

# Why Europe and the West? Why Not China?

David S. Landes

**T**he world history of technology is the story of a long, protracted inversion. As late as the end of the first millennium of our era, the civilizations of Asia were well ahead of Europe in wealth and knowledge. The Europe of what we call the Middle Ages (say, tenth century) had regressed from the power and pomp of Greece and Rome, had lost much of the science it had once possessed, had seen its economy retreat into generalized autarky. It traded little with other societies, for it had little surplus to sell, and insofar as it wanted goods from outside, it paid for them largely with human beings. Nothing testifies better to deep poverty than the export of slaves or the persistent exodus of job-hungry migrants.

Five hundred years later, the tables had turned. I like to summarize the change in one tell-tale event: the Portuguese penetration into the Indian Ocean led by Vasco da Gama in 1498. This was an extraordinary achievement. Some scholars will tell you that it was some kind of accident; that it could just as easily have been Muslim sailors, or Indian, or Chinese to make the connection from the other direction. Did not the Chinese send a series of large fleets sailing west as far as the east African coast in the early fifteenth century—bigger, better and earlier than anything the Portuguese had to show?

Don't you believe it. These affirmations of Asian priority are especially prominent and urgent nowadays because a new inversion is bringing Asia to the fore. A "multicultural" world history finds it hard to live with a eurocentric story of achievement and transformation. So a new would-be (politically correct) orthodoxy would have us believe that a sequence of contingent events (gains by Portugal and then others in the Indian Ocean, followed by conquests by Spain and then others in the New World) gave Europe what began as a small edge and was then worked up into centuries of dominion and exploitation. A gloss on this myth contends that

a number of non-European societies were themselves on the edge of a technological and scientific breakthrough; that in effect, European tyranny (to paraphrase Thomas Gray's "Elegy Written in a Country Churchyard"), "froze the genial current of the [Asian] soul."

A variant on this history-as-accident (or luck) is the pendulum approach associated with Jack Goody's (1996) book, *East in the West*. Everything starts on an even keel thanks to the allegedly common heritage of the Bronze Age; but then different parts move ahead, only to be caught up and passed by others, which then lose ground to their predecessors. So Europe was just especially lucky, taking the lead at the crucial turn to the Industrial Revolution. But Asia's turn will now come; indeed is already coming. As Goody (pp. 231–232) writes: "[I]t is a pendular movement that continues today, with the East now beginning to dominate the West in matters of the economy." As for efforts to understand this European success—especially explanations based on allegedly deep characteristics that were present in Europe but wanting in China—such efforts are irrelevant, writes Goody (p. 238):

... since all these features must have been present [in China] at the earlier period. Those discussions can be seen for what they are, as representing the understandable but distorting tendency of Europeans to inflate their overall contribution to world society and even to 'Western civilisation', a tendency reinforced by their undoubted achievements over the past few centuries. Such inflation of oneself inevitably involves the deflation of others; self-congratulation is a zero-sum game.

But of course, Westerners were not alone in noticing some European deep characteristics. Thus Abu Talib, an Indian Muslim visitor to Britain late eighteenth century, commenting on British precocity in mechanization: "The British," he wrote (cited in Khan, 1998, p. 303), "were endowed with a natural passion for technical innovation. They possessed inventive skills and preferred to perform even minor routine jobs with the aid of mechanical instruments rather than manually. They had such great passion for the use of technical instruments that they would not perform certain tasks unless the necessary instruments were at their disposal." The French, he went on, were not like that.<sup>1</sup>

I shall return later to this revisionist debate. Here, suffice to say: 1) The Portuguese success was the result of decades of rational exploration and extension of navigational possibilities in an ocean (the south Atlantic) that was hostile to traditional techniques of navigation, which essentially involved following the coastline. This technological enhancement rested in turn on a systematic utilization of astronomical observations and calculations, taken from the Muslims and transmitted largely by Jewish intermediaries, which allowed the Portuguese to follow winds and currents across the south Atlantic, and then use a knowledge of latitude to swing back around the tip of Africa and into the Indian Ocean. 2) The Chinese

<sup>1</sup> Khan (1998, p. 328, n. 122) notes further that the Arabic lacked the vocabulary needed to speak of factory manufacture or machinery. For the latter, Abu Talib used "wheels and tools."

abandonment of westward exploration was partly the result of contingent political events; but at bottom it reflected the values and structures of Chinese society and civilization. 3) European exploitation of the breakthrough rested on a disparity of power technology (better powder and better guns) as well as on navigational superiority.

The extension of European power into other parts of the world was the expression of these and other disparities. Why other regions did not keep up with Europe is an important historical question, for one learns almost as much from failure as from success. It is not possible in brief compass, of course, to pose this question for every non-European society or civilization; but three do deserve serious reflection: Islam, China, and India. I shall focus in this essay on China.

### **The First Chance: Science without Development**

The one civilization that was in a position to match and even anticipate the European achievement was China. China had two chances: first, to generate a continuing, self-sustaining process of scientific and technological advance on the basis of its indigenous traditions and achievements; and second, to learn from European science and technology once the foreign “barbarians” entered the Chinese domain in the sixteenth century. China failed both times.

The first failure has elicited much scholarly inquiry and analysis. And yet it remains an abiding mystery. The China specialists tell us, for example, that in a number of areas of industrial technique, China long anticipated Europe: in textiles, where the Chinese had a power-driven spinning machine in the thirteenth century, some 500 years before the England of the Industrial Revolution knew water frames and mules; or in iron manufacture, where the Chinese early learned to use coal and probably coke (as against charcoal) in blast furnaces for smelting iron and were turning out perhaps as many as 125,000 tons of pig iron by the later eleventh century—a figure not achieved by Britain until 700 years later (Elvin, 1973, p. 85).<sup>2</sup> In general, one can establish a long list of instances of Chinese priority: the wheelbarrow, the stirrup, the rigid horse collar (to prevent choking), the compass, paper, printing, gunpowder, porcelain. (But not the horse-shoe, which implies that the Chinese did not make use of the horse for transport.)

The mystery lies in the failure of China to realize the potential of some of the most important of these inventions. One generally assumes that knowledge and know-how are cumulative and that a superior technique, once known, will domi-

<sup>2</sup> Elvin (1973) gives the figure as “between 35,000 to 40,000 tons and 125,000 tons,” but says he prefers the higher estimate. He relies here on Yoshida Mitsukuni, a Japanese specialist writing in 1967. Work by Hartwell (1966, p. 34), also advances the higher figure. In Hall (1985, p. 46), this becomes “at least 125,000 tons.” In this regard, Elvin (p. 285) quotes a description by Yen Ju-yu of iron works on the Hupei/Shensi/Szechwan borders with blast furnaces 18 feet high, using charcoal and hand-operated bellows (more than ten persons relaying one another) and working continuously. The iron was apparently used for castings, and there is no indication of further refining as either wrought iron or steel.

nate older methods and remain in use. But Chinese industrial history offers a number of examples of technological regression and oblivion. The machine to spin hemp was never adapted to the manufacture of cotton; cotton spinning was never mechanized; and coal/coke smelting was allowed to fall into disuse, along with the iron industry. Why, asks Elvin (1973, pp. 297–298)?

