce and market exchanges were an important part of the rural economy, even in the most remote parts of Lingnan, until about 1550 it is unwarranted to think of the rural economy as being commercialized. To be sure, as the population grew from 1400 to 1550, the gross amount of crops marketed and the number of rural markets increased, but they did so at the same rate as the growth of population. Indeed, the

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[69]Braudel cites the early seventeenth-century observations of a Spanish friar: "Father de Las Cortes admired the multiple harvest in the Canton area in 1626. He noted that from the same land, 'they obtain three consecutive harvests in one year, two of rice and one of wheat, with a yield of 40 or 50 to 1, because of the moderate heat, atmospheric conditions and most excellent soil, much better and more fertile than any soil in Spain or Mexico." Fernand Braudel, *Civilization and Capitalism 15th-18th Century*, vol.1 *The Structures of Everyday Life* , Sian Reynolds trans. (New York: Harper and Row, 1981): 152.

proportion of agricultural land devoted to commercial crops in 1550 was about what it had been in 1400. But from 1550 on, the agricultural economy of Lingnan became highly commercialized, by which I mean that markets and marketing activity expanded at a rate faster than that of the population.

The most immediate stimulus for the commercialization of the economy was the expansion of export possibilities for numerous goods produced in and around South China, especially silk, sugar, and porcelain, among other items which Chinese merchants capitalized on, spurring further expansion of agricultural and industrial productive capacity. Most of the trade in the early sixteenth century was with Japan and Southeast Asia, and later with Portuguese and Dutch traders as well. As is now well known, huge amounts of silver flowed into China, not necessarily in payment for Chinese exports, but because of the demand in China for silver expressed in high silver prices relative to gold and copper.[70] After 1571, trade through Manila also brought silver into the South China economy. Chinese merchants from Guangdong and Fujian provinces sailed to Manila with their goods, which the Spanish exchanged for silver from the American mines; from there the silver flowed back to China, and the Chinese commodities found their way to Europe. By 1600, this trade resulted in an annual inflow of perhaps 200,000 kilograms of silver into the coastal economies of south and southeast China, from Ningpo south to Guangzhou.[71]

The increased exports of silk precipitated significant changes in land use patterns. In the Pearl River delta, the silk industry developed on a base that had been created first by the "sand flat" fields, and then a particular combination of fish ponds with fruit trees. In the fifteenth century, peasant farmers in the Pearl River delta began replacing some of their "sand flat" rice fields with fish ponds, probably in response to increased demand from the city of Guangzhou. The mud and the muck raked up into embankments

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[70]See especially Richard von Glahn, *Fountain of Fortune* (Berkeley and Los Angeles: University of California Press, 1996): 126-42; Dennis O. Flynn and Arturo Giraldez, "Born with a 'Silver Spoon':The Origin of World Trade," *Journal of World History* 6, no. 2 (Fall 1995): 201-22; and Andre Gunder Frank, *ReOrient: Global TRade in the Asian Agae* (Berkeley and Los Angeles: University of California Press, 1998): 111-16..

[71]See William S. Atwell's articles, "Notes on Silver, Foreign Trade, and the Late Ming Economy," *Ch'ing Shih Wen-t'i* iii, 8 (1977):1-33, and "International Bullion Flows and the Chinese Economy Circa 1530-1650," *Past and Present* 95 (May 1982): 68-90.

above the flood plain protected the ponds from flooding, while the high water table filled the hole with water, and the pond was stocked with various kinds of carp fry netted from local waters.[72] On the embankments, peasant farmers in the early Ming planted mostly fruit trees (*long-yan*, litchi, etc.), giving rise to the "fruit tree and fish pond" (*guo ji yu tang*) combination. The carp fed on organic matter that either dropped or was thrown into the pond, while the muck scooped up from the pond fertilized the fruit trees and the rice fields, and added height to the embankments and more protection for the fish ponds.

The "fruit tree and fish pond" culture provided a ready-made base for expansion of the silk industry when increased demand warranted. As the demand for silk increased, peasant farmers replaced the fruit trees with mulberry trees, giving rise to the "mulberry tree and fish pond" system, and then began digging up even more rice paddies. By 1581, in the Longshan area of Shunde county, 18 percent of the productive "land" was fish ponds, and when combined with the mulberry trees on the embankments, accounted for about 30 percent of the cultivated land area.[73]

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[72]In the twentieth century, five kinds of fish were reared in the ponds, all from fry secured from local rivers. See William E. Hoffman, "Preliminary Notes on the Fresh-Water Fish Industry of South China, Especially Kwangtung Province," *Lingnan Science Journal* vol. 8 (Dec. 1929): 167-68.

[73]Ye Xian'en and Tan Dihua, "Lun Zhujiang sanjiaozhou de zu tian." In *Ming Qing Guangdong shehui jingji xingtai yanjiu*. Guangzhou: Guangdong renmin chuban she, 1985: 22. The "mulberry (or fruit) tree and fish pond" system often is cited an example of a sustainable, premodern agricultural ecosystem. In any sustainable ecosystem, natural or otherwise, the mineral and energy resources necessary for life are recycled, and the losses from the system are so small that they can be easily replaced (such as by the weathering of rock or the fixation of nitrogen by bacteria). That, in essence, is what the fish pond system accomplished. Silk worm excrement, leaves from the trees, and other organic material were gathered and thrown into the fish pond, providing food for the carp; the fish were harvested annually, with the muck formed from the fish waste and other decomposed organic matter then scooped out and used to fertilize the mulberry trees and rice fields. In the words of a modern ecologist, "there is a closed nutrient recycling loop via decomposition and mineralization in orchards, fields, and ponds. Nutrient export across the system boundaries takes place only with stream runoff, and with sales of plant or animal products." See E. F. Bruenig et al. *Ecological-Socioeconomic System Analysis and Simulation: A Guide for Application of System Analysis to the Conservation, Utilization, and Development of Tropical and Subtropical Land Resources in China.* Bonn: Deutsches Nationalkomitee für das UNESCO Programm "Der Mensch und die Biosphäre," 1986.

As peasant farmers dug up the rice fields for the "mulberry tree and fish pond" system, they turned to the market to purchase their food, and markets both grew in size and in number. In the 45-year period from 1558 to 1601, the total number of markets in Guangdong province increased from 435 to 762, an increase of 75%, a rate far exceeding the population growth for the same period. Furthermore, this rate of increase was more or less evenly spread throughout the province, with a greater rate found in the four core counties in the Pearl River delta. Focusing upon the 21 counties comprising the entire Pearl River delta, the number of markets increased from 95 in 1558 to 167 in 1601, an increase of 75%.[74] But within the delta, three-quarters of all markets were located in just the four counties that comprised Guangzhou and its immediately surrounding area: Shunde, Dongguan, Nanhai, and Xinhui. And in those counties, the markets had increased from 59 in 1558 to 115 in 1601, a growth of 95 percent. What happened seems clear enough. In the second half of the sixteenth century, the pace of economic activity accelerated most rapidly in the four Pearl River delta counties making up and surrounding the city of Guangzhou, and then spread more generally throughout Lingnan.