It would seem that none of the conventional explanations tells us in convincing fashion why technical progress was absent in the Chinese economy during a period that was, on the whole, one of prosperity and expansion. Almost every element usually regarded by historians as a major contributory cause to the Industrial Revolution in north-western Europe was also present in China. There had even been a revolution in the relations between social classes, at least in the countryside; but this had had no important effect on the techniques of production. Only Galilean-Newtonian science was missing; but in the short run this was not important. Had the Chinese possessed, or developed, the seventeenth-century European mania for tinkering and improving, they could easily have made an efficient spinning machine out of the primitive model described by Wang Chen. A steam engine would have been more difficult; but it should not have posed insuperable difficulties to a people who had been building double-acting piston flame-throwers in the Sung dynasty. The crucial point is that nobody tried. In most fields, agriculture being the chief exception, Chinese technology stopped progressing well before the point at which a lack of scientific knowledge had become a serious obstacle.

Why indeed? Sinologists have put forward several partial explanations. Those that I find most persuasive are the following.

First, China lacked a free market and institutionalized property rights. The Chinese state was always stepping in to interfere with private enterprise—to take over certain activities, to prohibit and inhibit others, to manipulate prices, to exact bribes. At various times the government was motivated by a desire to reserve labor to agriculture or to control important resources (salt and iron, for example); by an appetite for revenue (the story of the goose that laid the golden eggs is a leitmotif of Chinese history); by fear and disapproval of self-enrichment, except by officials, giving rise in turn to abundant corruption and rent-seeking; and by a distaste for maritime trade, which the Heavenly Kingdom saw as a diversion from imperial concerns, as a divisive force and source of income inequality in the ecumenical empire, and worse yet, as an invitation to exit. This state intervention and interference encountered evasion and resistance; indeed, the very needs of state compelled a certain tolerance for disobedience. Still, the goal, the aim, the ideal was the ineffable stillness of immobility. When in 1368 the new Chinese emperor inaugurated a native (Ming) dynasty to replace the defeated Mongol invaders, he ascended the throne in Nanjing as the Hongwu (“Vast Martial”) emperor. Let not the name deceive the reader: Hongwu’s goal was anything but war. He wanted rather to immobilize the realm. People were to stay put and move only with the permission of the state—at home and abroad. People who went outside China without permission were liable to execution on their return. The Ming code of core laws also sought to block social mobility, with severe penalties for those jumping professional

and occupational barriers. In this regard, Timothy Brook (1998, p. vii) cites in epigraph one of the Hongwu emperor's favorite moral dicta:

Let the state be small and the people few;  
So that the people . . . fearing death, will be reluctant to move great  
distances  
And, even if they have boats and carts, will not use them.  
So that the people . . . will find their food sweet and their clothes  
beautiful,  
Will be content with where they live and happy in their customs.  
Though adjoining states be within sight of one another and cocks crow-  
ing and dogs barking in one be heard in the next,  
Yet the people of one state will grow old and die without having had any  
dealings with those of another.

These matters reached a wretched climax under the Ming dynasty (1368–1644), when the state attempted to prohibit all trade overseas.<sup>3</sup> Such interdictions led of course to evasion and smuggling, with concomitant corruption (protection money), searches for contraband, confiscations and punishment. All of this necessarily acted to strangle initiative, to increase risk and the cost of transactions, and to chase talent from commerce and industry.

A second reason why China did not realize the economic potential of its scientific expertise involved the larger values of the society. The great Hungarian-German-French sinologist, Etienne Balazs (1968 [1988]; see also Balazs, 1964), saw China's abortive technology as part of a larger pattern of totalitarian control. He recognizes the absence of freedom, along with the weight of custom and consensus and what passed for higher wisdom. His analysis (pp. 22–23) is worth repeating:

. . . if one understands by totalitarianism the complete hold of the State and its executive organs and functionaries over all the activities of social life, without exception, Chinese society was highly totalitarian. . . . No private initiative, no expression of public life that can escape official control. There is to begin with a whole array of state monopolies, which comprise the great consumption staples: salt, iron, tea, alcohol, foreign trade. There is a monopoly of education, jealously guarded. There is practically a monopoly of letters (I was about to say, of the press): anything written unofficially, that escapes the censorship, has little hope of reaching the public. But the reach of the

<sup>3</sup> The imperial authorities vacillated in their attitude to foreign trade, now favoring it, now clamping down; and these tergiversations were in themselves a deterrent to stable enterprise and capital accumulation. In addition, even when the state relented, it did so in circumstances that pushed the traders into illicit operations. Thus, the early Mongol (Yuan) dynasty (1280–1368) allowed freedom of enterprise, but then succumbed to the temptation of instituting a licensing system. This enabled officials to play the role of capitalist, financing venturers and dividing profits 70-30: 70 for the official, 30 for the working trader. That was greedy, compared to the typical European 50-50 split. The traders presumably sought to conceal gains, but in the long run, trade had to suffer.

Moloch-State, the omnipotence of the bureaucracy, goes much farther. There are clothing regulations, a regulation of public and private construction (dimensions of houses); the colors one wears, the music one hears, the festivals—all are regulated. There are rules for birth and rules for death; the providential State watches minutely over every step of its subjects, from cradle to grave. It is a regime of paper work and harassment, endless paper work and endless harassment.

The ingenuity and inventiveness of the Chinese, which have given so much to mankind—silk, tea, porcelain, paper, printing, and more—would no doubt have enriched China further and probably brought it to the threshold of modern industry, had it not been for this stifling state control. It is the State that kills technological progress in China. Not only in the sense that it nips in the bud anything that goes against or seems to go against its interests, but also by the customs implanted inexorably by the *raison d'Etat*. The atmosphere of routine, of traditionalism, and of immobility, which makes any innovation suspect, any initiative that is not commanded and sanctioned in advance, is unfavorable to the spirit of free inquiry.

In short, to go back to Elvin (1973), the reason the Chinese did not develop based on their scientific knowledge is that no one was trying. Why try? Especially since the Chinese were not without their own quiet resources to thwart bureaucratic interferences and frustrations—reliance on personal and familial collaboration, for example, in place of arbitrary or institutional practice in business. In such matters, personal trust could yield more dependable performance than legal rules.

In all this, the contrast with Europe was marked. Where fragmentation and national rivalries compelled European rulers to pay heed to their subjects, to recognize their rights and cultivate the sources of wealth, the rulers of China had a free hand. Again Elvin (1973, pp. 224–225) captures some of this:

... it was the great size of the Chinese Empire which made the adoption of the policies of the Ming emperors possible. In a Chinese subcontinent made up of smaller independent states, like those of the Five Dynasties [907-960 C.E.] or the Ten Kingdoms, no government could have afforded to close itself off. International economic interdependence (as that between regions would have become) would have removed this option; and the need for diplomatic and military alliances, and revenue from foreign trade, would have made isolationism undesirable. With smaller states, there might also have been, as there was in north-western Europe in early modern times, a closer conscious identification of the governed with their countries and rulers. Prior to modern communications, the immensity of the empire precluded nationalism.

Whatever the mix of factors, the result seems to have been a curious pattern of isolated initiatives and sisyphian discontinuities—up, up, up and then down again—almost as though the society were constrained by a homeostatic braking mechanism or held down by a silk ceiling. The result, if not the aim, was a kind of

change-in-immobility; or maybe immobility-in-change. Innovation was allowed to go (was able to go) so far and no farther.<sup>4</sup>

The Europeans knew much less of these interferences. Instead, they entered during these centuries into an exciting world of innovation and emulation that challenged and tempted vested interests and kept the forces of conservatism scrambling. Changes were cumulative, news of novelty spread fast and a new sense of progress and achievement replaced an older, effete reverence for authority. This intoxicating sense of freedom touched (infected) all domains. These were years of heresies in the church, of popular initiatives that, we can see now, anticipated the rupture of the Reformation; of new forms of expression and collective action that challenged the older organization of society and posed a threat to other polities; of new ways of doing and making things that made newness a virtue and a source of delight.

Important in all this was the role of the Christian church in Europe as custodian of knowledge and school for technicians. One might have expected otherwise: that organized spirituality, with its emphasis on prayer and contemplation, would have had little interest in technology; and that with its view of labor as penalty for original sin, it would have had no concern to save labor. And yet everything seems to have worked in the opposite direction: The desire to free clerics from time-consuming earthly tasks led to the introduction and diffusion of power machinery and, beginning with the Cistercians in the twelfth century, to the hiring of lay brothers (*conversi*) to do the dirty work, which led in turn to an awareness of and attention to time and productivity. All of this gave rise on monastic estates to remarkable assemblages of powered machinery—complex sequences designed to make the most of the water power available and distribute it through a series of industrial operations. A description of the abbey of Clairvaux in the mid-twelfth century (cited in White, 1978, p. 245–246) exults in this versatility: “*coquendis, cribrandis, vertendis, terendis, rigandis, lavandis, molendis, molliendis, suum sine contradictione praestans obsequium.*” The author, clearly proud of these achievements, further tells his readers that he will take the liberty of joking (the medieval clerical equivalent of, “if you’ll pardon the expression”): the fulling hammers, he says, seem to have dispensed the fullers of the penalty for their sins; and he thanks God that such devices can mitigate the oppressive labor of men and spare the backs of their horses.

Why this peculiarly European joy in discovery? This pleasure in the new and better? This cultivation of invention—or what some have called “the invention of invention”? Different scholars have suggested a variety of reasons, typically related to religious values. One possible reason grows from the Judaeo-Christian respect for manual labor, summed up in a number of biblical injunctions. One example will suffice: when God warns Noah of the coming flood and tells him he will be saved, it is not God who saves him. “Build thee an ark of gopher wood,” says the Lord, and

<sup>4</sup> For example, Max Weber (1922 [1951], as cited in Hall, 1985, p. 41) argued that the administrative bureaucracy was undermanned, so that government came to know and respond to changes only after they had gotten under way. Hence a pattern of “intermittent and jerky” homeostatic interventions.

Noah builds an ark to divine specifications. A second and related reason is the Judaeo-Christian subordination of nature to man. This belief is a sharp departure from widespread animistic beliefs and practices that saw something of the divine in every tree and stream (hence the naiads and dryads). Ecologists today might say these animistic beliefs were preferable to what was put in their place, but no one was listening to pagan nature-worshippers in Christian Europe. A third reason stems from the Judaeo-Christian sense of linear time. Other societies thought of time as cyclical, returning to earlier stages and starting over again. Linear time can be thought of as progressive or regressive, as moving on to better things or declining from some earlier, happier state. For Europeans in our period, the progressive view prevailed.

In the last analysis, however, I would stress the role of the market: the fact that enterprise was free in Europe, that innovation worked and paid, that rulers and vested interests were narrowly constrained in what they could do to prevent or discourage innovation. Success bred imitation and emulation; also a sense of power that would in the long run raise men almost to the level of gods. The old legends remained—the expulsion from the Garden, Icarus who flew too high, Prometheus in chains—to warn against hubris. The very notion of hubris—cosmic insolence—is testimony to some men’s pretensions and the efforts of others to curb them. But the doers were not paying attention.

## **The Second Chance: Learning from the Barbarians**

At the time the first Europeans arrived in the Indian Ocean and made their way to China, the Celestial Empire as it was called was, at least in its own eyes, the premier political entity in the world—first in size and population, first in age and experience, untouchable in its cultural achievement, apparently imperturbable in its sense of moral and spiritual superiority.<sup>5</sup> The Chinese lived, as they thought, at the center of the universe; around them, lesser breeds basked in their glow, reached out to them for light, gained stature by doing obeisance and offering tribute. Their emperor was the “Son of Heaven,” the unique, godlike representative of celestial power. Those few who entered his presence showed their awe by kowtowing—kneeling and touching their head nine times to the ground; others kowtowed to anything emanating from him—a letter, a single handwritten ideograph. The paper he wrote on, the clothes he wore, everything he touched partook of his divine essence. Western diplomats allowed the Chinese to compel them to these gestures, which they “considered an essential part of a tributary system of foreign relations” (Spence, 1998, p. 42). By doing this, “the Westerners were

<sup>5</sup> These Portuguese sailors of the sixteenth century were of course not the first Europeans to make their way to China. The best known of the earlier visitors is Marco Polo, who came in the thirteenth century from Venice, then the richest city in Europe, yet thought it a small town by comparison with what he saw in Cathay.



unwittingly shoring up the Qing court's views of China's superiority" (Spence citing Wills, 1984).

Those who represented the emperor and administered for him were chosen on the basis of competitive examinations in Confucian letters and morals. These mandarin officials were in effect the embodiment of the higher Chinese culture, invested with its prestige, imbued with its wholeness and sublime superiority. Their self-esteem and haughtiness had ample room for expression and exercise on their inferiors and were matched only by their "stunned submissiveness" and self-abasement to superiors (Welsh, 1993, p. 16, who in this case quotes without reference). Nothing conveyed so well their rivalry in humility than the morning audience, when hundreds of courtiers gathered from midnight on and stood about in the open air, in rain and cold and fair, to wait for the emperor's arrival and perform their obeisance. They were not wasting time; their time was the emperor's. They could not afford to be late, and punctuality was not enough: unpunctual earliness was proof of zeal (Landes, 1983; see also Huang, 1981).