The Chinese Coastal Trade. Although the commercialization of the agricultural economy was disrupted in the second half of the seventeenth century because of wars and collateral disasters attending the change of dynasties from the Ming to the Qing, the process resumed again in 1685 after the Kangxi emperor reopened the coast for trade. And as soon as the emperor did so, Chinese merchants set sail up and down the China coast as well as overseas for ports to the south in the South China Sea as well as to the north in Japan. The numbers of ships must have been impressive, for the provincial governor Li Shizheng commented that "in any given year, a thousand ships come and go [from Guangdong]."[75] Governor Li's comment was only impressionistic, but he does convey the sense of a fairly large fleet of Chinese-owned and -manned junks plying the waters in the years after the coast was opened. Moreover, Governor Li's impression of "thousands" of junks is confirmed by the English Captain Hamilton, who, on a trading mission to Guangzhou in 1703, observed that "there is no Day in the Year

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[74]Ye Xian'en and Tan Dihua, "Ming Qing Zhu Jiang sanjiaozhou nongye shangyehua yu xushi de fazhan." *Guangdong shehui kexue* (1984.2): 78.

[75]Quoted in Huang Juzhen, "Qingdai qianqi guangdong de dui wai maoyi" (Paper presented at the 4th International Conference on Chinese Social and Economic History, 1987): 6.

but shews 5,000 Sail of Jonks, besides small Boats for other Services, lying before the City."[76]

The resurgence of overseas trade in the first half of the eighteenth century thus was carried mostly by Chinese rather than European merchants, imparting a slightly different character to the overseas trade and hence in demand for Chinese goods. The trade flows between China and the South China Sea were characterized by Chinese exports of manufactured or processed goods, and imports of raw materials and food, a typical core-periphery relationship. According to Cushman, junks from China carried chinaware, earthenware, silk and cotton textiles, brass- and copper ware made into utensils or dishes, paper, as well as dried and salted vegetables and fruits and a variety of smaller manufactured items; Viraphol adds iron works of all kinds—pans, axes, cast iron, metal tubes, and wire—to the list.[77] Imports from Siam included wood for building and for extracting dyes used in the textile industry, raw materials for drugs, hides for farm equipment, various spices, and raw cotton.[78]

Changes in Cropping and Land Use Patterns. The raw cotton originated in India, and was brought to Siam either by Indian, Muslim, or Portuguese traders where it was in turn purchased by Chinese merchants. The raw cotton is interesting because it points to aspects of China's coastal trade and to cropping and land use patterns in Lingnan that become increasingly important during the eighteenth and nineteenth centuries. Clearly, the raw cotton was imported in order to be spun and woven into cloth of varying grades, some of which was in turn exported back to Siam as finished goods, but most of which was sold within Lingnan. According to Qu Dajun (writing about 1700), "the cotton cultivated in Guangdong is not sufficient to satisfy the needs of the ten prefectures."[79] The importation of

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[76]Hosea Ballou Morse, *The Chronicles of the East India Company Trading to China, 1635-1834* (Taibei: Chengwen Reprint, 1966), vol. 1:104.

[77]Sarasin Viraphol, *Tribute and Profit: Sino-Siamese Trade 1652-1853* (Cambridge MA: Harvard University Council on East Asian Studies, 1972): 51.

[78]Jennifer Wayne Cushman, *Fields from the Sea: Chinese Junk Trade with Siam during the Late Eighteenth and Early Nineteenth Centuries* (Ithaca NY: Cornell University Studies on Southeast Asia, 1993): 82-83, 87.

[79]Qu Dajun, *Guangdong xin yu* (Hong Kong: Zhonghua Shuju, 1974 edition of early Qing text): 426; also quoted in Sucheta Mazumdar, *A History of the Sugar Industry in China: The Political Economy of a Cash Crop in Guangdong, 1644-1834* (UCLA Ph.D. dissertation, 1984): 350, but translated slightly differently.

the raw cotton meant that local sources could not satisfy the demand, and so producers looked elsewhere for their supplies.

To be sure, some peasant farmers had planted some cotton in and around the Pearl River delta. According to seventeenth-century gazetteers cited by Sucheta Mazumdar (a scholar who has studied extensively the commercialization of agriculture in the Pearl River delta), cotton was planted in rotation with sugar cane in Panyu county. Of all the delta counties, Panyu had higher and drier land than lower-lying "sand flat" counties like Nanhai or Xiangshan, more suitable to either cotton or sugar cane. Nonetheless, according to Mazumdar, "cotton was not grown extensively in the Delta,"[80] and its rotation with sugar cane disappeared sometime in the eighteenth century. It is possible that peasant farmers had begun to experiment with cotton after coastal trade resumed, responding to the demand of the textile industry in and around the city of Foshan (located in northern Nanhai county a few miles west of Guangzhou). But the little evidence that we have indicates that cotton cultivation died out. For whatever reasons—perhaps because of quality, perhaps because of price—the local cotton textile industry turned instead to importing raw cotton not just from India, but also from central and northern China.

Indeed, the importation of raw cotton from the Yangzi River delta constituted one half of an important coastal trade circuit during the eighteenth century, where merchants brought sugar from Guangdong to the markets of the Yangzi River delta to exchange for raw cotton grown in Jiangsu and Hubei:

> In the Second and Third month, people from Min (Fujian) and Yue (Guangdong) come carrying crystallized sugar to sell. In the autumn they don't buy cloth, but only buy ginned cotton and return. Hundreds and thousands of ships all load up pile upon pile of bags because there [in Guangdong], among themselves, they can spin and weave it.[81]

Mazumdar rightly calls this an "interlinked structure of the sugar-cotton trade," and devotes considerable attention to analyzing how it

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[80]Mazumdar: 292.

[81]Quoted in Mazumdar: 350.

worked.[82] What is important to note here, though, is that the export trade in cotton textiles woven in Guangzhou did not stimulate the expansion of cotton cultivation in the Pearl River delta, but instead of sugar cane. The cane was grown in counties on the edge of the Pearl River delta: Panyu, Dongguan, Zengcheng, and Yangchun were the most important. Sugar cane also was grown up the Guangdong coast in Haifeng and Huilai counties, as well as in easternmost counties in Chaozhou prefecture.

To meet the demand for raw cotton, the expansion in the production of sugar cane did not require additional land to be cleared. Rather, what happened is that production was simply switched, on fields already in production, from rice to sugar cane. Doing so required little by way of large capital outlays, such as massive land clearance, swamp drainage, polder construction, or irrigation projects did, thereby putting sugar cane production within the reach of most peasant households. Most of this switching was on land tilled (whether it was owned or rented is a separate question) by peasant farmers, although Mazumdar does think it possible that merchants or rich peasants may have operated large "plantations" with wage labor.[83]

Sugar cane therefore replaced rice, and as the amount of land allotted to sugar cane increased, the amount devoted to rice shrank, more or less on a one-for-one basis. By the middle of the eighteenth century, substantial portions of the land in several counties had become devoted to sugar cane: "In Panyu, Dongguan, and Zengcheng [counties], four out of ten [peasant farmers] produce sugar; in Yangchun, six out of ten do. The cane fields almost equal the rice fields."[84] By the nineteenth century, entire villages specialized in only sugar cane.[85] In 1819, for instance, the shipwrecked English Captain J. Ross observed "continued fields of sugar-cane" and "plantations of sugar-cane" on the Leizhou peninsula and to the north in Gaozhou prefecture.[86]

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[82]Mazumdar, chapter VI.