Such cultural triumphalism combined with petty downward tyranny made China a singularly bad learner. What was there to learn? This rejection of the strange and foreign was the more anxious for the very force of the arrogance that justified it. For that is the paradox of the superiority complex: it is an expression of insecurity. It is intrinsically brittle; those who nourish it, need it, and depend on it are also those who fear nothing so much as contradiction. The French today are so persuaded of the superiority of their language that they dither and tremble at the prospect of a borrowed word, especially if it comes from English. The same holds for Ming China: they were so convinced of their ascendancy that they quaked before the challenge of Western technology, which was there for the learning.

The irony is that those first Portuguese visitors and Catholic missionaries used the wonders of western technology to charm their way into China. The mechanical clock was the key that unlocked the gates. The mechanical clock was a European mega-invention of the late thirteenth century, crucial not only for its contribution to temporal discipline and productivity, but its susceptibility of improvement and its role at the frontier of instrumentation and mechanical technique. The water clock is a dunce by comparison. For the Chinese in the sixteenth century, the mechanical clock came as a wondrous machine capable not only of keeping time but of amusing and entertaining. Some clocks played music; others were automata with figurines that moved rhythmically at intervals. Clocks, then, were the sort of thing that the emperor would want to see, that had to be shown him if only to earn his favor, that a zealous courtier had to show him before someone else did. But that was not so easy. This magical device had to be accompanied. Where all Chinese instincts and practice dictated that foreigners should be kept at a distance, confined to some peripheral point like Macao and allowed to proceed to the center only by exception, the clock, in its sixteenth-century avatar, needed its attendant clock-maker and keepers.

The Chinese loved clocks and watches. They were less happy, though, with their European attendants. The problem here was the Chinese sense of the wholeness of culture, the link between things, people and the divine. The Catholic priests

who first brought them these wonderful machines were salesmen of a special kind. They sought to convert the Chinese to the one true God, the trinitarian God of the Roman church, and the clocks were not only an entry ticket but an argument for the superiority of the Christian religion. Were not those who could make these things, who possessed all kinds of special astronomical and geographical knowledge to the bargain, were they not superior in the largest moral sense? Was not their faith truer, wiser? The Jesuits were prepared to make such an argument, stretching the while the rules and rites of the Church to fit the premises and win the sympathy of an understandably skeptical Chinese elite. (The Chinese ideographs for ancestor worship, for example, became the signifiers for the Christian mass.) But European laymen made the argument as well. Here is Gottfried Wilhelm von Leibniz (1646–1716), mathematician (coinventor of the calculus) and philosopher (as quoted in Landes, 1983, p. 45, from a letter written circa 1675):

What will these peoples say [the Persians, the Chinese], when they see this marvelous machine that you have made, which represents the true state of the heavens at any given time? I believe that they will recognize that the mind of man has something of the divine, and that this divinity communicates itself especially to Christians. The secret of the heavens, the greatness of the earth, and time measurement are the sort of thing I mean.

This argument, whether explicit or implicit, did carry occasionally. The Catholic missionaries had some small success, although they had trouble persuading their open-minded “converts” to be good exclusivists (no other faith but the “true” faith) in the European tradition. But most Chinese saw these pretensions for what they were: an attack on Chinese claims to moral superiority, an assault on China’s self-esteem.

The response, then, had to be a repudiation or depreciation of Western science and technology (Cipolla, 1967; Landes, 1983, chapter 2). Here is the K’ang Hsi emperor, the most open-minded and curious of men in his pursuit of Western ways, the most zealous in teaching them (as translated by Spence, 1974, p. 74): “[E]ven though some of the Western methods are different from our own, and may even be an improvement, there is little about them that is new. The principles of mathematics all derive from the *Book of Changes*, and the Western methods are Chinese in origin . . .”

That was the heart-warming myth. So the Chinese, who were not prepared to give up clocks, who wanted clocks, who recognized their Western origin—these same Chinese trivialized clocks as toys (which for many they were) or as nonfunctional symbols of status, unaffordable by or inaccessible to most. Premodern imperial China did not think of time knowledge as a personal right. The hour was sounded by the authorities, and the right to own a timepiece was a rare privilege. As a result, although the imperial court set up workshops to make clocks and got their Jesuit clockmakers to train some native talent, these Chinese makers never arrived at the level of Western horologists—for want of the best teachers and lack of commercial competition and emulation. Nor did imperial China ever develop a

clockmaking trade comparable to that found in European countries. The same sin of pride (or indifference) shaped the Chinese response to European armament. Here was something that was anything but a toy. Cannons and muskets were instruments of death, hence of power, and the Chinese had every reason to interest themselves in these artifacts, the more so as the seventeenth century saw the progressive dissolution of the Ming dynasty and the conquest of China by a Tartar people from the north. These were decades of war, and the balance of power might well be tilted by access to these European inventions.

Yet the Chinese never learned to make modern guns. Worse yet, they had known and used cannon as early as the thirteenth century but had forgotten much of what they had once known. Their city walls and gates had emplacements for cannon, but no cannon. Who needed them? The enemies of China did not have them. Yet China did have enemies, without and within, and no European nation would have been deterred from armament by enemy weakness; when it came to death, as in so many other things, the Europeans were maximizers. European technology was also monotonic-increasing: each gain was the basis for further gain. The Chinese record of advance followed by regression, step-forward, step-back, signaled an entirely different process. The Chinese, we are told, had a proverb: He who does not go forward will go backward (Peyrefitte, 1992, p. 157). The saying was apparently as much observation as prescription.<sup>6</sup>

So it was that in the seventeenth century, when the Portuguese in Macao offered three cannon to the emperor by way of gaining favor, they had to send three cannoneers along with them. Similarly, the Chinese hired on occasion Portuguese musketeers to do some fighting for them, and they got their Jesuit theologian-mechanicians to make them cannon. These cannon seem to have been among the best the Chinese had, so good compared to the run-of-the-foundry product that some were still in use in the nineteenth century, some 250 years later. If most Chinese guns did not last that long, it was because they were notoriously unreliable, more dangerous to the men who fired them than to the enemy. We even have one report of the use of clumps of dried mud as cannonballs. These at least had the merit of allowing the force of the explosion to exit by the mouth of the tube. In general, the authorities frowned on firearms, perhaps because they doubted the loyalty of their subjects (Cipolla, 1966, especially pp. 116–119).<sup>7</sup> In view of the inefficacy of these pieces, one wonders what they had to fear. Presumably the improvement that comes with use.

All of this may seem irrational to a means-ends oriented person, but it was not quite that; the ends were different. The European may have thought that the

<sup>6</sup> Students of the history of Chinese technology and science, most notably Joseph Needham and his team, have made much of Chinese priority in discovery and invention, pushing the origins of important techniques and devices far back, well before their appearance in Europe. They see this quite properly as a sign of exceptional creativity and precocity, as discussed earlier in this paper, but they would do well then to ask why the subsequent retreat and loss.