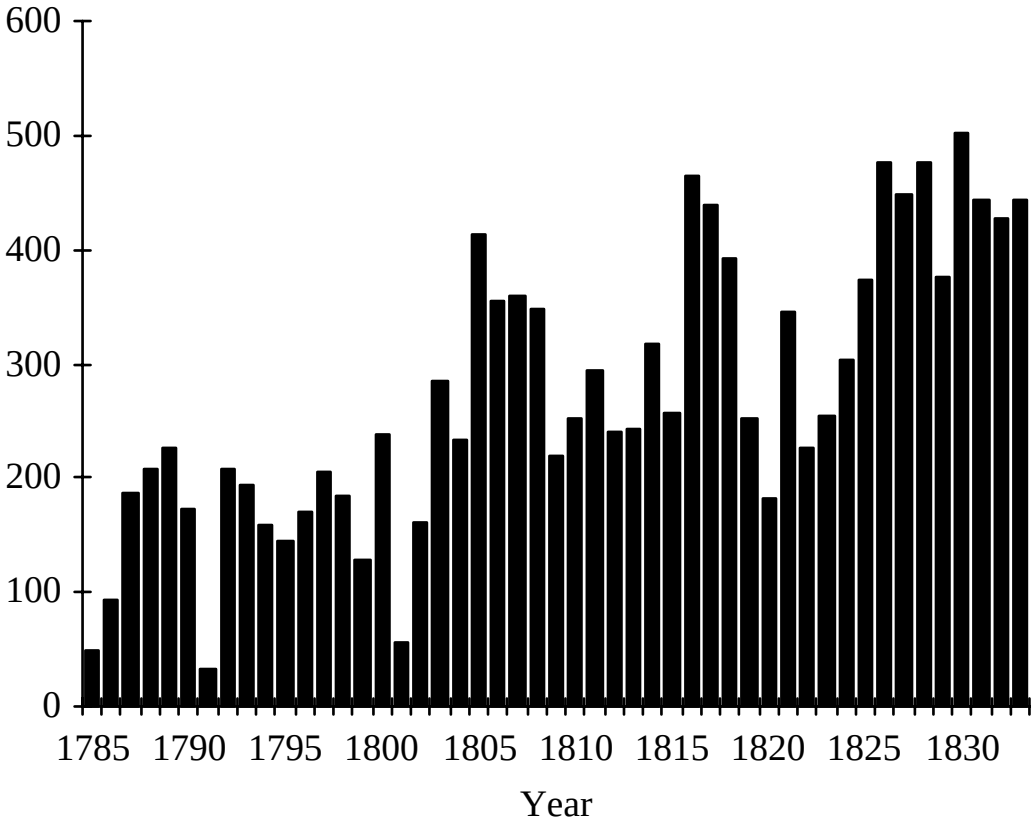
[83]Mazumdar: 290-91.

[84]Li Diaoyuan, *Yuedong biji* (Shanghai: Huiwentang,1915): juan 14.

[85]Mazumdar: 288.

[86]"Journey of a Trip Overland from Hainan to Canton in 1819," *The Chinese Repository* vol. XVIII no. 5 (May 1849): 237.

Fig. 6. Raw Cotton Imports from India, 1785-1833



The demand for raw and woven cotton, I think, was driven by Lingnan's domestic market. Not only was raw cotton from India imported (see Fig. 7), but I estimate about half as much again came into Lingnan through the sugar-cotton trade circuit. Given estimates of per capita consumption of cotton cloth,[87] these cotton imports could have clothed about 75 percent of the population of Guangdong province. Of course, per capita figures obscure differences in rates of consumption, but the fact remains that a lot of cotton was being carded, spun, woven, and purchased in Lingnan. I estimate that around the turn of the nineteenth century, Lingnan consumed about 25 percent of all cotton cloth produced in China.

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[87] Xu Dixin and Wu Chengming, *Zhongguo zibenzhuyi de mengya* (Beijing: Renmin Chuban she, 1985): 322-24.

Silk. Where domestic demand drove the cotton-sugar trade cycle, foreign demand expanded silk production. From about 25,000 piculs of silk in 1723, exports of Guangdong silk increased steadily for the next century, reaching about 1.1 million piculs (one picul is 133 pounds) in 1828.[88] The trend was virtually linear, with the silk exports increasing by 10,000 piculs each year. From 1828 to 1834 the exports doubled, largely because the vast increase in the amount of smuggled opium gave the East India Company a cheaper commodity than silver with which to trade for silk (as well as tea). The Opium War (1839-42) disrupted trade, but afterwards silk exports quickly rebounded to the 1834 level before doubling again from 1850 to 1860. The story of silk exports thus can be characterized by steady if not unspectacular growth during the eighteenth century followed by exponential growth in the 1830s and the 1850s.

The increased silk production in the eighteenth and nineteenth centuries came not from any technological advances, but from expansion of the tried and true "mulberry tree and fish pond" method pioneered centuries earlier. According to Alvin So's calculations, to increase silk exports from 25,000 to 1.1 million piculs required expanding the acreage devoted to mulberry trees from 500 to 22,000 *mu* (one *mu* is about one-sixth of an acre), nearly all of which occurred in the Pearl River delta. However, because of the mulberry tree and fish pond system, the amount of land converted to the system was substantially greater. Indeed, So states that the rule of thumb was that "the land in about four-tenths of any given area was dug out and large ponds were formed. The excavated soil was thrown on the other six-tenths of the land, thereby raising the level."[89] Thus the amount of land converted to the "mulberry tree and fish pond" combination by 1828 was more than 35,000 *mu* (about 6,000 acres).

Like the expansion of acreage devoted to sugar cane, the increase in the "mulberry tree and fish pond system" came at the expense of rice paddies. Nanhai and Shunde county gazetteer entries are quite explicit on this point: "Rice fields were turned into mulberry embankments and fish ponds; mulberry bushes were planted on the newly constructed embankments; ...lower part with fishing, upper part with mulberry."[90] By the twentieth century, according to the geographer Trewartha, virtually all

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[88] Alvin So, *The South China Silk District: Local Transformation and World-System Theory* (Albany: State University of New York Press, 1986): 80-81.

[89] So: 84-85.

[90] Translated and quoted in So: 85.

the land in Nanhai and Shunde counties had become devoted to sericulture: "From one of the low hills in the delta's specialized mulberry area as far as the eye can reach in any direction, there are closely spaced fields of dark green mulberry shrubs intersected by narrow canals and dotted with ponds of water scattered irregularly between the fields."[91]

Food Deficits. Meeting the world demand for silk, then, like meeting the demand for sugar, resulted in a particular form of commercialization where land that had been devoted to rice was converted to a crop that was sold on the market, rather than consumed on the farm. What this pattern meant was that peasant producers therefore had to obtain their food not from their farms but from the market. By the early eighteenth century, peasant farmers in the Pearl River delta had turned to producing cash, industrial, and commercial crops to such an extent that the province was known as a chronic food-deficit region. During the reign of the Yongzheng emperor (1722-35), officials both in Guangdong and from other provinces complained that Guangdong produced just one-half of the rice required to meet the needs of its population because, as one official charged, "coveting profit, [peasant farmers] have planted much land in *long-yan*, sugar cane, tobacco, and indigo."[92] Not only peasant farmers who had turned to commercial crops looked to the market to buy rice, but so too did a substantial non-farm working population: "Those who work for wages, who fish, who work in the salt pans and who pick tea outnumber those who work in the fields," one provincial official observed in 1735.[93]

Commercialized agriculture, even in the early decades of the eighteenth century, thus may have claimed half or more of the arable land in Guangdong province.[94] Not only is there little reason to think that that percentage shrank during the eighteenth century, but all the available evidence suggests that peasant farmers devoted increasing proportions of their land to commercial and non-food crops such as sugar cane, mulberry bushes, fruit trees, fish ponds, tobacco, and vegetables. Furthermore, most of this commercialization was centered in the Pearl River delta region

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[91]Quoted in So: 85.