<sup>7</sup> Cipolla (1966) is not a sinologist and had to rely exclusively on European sources, including the testimony of Christian missionaries and travelers, but his “global vision” gives him crucial insights that are missing in the specialist literature. *Guns, Sails, and Empires* is a remarkable book.

purpose of war was to kill the enemy and win; the Chinese, strong in space and numbers, thought otherwise. Here is Mu Fu-sheng (1963, pp. 76–77, a pseudonym cited in Cipolla, 1966, p. 120) on the imperial viewpoint:

. . . military defeat was the technical reason why Western knowledge should be acquired, but it was also the psychological reason why it should not be. Instinctively the Chinese preferred admitting military defeat, which could be reversed, to entering a psychological crisis; people could stand humiliation but not self-debasement . . . . The mandarins sensed the threat to Chinese civilization irrespective of the economic and political issues, and they tried to resist this threat without regard to the economic and political dangers. In the past the Chinese had never had to give up their cultural pride: the foreign rulers always adopted the Chinese civilization. Hence there was nothing in their history to guide them through their modern crisis.

Along with Chinese indifference to technology went imperviousness to European science. The same conditions applied. The Jesuits and other Christian clerics brought in not only clocks but (sometimes obsolete) knowledge and ideas. Some of this was of interest to the court: in particular, astronomy and techniques of celestial observation were extremely valuable to a ruler who claimed a monopoly of the calendar and used his mastery of time to impose on the society as a whole. The Jesuits, moreover, trained gifted Chinese students who went on to do their own work: mathematicians who learned to use logarithms and trigonometry and astronomers who prepared new star tables.

Little of this got beyond Peking, however, and the pride some took in the new learning was soon countered by a nativist reaction that reached back to long-forgotten work of earlier periods. One leader of this return to the sources, Wen-Ting (1635–1721), examined the texts of mathematicians who had worked under the Song dynasty (10th–13th centuries) and proclaimed that the Jesuits had not brought much in the way of innovation. Later on, his manuscripts were published by his grandson under the title “Pearls Recovered from the Red River” (as discussed in Taton, 1963–1966, volume 2, p. 592). The title was more eloquent than intended: by this time much of Chinese scientific “inquiry” took the form of raking alluvial sediment.

Meanwhile European science marched ahead, and successive churchmen brought to China better knowledge than their predecessors (though still well behind the frontier). Here, however, the churchmen were thwarted by the constraints of their mission. The Christian missionaries had laid so much stress on the link between scientific knowledge and religious truth that any revision of the former implied a repudiation of the latter. When in 1710 a Jesuit astronomer sought to use new planetary tables based on the Copernican system, his superior would not permit it, for fear of “giving the impression of a censure on what our predecessors had so much trouble to establish and occasioning new accusations against [the Christian] religion” (Taton, 1963–1966, volume 2, p. 590).

To recall these many instances of intellectual xenophobia is not to imply that

all Chinese were hostile to European ideas. We know that a few far-sighted officials and at least one emperor understood that the empire had much to gain by learning new ways.<sup>8</sup> They were thwarted, however, not only by the studied complacency of an insecure superiority—also by a sense of completeness<sup>9</sup>—but by the intrigue of a palace milieu where innovations were judged by their consequences for the balance of power and influence. No proposals were made that did not incite resistance; no novelties offered that did not frighten vested interests. At all levels, moreover, fear of reprimand (or worse) outweighed the prospect of reward. A good idea brought credit to one's superior; a mistake was invariably the fault of subordinates.

One consequence was a prudent, almost instinctive, resistance to change. This is the heart of the matter: the response to difference and change. The Jesuit missionary Louis Le Comte (1655–1728) deplored this conservatism (as quoted in Cipolla, 1966, p. 120): “They are more fond of the most defective piece of antiquity than of the most perfect of the modern, differing much in that from us [Europeans], who are in love with nothing but what is new.” George Staunton, secretary to what is called the Macartney embassy from Great Britain to China from 1792 to 1794, disheartened by Chinese indifference to suggestions for improvement of their canals, lamented (Macartney, 1804, volume 6, p. 6), “In this country they think that everything is excellent and that proposals for improvement would be superfluous if not blameworthy.” A half-century later a Christian friar, Evariste Huc (1844–1846, volume 6, p. 81), discouraged perhaps by the sisyphian task of missionizing, despairingly observed: “Any man of genius is paralyzed immediately by the thought that his efforts will win him punishment rather than rewards.”

Another consequence was a plague of lies and misinformation: officials wrote and told their superiors what they wanted to hear; or what the subordinate thought the superior would want to hear.<sup>10</sup> The smothering of incentive and the cultivation of mendacity are characteristic weaknesses of large bureaucracies, whether public or private (business corporations). These are composed of nominal colleagues, who are supposedly pulling together but in fact are adversarial players. What is more, they compete within the organization, not in a free market of ideas, but in a closed world of guile and maneuver. Here the advantage lies with those in place. Reformers and subversives beware.

The rejection of foreign technology was the more serious because China itself had long slipped into a regime of technological and scientific inertia, coasting along on the strength of previous gains and slowly losing speed as a result of the

<sup>8</sup> The curse of foreignness remained though. In a letter of November 1640, the Jesuit von Bell wrote: “The word *hsi* [Western] is very unpopular, and the Emperor in his edicts never uses any word than *hsin* [new]; in fact the former word is used only by those who want to belittle us” (Taton, 1963–1966, volume 2, p. 589, n. 1).

<sup>9</sup> For a discussion in this spirit, see Crone (1989, pp. 172–173): “China is a star example of a successful civilization. . . . China reached the pinnacle of economic development possible under pre-industrial conditions and stopped: no forces pushing it in a different direction are in evidence. . . .”

<sup>10</sup> This is one of the major contributions of Peyrefitte's (1992) book. Because he gained access to the Chinese archives, including papers read and annotated by the emperor, Peyrefitte is able to show the inner workings of bureaucratic equivocation and offer a valuable case study.

inevitable frictions of vested interest and diversion of talent and wealth into the comfort and gratification of gentility. It has been argued that such retirements from the fray should not deter ambitious newcomers; on the contrary, the prospect of happy exits should encourage entry, and departures should make room for others. But in most aristocratic societies, the availability of more esteemed careers seems to divert talent from commerce and industry by offering short cuts to high status. The withdrawal of successful merchants into land and office is seen as a logical promotion, a legitimate escape. In such circumstances, the presence of groups precluded by birth (thus merchants in Tokugawa Japan) or belief (Protestant dissenters in England) from access to office and honors—the existence, in other words, of a reserved pool of talent—may paradoxically be a strong contribution to otherwise inhibited economic development.