[92]Memorial dated Yongzheng 5.4.13, *Gongzhongdang Yongzheng chao zouzhe* (Taibei: Guoli gugong bowuyuan, 1977-88), vol. 8: 25. Hereafter cited as YZ 5.4.13, YZCZZ vol. 8: 25.

[93]Memorial dated YZ 12.9.2, YZCZZ vol. 23: 468.

[94]The Pearl River delta alone accounted for about one-third of all arable.

around the city of Guangzhou, the economic and administrative center for the entire region.[95]

Commercialization of Rice. To meet the food demands in the Pearl River delta, peasant farmers elsewhere in Lingnan began producing rice for export. Throughout the East, West, and North River drainage basins, local markets gathered rice from their hinterlands for export down river to the delta. As far up the East River as Heyuan, the market exported rice down river, and even the market in Yong'an, perhaps one of the most remote and least accessible counties in all of Lingnan, exported rice to Heyuan. In Guangxi, two of the three largest rice export markets were on the West River, one in Wuzhou and the other up river at Xunzhou; a third collected rice from Liuzhou prefecture. Rice merchants from Guangzhou and Foshan established offices (*hui guan*) at all of the third-level markets, and were quite active in purchasing rice for the Guangdong market. Indeed, the most important commercial crop throughout the vast Lingnan hinterland drained by these major rivers was rice. So great was market demand for rice by the nineteenth century that peasants in Fengchuan county (up the West River near the border with Guangxi) "ate yams and sweet potatoes in order to sell rice for cash," and in Cangwu and Cenxi counties peasants without immediate access to water transportation carried sacks of rice on their backs to market.[96] By the middle of the eighteenth century, an integrated market for rice knit all of Lingnan together into a single market, sending rice from low-priced surplus areas to the place where demand and prices were the highest, in the Pearl River delta. Food flowed throughout the system, amounting to as much of 25 percent of all rice grown in Lingnan.

From the late Ming through the nineteenth century (and into the twentieth, for that matter), the commercialization of agriculture thus had precipitated changes in cropping and land use patterns, transforming rice paddies into fish ponds and mulberry fields in the Pearl River delta, and into sugar cane fields all along the coast, down to and including the Leizhou peninsula. A landscape in Guangdong province that had been covered with rice fields thus was reworked under the demands of commerce into a new landscape, one that said "trade" rather than "food." But if these changes in the land were restricted to fields that already supported agriculture, in the

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[95]Ye and Tan 1985: ch. 4. See also Mazumdar 1984: ch 5.

[96]Luo Yixing. "Shi lun Qing dai qian zhong qi Lingnan shichang zhongxin de fenbu tedian" (Paper presented in Shenzhen at the Fourth International Conference on Qing Social and Economic History, 1987): 8-15.

eighteenth century pressures were building to clear more forested land for agriculture, transforming wooded hills and plains into human artifice.

THE STATE

In the first half of the eighteenth century, Chinese officials were not unaware of the strain of population on the land and hence on food supplies and rice prices. The Guangxi provincial military commander, Han Liangfu, noted that "the population doubled during the Kangxi reign (1661-1722)," and that "while the population increases daily, the amount of land under cultivation does not."[97] A few years later, another official opined that "throughout the world the population tends to increase; only by bringing land into production can they all be fed."[98] What is interesting and significant is that the new Yongzheng emperor (reigned 1723-35) connected the rising population with the amount of land under cultivation, and then launched a massive state-supported campaign to bring new land into production. In his edict announcing the land reclamation incentives, the Yongzheng emperor reasoned: "Population has increased of late, so how can [the people] obtain their livelihood? Land reclamation is the only solution."[99] For the thirteen years of his reign, a considerable number of memorials were written on the question of land and land reclamation, leaving a written record unique in the Qing dynasty. The Yongzheng land reclamation campaign is significant not because of the actual amount of land that was brought into cultivation, but especially for what it reveals about the relationship between population and land in Lingnan in the early eighteenth century.

Ascending the throne as a mature, 45-year-old adult who had out-maneuvered (usurped from, some contemporaries alleged) his sibling rivals, the Yongzheng emperor had clearly formed ideas about how to rule, many of which represented reactions to what he saw as shortcomings in his father's ruler ship. Conceiving of himself and his state in more activist terms, and perhaps believing that the Kangxi emperor's relaxed attitudes and practices had led to substantial problems, not the least of which was population growth without commensurate increases in land under cultivation, the Yongzheng emperor signaled his intent to pursue "land

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[97] Memorial dated YZ2.4i.17, YZCZZ vol. 2: 582-83

[98] Memorial dated YZ5.7.1, YZHWZZ vol. 10: 101-03.

[99] *Qing [Yongzheng] shi lu*, edict of YZ1.4, juan 6: 25.

reclamation" just four months into his reign. To encourage peasant farmers "to reclaim and report land without interference or obstruction from officials," Yongzheng extended six-year tax remissions to newly reclaimed paddy land and 10-year remissions to unirrigated land.[100] And in an edict issued eight months later, the Yongzheng emperor placed responsibility on officials "from governors on down" to "encourage agriculture." He ordered that county magistrates annually select one "seasoned farmer" who exemplified good farming skills and reward him with an honorary button of the eighth rank.[101]

Responding to the emperor's initiative, officials in both Guangxi and Guangdong provinces reported vast stretches of potentially arable land in their provinces, and proposed plans to bring the lands into production. In Guangdong, according to one official's 1729 memorial to the emperor,

> The land area…is vast, and the population is densely settled. But those who are engaged in commerce are many, while those who labor in the fields are few, so that the food harvested here is insufficient to meet the needs of the populace. Even in a good year rice must be purchased from Guangxi; when there are food shortages, the poor are defenseless.
>
> I have been in Guangdong for four years now, and in each of those years I have traveled [throughout the province] on official business. With my own eyes I have seen reclaimable wasteland in each prefecture; there are none without some, especially Zhaoqing, Gaozhou, Leizhou, and Lianzhoufu prefectures. The reasons given for the unclaimed land [there] include: "It's not on a waterway;" "Small folk don't have the wherewithal to undertake [reclamation];" or "I once wanted to reclaim land, but I didn't have the right tools." For these reasons reclaimable land in Guangdong goes to waste and the province runs a food deficit.[102]

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100 *Qing [Yongzheng] shi lu*, edict of YZ1.4, juan 6: 25.

101 "The peasant's lot," the emperor intoned as a preface to selecting one among them to honor, "is hard; his hands and feet are covered with calluses…He pays rent and taxes, provides for his parents, and raises his children." *Qing [Yongzheng] shi lu*, juan 16: 25-26.

102 YZCZZ 12: 599; 7.3.3.

The first plans proposed large-scale land development schemes based on models pioneered some years earlier in the northern province of Zhili and the frontier province of Yunnan, where in return for "contributions" to the state, gentry degree holders and demoted or disgraced officials received the rights to thousands of *mu* (a *mu* is about one-sixth of an acre) of "waste land," upon which they would settle tenants and clear the land for agriculture. For various reasons these large-scale land development plans proved either unworkable and spawned so much official corruption or tax evasion that they failed, leaving the new Qianlong emperor (reigned 1736-95) with both the opportunity and the desire to chart a different course.