### Why Did China “Fail”?

One of the great mysteries of Chinese history is why China did not produce from within the kind of scientific and industrial revolutions that gave Europe world dominion. A thousand years ago, the Chinese were well ahead of anyone else and certainly of Europe. Some would argue that this superiority held for centuries thereafter. Why, then, did China “fail”?

Some China scholars would mitigate the pain by euphemism, as in Fairbank and Reischauer (1960, p. 291, cited in Oshima, 1987, p. 34): “Chinese society, though stable, was far from static and unchanging . . . the pace was slower . . . the degree of change less . . .”<sup>11</sup> (True, but the issue remains.) Others would dismiss the question as unanswerable or illegitimate. *Unanswerable* because it is said to be impossible to explain a negative. (This is certainly not true in logic; the explanation of large-scale failure and success is inevitably complicated, but that is what history is all about.) *Illegitimate* because where is the failure? The very use of the word imposes non-Chinese standards and expectations on China. (But why not? Why should one not expect China to be interested in economic growth and development? To be curious about nature and want to understand it? To want to do more work with less labor? The earlier successes of China in these respects make these questions the more pertinent and acute.)

What about the relations between science and technology? Did the one matter to the other? After all, science was not initially a major contributor to the European Industrial Revolution, which was built largely on empirical technological advances by practitioners. What difference, then, to Chinese practitioner technology if science had slowed to a crawl by the seventeenth century?

The answer, I think, is that in both China and Europe, science and technology were (and are) two sides of the same coin, two manifestations of a common

<sup>11</sup> Indeed, Fairbank and Reischauer (1960) suggest that the reason for Chinese “stability” was “the very perfection that Chinese culture and social organization had achieved by the thirteenth century.” The contrast with Europe, roiling with imperfection, could not be sharper.

approach to problems and experience. The response to new knowledge of either kind is of a piece, and the society that closes its eyes to novelty from one source has already been closing them to novelty from the other.

In addition, China lacked the institutions that made for a cumulative process of finding and learning: the schools, the academies, the learned societies, the challenges and competitions. The sense of give-and-take, of standing on the shoulders of giants, of collective as well as individual achievement, of an inherited but ever imperfect treasure, of progress—all of these were weak or absent in China. And this is another paradox. On the one hand, the Chinese formally worshiped their intellectual ancestors; in 1734 an Imperial decree required court physicians to make ritual sacrifices to their departed predecessors (Taton, 1963–1966, volume 2, p. 590). On the other, the Chinese showed a deplorable tendency to let the findings of each new generation slip into oblivion, to be recovered perhaps at a later date by antiquarian and archaeological research.<sup>12</sup>

The history of Chinese advances, then, is one of points of light, separated in space and time, unlinked by replication and testing, obfuscated by metaphor and pseudo-profundity, limited in diffusion (with no technology for diffusion comparable to European printing)—in effect, a succession of ephemera. Much of the technical vocabulary was invented for the occasion and fell as swiftly into disuse; so that later scholars spent much of their effort trying to decipher these otherwise familiar ideograms. Much thought remained mired in metaphysical skepticism and speculation. Here Confucianism, with its easy disdain for scientific research, which it disparaged as “interventionist” and superficial, contributed its discouraging word. A poem written in the early nineteenth century by the son of the then–prime minister, himself a high state dignitary, warned (as quoted in Taton, 1963–1966, volume 2, p. 593): “With the microscope you see the surface of things. . . . But do not suppose you are seeing the things in themselves.”<sup>13</sup>

The effect was discredit or indifference to science and technology, the greater for the want of mutual verification and support. This want of continuing intellectual exchange and reinforcement, this subjectivity, is what more than anything explains the uncertainty of scientific gains and the easy loss of impetus. Chinese savants had no way of knowing when they were right. It is subsequent research, mostly Western, that has discovered and awarded palms of achievement to the more inspired.

Small wonder that China reacted so unfavorably to European imports. European knowledge was not only strange and implicitly belittling. In its ebullience and excitement, its urgency and competitiveness, its brutal commitment to truth and efficacy (Jesuits excepted), it went against the Chinese mindset.

<sup>12</sup> This ongoing slippage happened in spite of considerable effort to collect knowledge and present it in encyclopedias. One such project, really a kind of anthology, may well have been the biggest project of its kind ever attempted: 800,000 pages (Spence, 1990, p. 86). But a plethora of encyclopedias is a bad sign: like still photographs, they are an effort to fix knowledge at a point of time. They are useful as reference works, especially for historians, but they can impede free inquiry.

<sup>13</sup> Of course, when the time came, one could find support in Confucianism for other positions. That is the nature of sacred writ: one can quote it to one’s purpose.

So the years passed, and the decades, and the centuries. China saw Europe leave it far behind. At first China was unbelieving and contemptuous. Later it became increasingly anxious and frustrated. From asking and begging, the Westerners became insistent and impatient. The British sent two embassies to China seeking improved trade relations: one headed by George Macartney in 1792 and a second headed by William Pitt Amherst in 1816. An underlying difficulty was that the Chinese were happy to sell to the British, but it was very difficult for the British to sell to the Chinese, except for silver and opium. After a series of diplomatic and trade confrontations, the First Opium War started in 1839. The British victory in that war resulted in the Treaty of Nanjing in 1842, which opened up Chinese ports to British ships, reduced Chinese tariffs on British goods, and ceded Hong Kong to the British.

### “There is Nothing We Lack”

Now England is paying homage.  
 My Ancestors' merit and virtue must have reached their distant shores.  
 Though their tribute is commonplace, my heart approves sincerely.  
 Curios and the boasted ingenuity of their devices I prize not.  
 Though what they bring is meager, yet,  
 In my kindness to men from afar I make generous return,  
 Wanting to preserve my good health and power.

Poem by the Qienlong Emperor on the occasion of the Macartney embassy (1793)

The Empire of China is an old, crazy, first rate man-of-war, which a fortunate succession of able and vigilant officers has contrived to keep afloat these one hundred and fifty years past, and to overawe their neighbours by her bulk and appearance, but whenever an insufficient man happens to have the command upon deck, adieu to the discipline and safety of the ship. She may perhaps not sink outright; she may drift some time as a wreck, and will then be dashed to pieces on the shore; but she can never be rebuilt on the old bottom.