With the ascension of the Qianlong emperor to the throne, the Qing state retreated from trying to increase the land under cultivation by giving incentives for large-scale land development projects. Indeed, when the new state policy was articulated in 1740, only the reclamation of "scattered plots" by individual and probably poor peasant families would be encouraged by the state:

> In each province, the population has increased, cultivable land cannot be expanded, and yet the poor have no way to make a living…But in mountainous regions with few fields, vacant land on the hill tops is relatively abundant and may be suitable for planting rice or miscellaneous crops…Henceforth all frontier provinces with cultivable scattered plots in the interior are to extend tax exemptions to [Han Chinese] and [non-Chinese] tribesmen [*yi*] who till these plots.[103]

The interpretation of "frontier provinces" was exceptionally broad, in fact including all provinces with any hilly or mountainous land at all.[104] The scope of "scattered plots" exempted from taxes by statute, though, varied by province. In Guangxi, paddy of one *mu* or less and dry land of three *mu* or less were tax exempt, while "in those parts of Guangdong, such as hill tops and ridges, where the land slopes, the soil is gravely and the rain runs off or dissipates, and people are trying to till it, the land is tax exempt."[105] In practice, the tax exemption was extended to the coastal plains of southwest

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[103] *Da Qing huidian shi li,* (Guangxu edition): juan 164.

[104] For a discussion of the vanishing of the Chinese frontier, see John F. Richards, *The Unending Frontier: An Environmental History of the Early Modern World* (Berkeley and Los Angeles: University of California Press, 2003): ch. 4.

[105] *Da Qing huidian shi li,* (Guangxu edition): juan 164.

Guangdong province in Gaozhou, Lianzhoufu, and the Leizhou peninsula, regardless of how much land was tilled.[106]

Under this new policy, a considerable amount of land, most of which was in the hills in the northern and northeastern sections of Guangdong and in western and northern Guangxi, or in the southwestern littoral, was cleared and planted. Officials continued to report the amounts of land cleared, some of which then were listed at various times in the *Veritable Records of the Qing Dynasty* (*Qing Shi Lu*), our only surviving record of the official tally. With missing years and considerable amounts of cleared land left out from the official count, only a fraction of the total has been captured in the official records. For Guangdong, according to figures gleaned from the *Qing Shi Lu* for the years from 1737 to 1800, about 800,000 *mu* of land was cleared for cultivation, or about 1,500 *mu* per recorded year. In Guangxi the reported amounts were considerably less, totaling just 150,000 *mu*, and most of that was irrigated paddy.

Over the century from 1753 to 1851, official state figures for Lingnan register just a 10 percent increase in the amount of cultivated land, an amount more or less in line with the amount of land reported as reclaimed and added to the tax rolls. These officials figures, though, are notoriously inaccurate, not just because the Qing state never conducted a land survey to begin with, but also because of under-reporting of new lands brought into cultivation, and the conversion of the *mu* from a measure of land area to a measure of tax liability (two or three *mu* of dry land, for instance, was taxed at the rate of one *mu* of irrigated land and therefore registered as one, not three, *mu*).

However, I estimate that the state added to the official cultivated land figures only about one-tenth of the amount actually reclaimed in the eighteenth and nineteenth centuries.[107] Even if my estimates of cultivated land area are high by 10-20 percent—or even 50 percent, for that matter—the implications are worth mentioning. If the amount of land under cultivation around 1700 represented the maximum that had been reached in

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[106]Three years earlier, in 1737, the governor of Guangdong had requested and received lower tax rates on "hard to reclaim land" in the southwest littoral. See the brief note discussing Yang Yongbin's memorial in *Qing (Qianlong) Shilu* juan 37:2a-b (entries for the second month of QL2).

[107]The estimates are discussed in Marks, *Tigers, Rice, Silk, and Silt: Environment and Economy in Late Imperial South China*, chapter 9.

either 1200 or 1600, then all the land that was brought into production after that was being tilled for the first time. And that was not a small amount of land: between 1693 and 1853, an additional 20 million *mu* was brought into production in each Guangdong and Guangxi provinces, doubling to 80 million *mu* the cultivated land acreage in Lingnan from anything experienced before. In terms of the percentage of the total Lingnan land area under cultivation, the amount increased from about 14 percent around 1713 to 24 percent in 1853, representing some 10,000 square kilometers of land. And because of the way in which land reclamation unfolded, most of those 10,000 square kilometers were "odd lots" in the hills. After 1853, little additional land was brought under the plow, indicating that the limits of cultivable land in Guangdong province had been reached by the middle of the nineteenth century.

THE TIGER

The obverse of the story of land clearance is the story of deforestation, but since eighteenth and even nineteenth century sources do not speak directly to the issue, that story can only be pieced together using later and indirect evidence. By the early twentieth century, though, the results were plain to those who began to look. In the hills of northern Guangdong, the forestry expert G. Fenzel observed "vast stretches of flat, barren hills, [with] wild grass growth."[108] If evidence both from earlier periods and from the twentieth century can be used to illuminate the eighteenth century land clearance, fire probably had been used to remove the forest cover and to ready the hillside for planting. Again, Fenzel: "In this process fire is amply used as a pioneer, till, soon, the whole surface of the mountains bordering the valley lies barren from top to bottom."[109] The non-Han Chinese were especially adept at the use of fire: "The Yao cause tongue-like inlets to be burnt into the forests where he cultivates on the rich soil—still more improved by the ashes—his barley, maize, or sweet potato for two or three years. After this period of crude and transitory cultivation, he…moves to another spot for the cultivation of his cereal and potatoes…When the soils are clear in this way, a special sort of rice, which

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[108]G. Fenzel, "On the Natural Conditions Affecting the Introduction of Forestry as a Branch of Rural Economy in the Province of Kwangtung, Especially in North Kwangtung," *Lingnan Science Journal* vol. 7 (June 1929): 81.

[109]Fenzel: 93.

grows on the steep slopes without terracing and artificial irrigation, or maize or sweet potatoes are grown."[110]

Land clearance for agriculture was not, of course, the only cause of deforestation: logging provided raw materials for the furniture, building, and shipping industries. Wood from forests also had been the major source of fuel for cooking and heating. How much impact this demand for energy contributed to deforestation is any body's guess, but there is clear evidence from the early nineteenth century that wood was no longer available for use as a fuel, at least in some parts of Lingnan. According to Captain J. Ross, who traveled overland from Hainan Island to Guangzhou in 1819 following the wreck of his ship, "this part of China is badly supplied with firewood, and the people are obliged to substitute straw, hay, and cow-dung." It was not that there were no trees, but that there were so few: "the country...was well cultivated, though hilly, with a few groves of small pines." The reason for the scarcity of forest, of course, is that peasant farmers had cleared and planted the land, which Ross described as "hilly and poorly cultivated, producing chiefly sweet potatoes, with a sprinkling of other vegetables."[111]

The vast, treeless grasslands observed in the early twentieth century thus had emerged as a result of a historical process of burning off the forest, planting a crop for two or three years, and then moving on to another location without replanting trees. By the twentieth century, the Yao tribesmen who Fenzel observed had taken to re-planting trees after they moved on; but Chinese did not do so then, and probably had not in earlier times either. After abandoning a cleared hillside, "the land is often invaded so seriously by weeds that further cropping is impossible," according to Robert Pendleton, a botanist who had studied similar processes in the Philippines.[112] After five or ten years, scrub brush might grow, and the soil regain some fertility, making it possible to burn it off again. "If, however, the weeds and the brush growing up in the abandoned clearings are removed by annual burning, tree growth has little chance to develop."[113]

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[110]Fenzel: 92.