George, Lord Macartney to his journal (cited in Welsh, 1993, p. 33)

The Chinese policy of superior indifference to Western things has been traditionally summed up in the dismissive letter of the Qienlong emperor (reigned 1736–1795) to George III, rejecting the British request of 1793 for trading rights and a permanent legation in Peking: “We have never set much store on strange and ingenious objects, nor do we need any more of your country’s manufactures.” So much for scientific instruments and technological devices. That is what I would call potent prose. It was by no means the only such contemptuous dismissal or trivial-



ization of foreign art and artifacts during these centuries of active contact (1550–1900). Thus, the Qienlong Emperor’s successor, receiving and dismissing Macartney’s successor Lord Amherst in 1816, told him in effect to get lost: “My dynasty attaches no value to products from abroad; your nation’s cunningly wrought and strange wares do not appeal to me in the least” (as quoted in Sahlins, 1988, pp. 10–11). These explicit expressions of contempt, coming as they did from the emperor himself, leave little room for extenuation. The historian, even the apologist, must deal with them—as the British had to. (They came back in 1839 with gunboats.)

Yet the argument has now been put forward that these back-of-the-hand dismissals were not a rejection of Western knowledge, but rather messages for internal consumption. The Manchu dynasty then ruling China was foreign, its legitimacy open to question. It could not afford to nourish its enemies by admitting to a lack of autonomy, an inferiority to other outsiders. (This very fear of yielding—the definition of learning as weakness!—is testimony in my opinion to cultural defensiveness and introversion.) In fact, this thesis continues, the Chinese were very much interested in Western techniques and artifacts, especially in the military realm. What they did not want to import was European ideologies; and these two, technology and ideology, were closely linked. It was the Christian missionaries who had done that, using, as we have seen, European knowledge and devices to suggest the superiority of European religion (Waley-Cohen, 1993). But this argument is not sustained by the facts nor is it persuasive in logic.

As to the facts: the Chinese long preceded the Europeans in the use of explosive powder, whether for display (fireworks) or use in weapons. Yet a study of their armament reveals a singular inability to enhance, by implication an indifference to, the destructive capacity of their bombards and cannon, to the point where they wreaked more fright than damage. Their very names bore witness to their inefficacy: thus we have the “nine-arrows, heart-penetrating, magically poisonous fire-thunderer,” a tube designed to blow a cluster of arrows in the direction of the enemy. Joseph Needham (1979) recognizes that these could not have gone very far, “since the gunpowder was not exerting its full propellant force.” But he conjectures that they might have some effect in close combat against lightly armored or unshielded personnel. Or the “eight-sided magical, awe-inspiring wind-and-fire cannon,” a vase-shaped bombard used to blow rubble and rubbish. Too bad those opposing these devices could not be told of their potent, magical, awe-inspiring names; they might have surrendered on the spot.<sup>14</sup>

Nor can one demonstrate a sustained and effective interest in European military technology by pointing to occasional instances of recourse to advice and

<sup>14</sup> The Chinese use of hyperbole in describing weaponry seems to be a convention, and historians would be well advised to contain their credulity. We have an account of firearms and explosives in the later Ming period that speaks of cannon that “when they strike a city wall can reduce it instantly to rubble”; and of bombards whose sighting devices are so accurate that one “might pick off a general or remove a prince,” as quoted in Elvin (1973, p. 94). For critical comments on the value of this weaponry, see Sivin (1978, p. 468). Elvin in fact is reasonably skeptical, if only because he wants to know why the Chinese started so fast and then slowed down.

technique from Jesuit missionaries. These good clerics were ready, in the cause of propagation of the faith (O Lord, what great things are done in thy name!), to teach the Chinese how to make and aim cannon. Adam Schall did this for the failing Ming dynasty, producing over 500 pieces of light artillery; and his successor Ferdinand Verbiest made another 500 over a period of 15 years (so two or three a month) for the Manchus. This small output—all the smaller because these guns had a deplorable tendency to blow up—found use on and off, remaining “an important part of the imperial arsenal until the end of the [Qing] dynasty” in the twentieth century. Similarly, we are told, a work on gunnery written by Schall in collaboration with a Chinese colleague and published in 1643 was revived and reprinted in 1841 at the time of the Opium War (Waley-Cohen, 1993, pp. 1521–1532).

Yet such longevity bespeaks a scarcely changing technology. What we have, in other words, is an accomplishment here, an event there, the import of a piece of knowledge and its sterilization. The contrast with the systematic, tireless pursuit of improved gun manufacture and gunnery in Europe, which enlisted the efforts of military and scientists, underlines not simply the backwardness of Chinese technology but, more important, the fundamental difference in attitude and approach.<sup>15</sup> What is more, the Chinese interest in European weaponry says little about a wider intellectual curiosity. It is a commonplace of the history of technological diffusion that the one thing that excites every ruler is the art of war. The Ottoman Turks learned little from the West other than the making of heavy cannon, and even there they continued to depend on European technicians. The Chinese, in seeking to make and use lighter artillery pieces, did better, but only because they borrowed later, when Europe had moved on from that technology. Imitation of Western clocks showed a similar pattern: China copied objects at or near the prevailing frontier, but did not adapt or improve.

As to logic: to see this kind of partial, episodic, intermittent appropriation, generally of knowledge and technique already obsolete in Europe, as evidence of an effective and continuing Chinese interest in science and technology is to be guilty of the fallacy of misplaced discreteness—to take points for a line. It may be important for reasons of self-awareness to chide European observers of the period for the complacency and sense of superiority they derived from their scientific and technological dominance. But it does not change the fact of dominance nor the high cost of Chinese self-sufficiency. If one is to feel superior, better to be superior; or better yet, to recognize the concurrent superiority of others.

The result of this line of thought is historiography handicapped by an ideological agenda. It tells the story that in the late eighteenth century, well before the Western incursion brought a new immediacy to the need for military reform, the Chinese were interested in technological advances and in what the West had to

<sup>15</sup> This improvement touched both the production of cannon (boring machine of Jean de Maritz) and the techniques of targeting and aiming. Leonhard Euler, a marvel of mathematical versatility, also played a key role in the measurement of longitude by lunar distances. On the advances in artillery, see Steele (1994).

offer. The evidence was readily available to Europeans who chose to grasp it. Yet in public the Chinese denied such an interest, primarily for reasons of domestic politics. Europeans, similarly influenced by developments at home, took that denial as evidence of an entire mental attitude: ingrained xenophobia and a concomitant resistance to progress. In the Age of Progress, such an attitude led automatically to the assumption that the Chinese were inferior beings (Waley-Cohen, 1993, pp. 1543–1544).

We know better today than to entertain such an assumption. Even so, the fact that Western Europe caught up with and passed China, leaving it far behind, has distressed numbers of Asia specialists. These have sought to exonerate China of the sin of failure either by blaming Europe (the crimes of imperialism) or by denying (delaying) the alleged Chinese shortfall, while stressing the many technological and scientific contributions of Asia to European civilization. Among the most vocal and influential of this sinophilic school: Janet Abu-Lughod (1989), André Gunder Frank (1998), Kenneth Pomeranz (2000) and John Hobson (2004). Against these, I would recommend a reading of the more realistic work of Joel Mokyr and Ricardo Duchesne (2006).