[111]*The Chinese Repository*, vol. XVIII no. 5 (May, 1849): 247.

[112]Robert Pendleton, "Cogonals and Reforestation with Leucaena Glauca," *Lingnan Science Journal*, vol. 12 (Oct 1933): 555.

[113]Pendleton: 556.

And in Lingnan, at least in the twentieth century, peasants habitually burned off the hills every year or two, not only rendering the hills unfit for replanting, but also preventing trees from growing. In Guangxi, Stewart observed that the peasant farmers "habitually fire most the burnable slopes in the vicinity of the homes during the dry season each year. The continuation of this practice tends to destroy the majority of the species of woody plants and change the aspect of a once richly forested country to that of a hilly or mountainous grassland."[114] In Guangdong too, according to Fenzel, Chinese farmers "annually burn down the grass covering the mountains."[115]

Besides eliminating forests, land clearance by burning, followed by periodic re-burning to prevent forests from returning, had an impact on the ability of the watershed to retain rainfall and prevent erosion. On the one hand, the rapid growth of the tough grasses following cultivation retarded soil erosion.[116] Unlike other parts of China where deforestation and shifting cultivation was not followed by the rapid invasion of grasses but by deep soil erosion and the silting of rivers, in Lingnan the grasslands may have prevented extensive soil damage during the summer monsoon. On the other hand, some soil erosion did occur, taking off the thin layer of humus-rich material on the forest floor. When that happened, the ability of the soil to retain water decreased. According to Stewart, the effects upon rivers in Guangxi were clear: "In Ling Yuin Hsien we found steadily flowing streams in the undisturbed areas of forest at the height of the dry season. At the same time the stream beds in the near-by cultivated and burned-over area were mostly dry. We believe that the preservation or replacement of woody vegetation cover on these slopes would so materially affect the moisture available during the dry season as too be of real economic benefit to the people because it would enable them to grow winter and spring crops, sometimes with the help of irrigation, which it is now impossible to produce on account of the dryness of the soil and the lack of precipitation at that season of the year."[117] Conversely, of course, with less water retained to seep out and keep the streams flowing in the dry season, more rainfall

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[114]Albert N. Steward, "The Burning of Vegetation on Mountain Land, and Slope Cultivation in Ling Yuin Hsien, Kwangsi Province, China," *Lingnan Science Journal*, vol. 13 (Jan 1934): 1.

[115]Fenzel: 42.

[116]Pendleton: 559.

[117]Steward: 2-3.

simply ran off during the summer monsoon, increasing the flow of streams and rivers, and hence of the incidence of flooding.

The immediate question, of course, is whether or not eighteenth-century peasant farmers too annually burned off the hills after they had cleared them of forest the first time, or whether forest might have reestablished itself. Unfortunately, there is little direct evidence, and the little there is, is ambiguous. For instance, when in 1793 the Englishman Staunton gazed down into Lingnan from the hills in the north, he observed "towards the southerly point of the compass…a tract of waste and barren ground. The hills scattered over the plain appeared, comparatively to the vast eminence from whence they were viewed, like so many hay-ricks; as is, indeed, the distant appearance of many other Chinese hills."[118] Clearly, Staunton saw at least one scar in the hills, and maybe all of the other hills, having the shape if not the color of "hay-ricks," were covered not with green forest but with grassland.

In the twentieth century, peasant farmers gave several reasons why they burned off the hills. One was that "after burning off hills the grass ashes wash down the slopes serving as a source of fertilizing material for the lower agricultural land." Pendleton thought this unlikely, since "there are frequently dug contour ditches which carry away the water and eroded material from the hills to prevent flooding of the rice of other low lands."[119] When Fenzel asked "the farmer why he annually burns down the grass covering the mountains…[the farmer] stereotypically replies that it is to deprive the robbers, tigers, and snakes of their dens."[120] This answer deserves to be taken seriously, and can provide some clues as to when the practice began of annually burning off the hills to prevent the re growth of forest cover.

Bandits. Banditry certainly was a problem in the eighteenth century, and probably had continued unabated for decades. The mid-seventeenth century crisis had spawned vast numbers of groups the state had labeled "bandits," and even eighteenth-century officials had justified land reclamation policies in part to alleviate banditry. But compared to the endemic bandit problem of the 1920s and 30s, the eighteenth century

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[118]Sir George L. Staunton, *An Authentic Account of an Embassy from the King of Great Britain to the Emperor of China*. (Philadelphia, 1799): vol. 2, pp. 213-14.

[119]Pendleton: 557.

[120]Fenzel: 42.

probably appeared calm. In principle, of course, it is possible to chart the presence of bandits from the numerous entries in local gazetteers, and thereby obtain a rough comparison with the twentieth century. But that exercise might not tell us anything about the peasant farmer's practice of burning off the hills, since, as adaptable sorts, bandits could flourish in most any kind of habitat. But not so tigers. Tigers required a particular habitat—forests—and did not inhabit grasslands.

Tigers. Indeed, along with notations on natural disasters, rebellions, and dragon sightings, the chronicles of local gazetteers are filled with reports of tiger attacks on villages. In 1680, for example, "In Xin'an county, many tigers injured people; [the tigers] were extremely numerous; the attacks stopped by the end of the year."[121] Three years earlier, "hundreds of people" had been injured by tiger attacks in Lianping county.[122] In the southwest littoral, tigers in 1723 attacked so many people and animals in Maoming that 37 people died.[123] In Guangxi province too, tigers entered villages and attacked people and animals, as in Huaiji county in 1752,[124] or in Liucheng county in 1696.[125] Villagers thus had reason to fear tigers, and tigers may well have been more numerous and threatening to peasant farmers than bandits.

The relevant and interesting thing about tigers, though, is their habitat: they live in forests, favoring in particular lowland riverine forests. Unlike lions who prefer grasslands or savanna, tigers stalk their prey from the cover and the shadows provided by forests.[126] The relationship is pretty

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[121] *Guangzhou fuzhi*, juan 80-81, entry for KX19.

[122] *Huizhou fuzhi*, juan 17-18, entry for KX16.

[123] *Gaoqing fuzhi*, juan 49, entry for YZ1.

[124] *Wuzhou fuzhi* (1769 ed.), entry for QL17.

[125] *Liuzhou fuzhi* (1764 ed.), entry for KX35.

[126] Edward O. Wilson has made the interesting point that while tigers and lions in captivity have been cross-bred ("The offspring are called tiglons when the father is a tiger and ligers when the father is a lion"), in the wild, the two species do not "hybridize." Besides radically different behavior (lions are social, while tigers are solitary), "they liked different habitats. Lions stayed mostly in open savanna and grasslands and tigers in forests." Edward O. Wilson, *The Diversity of Life* (Cambridge: Belknap Press of Harvard University Press, 1992): 39. Had lions been anywhere near Lingnan when the burning off of the hills began, lions might have replaced tigers and the peasant farmer's would have been faced with that old choice: which do you prefer, the tiger or the lion?

simple: no forests, no tigers. The converse also held: where there were tigers, there were forests in Lingnan. And the forest had to have been quite large: a single adult tiger requires between 20 and 100 square kilometers of forested habitat to sustain itself, depending on the availability of large game.