It is all well and good to point to the sin of Western pride, but not by inventing or avoiding reality. On the one hand, the Europeans could and did on occasion succumb to the temptations of arrogance; and then to their cost. In matters of science, for example, the French were particularly sensitive in their self-esteem and still are.<sup>16</sup> On balance, however, European opinion tended to rest on performance and achievement. European scientists rarely refused to learn or copy, and they were only too ready to revise their judgment when presented with the facts. (Scientists could also be ferociously dismissive, however, in disputes over priority.) The same for European travelers confronted with foreign achievement. To be sure, European judgments were based too much perhaps on their infatuation with material knowledge and achievement; hence the tendency to measure men by their ability to use and make machines. But of course, that is the kind of measure economists still use when we rank countries by product and income per head. China could have used some of this.

What all of this points to is the overwhelming importance of self-respect, the power of self-image to distort and mislead. Confronted with a near terminal case of cultural superiority in China, the historian is tempted to play the role of comforter and to stroke the object of his affections as the master a pet. That's all right for pets, which don't have to grow up, but not for countries, which do.

Imperial China open-minded, curious? No way.

<sup>16</sup> See Guerlac (1979) on the protracted French reluctance to accept Newtonian physics.

## References

- Abu-Lughod, Janet.** 1989. *Before European Hegemony*. New York: Oxford University Press.
- Balazs, Étienne.** 1964. *Chinese Civilization and Bureaucracy*. New Haven: Yale University Press.
- Balazs, Étienne.** 1968 [1988]. *La bureaucratie céleste: recherches sur l'économie et la société de la Chine traditionnelle*. Présentation de Paul Demiéville. Paris: Gallimard.
- Brook, Timothy.** 1998. *The Confusions of Pleasure: Commerce and Culture in Ming China*. Berkeley: University of California Press.
- Cipolla, Carlo M.** 1966. *Guns, Sails and Empires: Technological Innovation and the Early Phases of European Expansion, 1400–1700*. New York: Pantheon Books.
- Cipolla, Carlo M.** 1967. *Clocks and Culture, 1300–1700*. London: Collins.
- Crone, Patricia.** 1989. *Pre-Industrial Societies*. Cambridge, Mass.: Blackwell.
- Duchesne, Ricardo.** 2006. "Asia First?" *Journal of the Historical Society*, March, 6:1, pp. 69–91.
- Elvin, Mark.** 1973. *The Pattern of the Chinese Past*. Stanford: Stanford University Press.
- Fairbank, John King and Edwin O. Reischauer.** 1960. *East Asia: The Great Tradition*. Boston: Houghton Mifflin.
- Frank, André Gunder.** 1998. *Re-Orient*. Berkeley: University of California Press.
- Goody, Jack.** 1996. *The East in the West*. New York: Cambridge University Press.
- Guerlac, Henry.** 1979. "Some Areas for Further Newtonian Studies." *History of Science*, 17, pp. 75–101.
- Hall, John A.** 1985. *Powers and Liberties: The Causes and Consequences of the Rise of the West*. Oxford: Blackwell.
- Hartwell, Robert.** 1966. "Markets, Technology, and the Structure of Enterprise in the Development of the Eleventh-Century Chinese Iron and Steel Industry." *Journal of Economic History*, March, 26:1, pp. 29–58.
- Hobson, John M.** 2004. *The Eastern Origins of Western Civilisation*. New York, Cambridge University Press.
- Huang, Ray.** 1981. *1587, A Year of No Significance: The Ming Dynasty in Decline*. New Haven: Yale University Press.
- Huc, Evariste Régis.** 1844–1846 [1928]. *Souvenirs d'un voyage dans la Tartarie, le Thibet et la Chine*. New York and London: Harper & Brothers.
- Khan, Gulfishan.** 1998. *Indian Muslim Perceptions of the West During the Eighteenth Century*. Karachi: Oxford University Press.
- Landes, David S.** 1983. *Revolution in Time: Clocks and the Making of the Modern World*. Cambridge, Mass.: Belknap Press of Harvard University Press.
- Macartney, George Macartney.** 1804. *Voyage en Chine et en Tartarie*. J. B. J. Breton, trans. Paris: Chez la Veuve Lepetit.
- Mu, Fu-sheng.** 1963. *The Wiltling of the Hundred Flowers; The Chinese Intelligentsia under Mao*. New York: Praeger.
- Needham, Joseph.** 1979. *The Guns of Kaifeng-fu: China's Development of Man's First Chemical Explosive: The Creighton Trust Lecture*. London: University of London.
- Oshima, Harry T.** 1987. *Economic Growth in Monsoon Asia: A Comparative Survey*. Tokyo: University of Tokyo Press.
- Peyrefitte, Alain.** 1992. *The Immobile Empire*. Jon Rothschild, trans. New York: A. A. Knopf.
- Pomeranz, Kenneth.** 2000. *The Great Divergence: Europe, China, and the Making of the Modern World Economy*. Princeton: University Press.
- Sahlins, Marshall.** 1988. "Cosmologies of Capitalism: The Trans-Pacific Sector of the 'World System.'" *Proceedings of the British Academy*, 74, pp. 1–51.
- Sivin, Nathan.** 1978. "Imperial China: Has Its Present Past a Future?" *Harvard Journal of Asiatic Studies*, 38, pp. 449–80.
- Spence, Jonathan D.** 1974. *Emperor of China: Self-Portrait of K'ang Hsi*. New York: Vintage Books.
- Spence, Jonathan D.** 1990. *The Search for Modern China*. New York: Norton.
- Spence, Jonathan D.** 1998. *The Chan's Great Continent: China in Western Minds*. New York: Norton.
- Steele, B. D.** 1994. "Muskets and Pendulums: Benjamin Robins, Leonhard Euler, and the Ballistics Revolution (1742–1753)." *Technology and Culture*, 35:2, pp. 348–82.
- Taton, René, ed.** 1963–1966. *A General History of the Sciences, Four Volumes*. A. J. Pomerans, trans. London: Thames and Hudson.
- Waley-Cohen, Johanna.** 1993. "China and Western Technology in the Late Eighteenth Century." *American Historical Review*, December, 98:5, pp. 1525–544.
- Weber, Max.** 1922 [1951]. *The Religion of China: Confucianism and Taoism*. Hans H. Gerth, trans. and ed. Glencoe, Ill.: Free Press.
- Welsh, Frank.** 1993. *A Borrowed Place: The History of Hong Kong*. New York: Kodansha International.
- White, Lynn Townsend.** 1978. *Medieval Religion and Technology: Collected Essays*. Berkeley: University of California Press.
- Wills, John E., Jr.** 1984. *Embassies and Illusions: Dutch and Portuguese Envoys to K'ang-hsi, 1666–1687*. Cambridge, Mass.: Council on East Asian Studies, Harvard University.
- Wong R. Bin.** 1997. *China Transformed: Historical Change and the Limits of European Experience*. Ithaca: Cornell.