If Chinese peasant farmers and literate chroniclers paid no attention to forests and failed to comment on the deforestation of the hills, thereby leaving us with no written records from which to reconstruct the story of deforestation, they did note tigers, especially tigers who attacked villages. Since tigers are indicators of forests, reports of tiger attacks in the chronicles of Chinese gazetteers can serve as proxies for forests. Charting the time and place of the tiger attacks thus should produce a picture, however fuzzy, of where the forests were, and where they were not. For from the point of view of the Chinese agriculturists, land reclamation, the clearance of hills, and the annual burning over of the grasslands may have been existential activities assuring the human population its food supply, but from the point of view of the tiger, the same actions constituted the destruction of their habitat. The destruction of tiger habitat by burning off the forest cover reduced the tigers' food supply, and contributed both to tiger willingness to enter villages searching for food, and to their willingness to attack and eat people.

The prevalence of "man-eating tigers," according to Charles McDougal (such tigers didn't overlook women and children, but the "man-eating" label is McDougal's), is highest under certain circumstances. Where the incidence of human-eating tigers is low, natural prey is adequate and the encroachment of humans into the environment is gradual. "In some areas tiger habitat has been completely destroyed without man-eating becoming a problem…In such cases the tigers were killed off at approximately the same rate that their habitat was removed…" But where human encroachment on tiger habitat occurred where in addition there was a reserve of good tiger habitat, tigers "were forced to occupy marginal habitat…Tigers forced to occupy areas where their normal food was in short supply supplemented the latter with livestock and also humans."[127] The record of tiger attacks in Lingnan, then, is indicative not merely of the destruction of tiger habitat, but also the existence of a forest reservoir from which more tigers emerged.

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[127] Charles McDougal, "The Man-Eating Tiger in Geographic and Historical Perspective," in Ronald L. Tilson and Ulysses S. Seal eds., *Tigers of the World: The Biology, Biopolitics, Management, and Conservation of an Endangered Species* (Park Ridge NJ: Noyes Publications, 1987):445-46.

Tiger attacks thus are meaningful indicators simultaneously of forests and of the encroachment of humans into tiger habitat. What does the historical record for Lingnan show? Let us begin by working backwards. Today, just a few tigers survive in the mountains on the border of northern Guangdong and Guangxi, not surprising in light of the extensive deforestation clearly documentable by the twentieth century.[128] In earlier centuries, the distribution of tigers was more general throughout Lingnan. Around 1700, according to Qu Dajun, "there are many tigers in Gaozhou, Leizhou, and Lianzhoufu. Merchants encounter them." Qu also noted that "in the wilds of Leizhou, there are many deer."[129] For the rest of Lingnan we lack the sweeping generalizations provided by Qu Dajun, but the record of tiger attacks can tell the story. In Guangzhou prefecture, most of the tiger attack records are before 1700. Of interest in the Qing records are those from the 1660s when the coastal population was relocated inland. When the people abandoned their fields, the land apparently rapidly reverted to scrub if not actually forest, and with the return of forest cover came the tigers: "Because of the relocation, grass and trees have grown in profusion [in the abandoned areas], and tigers have become bold."[130]

Significantly, in Guangzhou prefecture the last tiger attack on record is for 1690. After that, the record of tiger attacks ends, presumably coincident with the destruction of tiger habitat there. A similar story can be told about Chaozhou prefecture, where the last recorded tiger attack was in 1708. The last tiger attack in Gaozhou prefecture (which was second only to Guangzhou in population density in 1820) was recorded in 1723. To the east in Huizhou, though, the records of tiger attacks continue through the eighteenth century, and in Shaozhou prefecture and in Nanxiong (to the north in the Nanling mountains), the last records are in 1813 and 1815 respectively. Records are more sparse in Guangxi, but in Wuzhou and Xunzhou, the last attacks were scattered from 1752 to 1777.

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[128]Lu Huoji, "Habitat Availability and Prospects for Tigers in China," in Ronald L. Tilson and Ulysses S. Seal eds., *Tigers of the World: The Biology, Biopolitics, Management, and Conservation of an Endangered Species* (Park Ridge NJ: Noyes Publications, 1987): 71-74. Lu estimates that 4000 tigers inhabited the area in 1949, 150-200 in 1981, and 50-80 in the mid-1980s.

[129]Qu Dajun, *Guangdong xinyu*, pp. 531, 532.

[130]*Huizhou fuzhi*, juan 18, entry for KX6.

The records of tiger attacks in Lingnan are anything from complete—some prefectural gazetteers, such as Lianzhoufu and Leizhou—do not include annual chronicles, and certainly some tiger attacks escaped official notice. Furthermore, tigers lived in areas that did not record any attacks, such as Conghua county which Qu Dajun said "has many tigers in the hills."[131] Nonetheless, I think the story the record of tigers attacks in Lingnan tells is clear enough. During the mid-seventeenth-century crisis when the human population decreased substantially and forest returned to much of Lingnan, the range of the tigers expanded, even into relatively densely populated areas like Guangzhou prefecture in the Pearl River delta. As population there (and elsewhere) began to recover and forests were cleared for agriculture, tigers and people came into contact. By 1700, tiger habitat probably had been destroyed in and around Guangzhou, while the hills in Guangdong and Guangxi remained forested, as was much of the southwestern littoral. As people moved into the hills and burned off forests, tiger attacks spread outwards, ending in the early nineteenth century in northernmost Guangdong. The record of tiger attacks followed the destruction of their habitat, and the end of tiger attacks in the early nineteenth century dates the nearly complete destruction of tiger habitat in Lingnan by then.

The willingness of Chinese peasant farmers to destroy tiger habitat may have been due in part to cultural beliefs. In the symbolism of the forces of nature, the tiger and the dragon represented the *yin* and the *yang* of weather: the dragon represented life-giving rain, spring time, and the east, the direction from which the rains came; the tiger symbolized drought, autumn, and the west, the direction from which dry, cold winds came. The rains came, Chinese peasant farmers believed, when the sleeping dragon arose from the depths of the water and ascended into the heavens, while drought was explained by the unwillingness or inability of the dragon to emerge from the water. In these instances, it was necessary to rouse the dragon, and so a tiger skull was dragged through pools in an attempt to arouse the dragon and bring the rains.[132] It is tempting to think that Chinese peasants, believing that tigers were a baleful influence on the rains, would not have objected to their wholescale destruction. Even if these beliefs did not cause Chinese peasant farmers to burn off the hills, neither did they provide any restraint.

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[131] Qu Dajun, *Guangdong xinyu*, p. 531.

[132] For descriptions of the drought-prevention ceremonies, see M. W. de Visser, *The Dragon in China and Japan* (Weisbaden, 1969): 119-120.

The accumulated evidence thus suggests the rapid deforestation of Lingnan in the eighteenth century, coincident with the population and cultivated land areas surpassing previous peaks in the Song and Ming, and with official state policy after 1740 encouraging the clearance of the hill country and the periodic—if not annual—burning of grass off the hills. If, as Ling Daxie has estimated, forests in 1700 had covered about half of the land area of Lingnan, decreasing to 5-10 percent by 1937,[133] then most of that deforestation and loss of habitat occurred during the eighteenth century.

THE END

By 1800, the landscapes of Lingnan had been made and remade, and the Chinese had left evidence of their transformations of the land not just in the landscape, but in written records as well. Deng Bi'nan, the official we met at the beginning of this paper writing in the "local products" section of the 1811 local gazetteer for Leizhou prefecture, thus was living at a time when the pace of environmental change was noticable. If land clearance destroyed the habitat of the tiger, pushing it to edge of extinction, the same fate awaited other wildlife too, as Deng reported. We can imagine Deng, an observant, curious, and scholarly man, turning to written records to find that they confirmed his feeling that species had been disappearing. With his observations confirmed by the written record, Deng then lamented both the passing of various species, and his fate at having recognized what was happening: "The reason these extinctions were not recorded before is that people then said that extinction was not possible…Today it is my task to record for posterity these extinctions in the appendix [to the local products section of the Leizhou gazetteer], [in the hope that my records will be of use] for later research."[134]

Deng was not living in a scholarly vaccum in Qing China, for there was a long tradition of research with which he was no doubt familiar and which conditioned his views of the extent and causes of environmental change. Following the ancient Confucian injunction from *The Great Learning* —"the extension of knowledge lies in the investigation of

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[133]Ling Daxie, "Wo guo senlin ziyuan de bianqian," *Zhongguo nongshi* 1983.2: 25-35.
[134]*Leizhou fuzhi* (1811 ed.): juan 2: 67a-b.

things"[135]—Chinese naturalists long had compiled treatises on plants and animals. One of the more recent (to Deng) would have been the early-eighteenth-century work by Chen Yuanlong, the *Perspective of Scientific and Technological Origins*, a work that included a wealth of information from rare and now lost books on plants and animals.[136] Whether Deng actually consulted that specific work or not, and who else in his time he might have discussed his ideas with, is not known. But the point is that Deng understood that he was writing in a specific scholarly tradition, and that his findings would be useful "for later research" of that particular scholarly community.[137]

Indeed, the seventeenth and eighteenth centuries had seen the flourishing of a new school of scholarship, the "kaozheng," or evidential scholarship. Deriving from a central concern for the reconstruction of antiquity based on rigorous study and critique of Han-era texts, kaozheng scholarship expanded in the eighteenth century to encompass most branches of knowledge as understood by the Chinese, including natural studies and historical geography. Kaozheng scholars kept notebooks for recording pertinent information as they read, and to note the sources of their information. Scholarly findings were passed via private meetings and letters among the scholarly elite.[138]

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[135]A chapter of a longer work, *The Great Learning* originally had been attributed to Confucius, but more probably it was the work of one of Mencius's students. In the twelfth century, the Neo-Confucian Zhu Xi canonized it as one of the Confucian classics. Needham rightfully sees the quotation as the inspiration of a vast Chinese tradition of scientific inquiry. Joseph Needham, *Science and Civilization in China*, vol. 6 *Biology and Biological Technology*, Part 1 *Botany* (Cambridge and New York: Cambridge University Press, 1986): 214.

[136]Ibid., 213.

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[138] Ibid., 174-77.

What Deng could not anticipate, of course, is how rapidly the world within which he lived, the one defined by the dynamics of the Chinese trade-tributary empire and the concerns of Confucian statecraft, soon would become enmeshed in the new world of competing, warring nation states emanating from Western Europe, bringing an end to his other-ordered world. His work thus was not useful for "later research" as he understood it, but rather to an American historian at the end of the twentieth century.

Deng Bi'nan's lament, while providing evidence of extinction, also points to the significant question of causation of environmental change. For Deng, the world he lived in provided ample evidence of the anthropogenic origins of extinctions. Everywhere throughout Lingnan there were reminders of the power of the Chinese people to remake the landscape. Near Guilin was the Lingqu Canal, built by orders of the First Emperor of Qin to link Lingnan's river systems with the Yangzi River; in northern Guangdong was the Meiling Pass, "chiseled" in 716 to facilitate trade from Guangzhou; in a prefecture neighboring Leizhou, a magistrate had redirected the flow of a river to increase irrigation to agriculture; and in Leizhou itself, seawalls some 25,000 *zhang* long (about 50 miles) constructed in the Song created over 10,000 *qing* of land.[139] Additionally, as I have shown in this paper, Chinese had created the malaria-free Pearl River delta; the human population had increased so much in Deng's time that they pressed everywhere in Lingnan, eliminating the frontier; with the encouragement of their emperors, they cleared and terraced mountains to plant food; to meet foreign demand for their products, they tore up and replaced rice paddies with cane fields or fish ponds and mulberry trees; and to feed the urban population, they moved grain huge distances from where it was produced to where it was consumed. In short, there was ample evidence everywhere Deng looked of both changes in the land, and of the causes of those changes: people.

That insight, of course, has a particularly contemporary ring, for it is quite different from the natural causes of extinction identified by nineteenth-century European scientists, including Darwin. So, which nineteenth-century body of thought is "true?" Deng's views—his scientific views—were grounded in his cultural, social, economic, and historic milieu. Does that make them "particular," "traditional," or "Oriental," as opposed to the universal, modern truths of Western science? Fortunately, social

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[139] *Guangdong tongzhi* (1822): 2085-86.

historians in the U.S. and Europe recently have dethroned the "heroic" model of science that arose in the culture wars of the Enlightenment and perdured through much of the twentieth century,[140] insisting instead that "the ideas of science are open to much the same kind of treatment as other ideas…Like all of man's [sic] intellectual life, scientific ideas grow out of specific cultural conditions and are validated by personal as well as social needs."[141]

Thus Darwin's ideas, as Donald Worster has shown, drew upon both Adam Smith's conceptualization of economic competition (reinforced by Darwin's encounters with the reality of industrialization in early-nineteenth century-London) and Malthus's "gloomy" explanation for the struggle for existence, thereby gaining acceptance in the Victorian world of raw capitalism and emergent imperialism: "The emphasis Darwin gave to competitive scrambling for place could not have been so credible to people living in another place and time."[142] Moreover, while Herbert Spencer usually is blamed for extending Darwin's ideas into "social Darwinism," providing a rationale for both ignoring the poor at home and conquering others (barbarians) abroad, the fact of the matter is that Darwin himself harbored those ideas, especially the latter. Toward the end of his life in 1881, Darwin opined that "the Caucasian races have beaten the Turkish hollow in the struggle for existence" and that "'an endless number of races' had to be wiped out by 'the higher civilized races'" for progress to occur.[143] In brief, since nature was an efficient economy, capitalism thus was natural, and Western dominance of the globe was inevitable. To most of the world's regret, we have lived with those equivalencies ever since. How different might the world have been had Deng Bi'nan's views instead spread to the West?

However congenial it might be for early-twenty-first century environmental historians to consider, Deng Bi'nan's view of the anthropogenic causes of environmental change was not "precocious," in the sense of an early flowering, for it came toward the end of 2,000 years of China's imperial history, not at the beginning of the "modern" world. Hence

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[140]Joyce Appleby, Lynn Hunt, and Margaret Jacob, *Telling the Truth about History* (New York and London: W. W. Norton and Co., 1994).

[141]Worster, x-xi.

[142]Ibid., 169.

[143]Ibid., 165.

his view of the anthropogenic, rather than natural causes, of extinction should be characterized more like Marx (famously paraphrasing Hegel) did the owl of Minerva, spreading its wings only as darkness began to fall.[144]

[144]G. W. F. Hegel, in the Preface to *The Philosophy of Right*, T. M. Knox, trans. (Chicago, London, and Toronto: Encyclopedia Britannica, 1952): 9.