East Is East and West Is West

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The world history of technology is the story of a long, protracted inversion. As late as the millennium, the civilizations of Asia were well ahead of Europe in wealth and knowledge. The Europe of what we call the Middle Ages (say, 10th 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 sum the change in one tell-tale event: the Portuguese penetration into the Indian ocean. 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 grand inversion is bringing Asia to the fore and history (as discipline) runs to justify and sanctify events \textit{ex post}. A new “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; 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 “froze the genial current of the [Asian] soul.”

This is not the place to enter further into this revisionist debate. Suffice to say here:

(1) The Portuguese success was the result of decades of rational exploration and extension of navigational possibilities in an ocean that was hostile to traditional coasting techniques. 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.
(2) The Chinese abandonment 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 Europe should have been pulling ahead 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.

**ISLAM**

The first is Islam, which inherited and developed the knowledge and ways of predecessor civilizations (Greek, Persian) in the area of its extension, which by the period we are talking about (roughly 1000 to 1500), went from the western end of the Mediterranean to the Indies. Islamic science and technology far surpassed those of Europe, which needed to recover its heritage and did so to some extent through
contacts with the Muslim world in such frontier areas as Spain. Islam was Europe's teacher.

And then something went wrong. Islamic science, even at its peak, was denounced as heresy by religious zealots. Under theological pressures toward spiritual conformity, thinkers and searchers bent to curbs on intellectual speculation and the dissemination of ideas. Very understandable: discretion could be a matter of life and death. The point of the defenders of the faith was that the truth had already been revealed; what led to and promoted the truth was useful and permissible; all the rest was deceit and error. The historian Ibn-Khaldun, conservative though he was in religious matters, was dismayed by the Muslim suspicion of and hostility toward learning:

When the Muslims conquered Persia (637-642) and came upon an indescribably large number of books and scientific papers, Sa' id bin Abi Waqqas wrote to Umar bin al-Khattab asking him for permission to take them and distribute them as booty among the Muslims. On that occasion, Umar wrote him: 'Throw them in the water. If what they contain is right guidance, God has given us better guidance. If it is

In 885, all professional copyists in Baghdad were required to swear an oath not to copy books of philosophy. And although the Arabs were quick enough to use paper, they refrained from printing for almost three centuries after its introduction in Europe.

On the conflicts of Muslim science and Islamic doctrine, see Hoodbhoy, Islam and Science, especially chs. 9 and 10.
error, God has protected us against it.²

These fetters were the stronger in that Islam does not, as Christianity does, separate the religious from the secular. The two constitute an integrated whole. The ideal state would be a theocracy; and in the absence of such fulfillment, a good ruler is one who leaves matters of the spirit and mind (in the widest sense) in the hands of the doctors of the faith.

As for technology, Islam knew areas of change and advance: one thinks of the rapid adoption of paper; or the introduction and diffusion of new crops such as coffee and sugar, or the Ottoman Turkish readiness to learn the use of cannon. But most of this was learned from outside and continued to depend on outside support. The springs of autonomous invention, such as they were, seem to have dried up. Even in the golden age (750-1100), there seems to have been a disconnection between thought and application: "For nearly five hundred years the world's greatest scientists wrote in Arabic, yet a flourishing science contributed nothing to the slow

Ibn Khaldun, *The Muqaddima: An Introduction to History* (London: Routledge and Kegan Paul, 1978), p. 373, cited in Hoodbhoy, *Islam and Science*, pp. 103-4. We have an analogous example of arrant cynicism and zealotry in Christian annals: when the French "crusader" army sent to repress the Cathar heresy broke into Béziers and was permitted (ordered) to put its inhabitants to the sword, the commander was asked how they might distinguish the good Christians from the heretics, to which he replied: "God will know his own."
advance of technology in Islam.\(^3\)

What this tells us is that the opportunity for technological development was wanting; for although science and technology do not necessarily connect, the availability of scientific knowledge and, even more, the prevalence of scientific standards of inquiry and proof can and should substantially promote the pursuit of technical improvement. The European experience of this link was to prove very different.

Thus Islamic science and technology of the “golden age” lost their vitality and fell behind European developments. The one area of potential innovation was the dynamic Ottoman empire, which began in the 12th century as nothing more than a migrant Turkish camp in northwestern Anatolia, got drawn into the internecine struggles of Byzantium and profited by taking over what was left of Rome, went from conquest to conquest against both Muslim and Christian adversaries. At its peak in the 16th century, its dominion went from the Indian Ocean almost to the Atlantic and it was moving up the Danube into central Europe.

But that was it. From the time of the defeat of the first Ottoman siege of

Vienna (1529), the empire suffered repeated setbacks in Europe as inchoate Christian polities got organized and mobilized resources against the Muslim enemy. Among other changes that made a difference, European military technology kept improving, and while the Ottomans tried to keep up, they were imitators rather than inventors. They understood the value of cannon and especially of siege artillery, but they depended on Christian technicians to do the founding. As the gap between Christian and Muslim guns grew, especially in the realm of field artillery, the Turks could not even make use of pieces captured in battle.\textsuperscript{4}

The same at sea: the Ottomans replaced their battle vessels with more of the same, while Christian naval armament changed and improved. Listen to the Ottoman historian Selaniki Mustafa Efendi reporting on the arrival in 1593 of the vessel that brought the second English ambassador to the Sublime Porte: "A ship as strange as this had never entered the port of Istanbul. It crossed 3700 miles of sea and carried 83 guns, besides other weapons. The outward form of the firearms was in the shape of a swine."\textsuperscript{5} This picturesque image was unconscious testimony to ignorance: these were iron naval cannon, made in England in quantity as nowhere

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\textsuperscript{4} Cf. Jones, \textit{European Miracle}, p. 185, citing Braudel, \textit{La Méditerranée}.

\textsuperscript{5} Lewis, \textit{Muslim Discovery}, p. 161.
else. That ship and a few others like it could have blown the Ottoman fleet (and the Venetian to the bargain) out of the water before it could get close enough to ram or grapple. Meanwhile the Ottomans tried to keep up by importing large quantities of war materiel: muskets, gunpowder, saltpeter, iron, blades; and this in spite of papal interdictions, anathemas, and excommunications. Much of this armament came from Protestant England, which also sold cannon to Catholic Spain; but then, what to expect from conscienceless heretics?

And not only armament. Over time the trade relations between Europe and the Levant were reversed. Where once eastern craftsmen supplied the Europeans with fine cloth, carpets, tapestries, faience, and the like in exchange for metal (copper and tin), slaves, and specie, from the sixteenth century on, it was Europe that now sold the manufactures in exchange for dried fruit, spices, cotton, cereals. The same for silk: in the Middle Ages Europe had bought Byzantine silk fabrics; now they imported raw silk and local producers in Turkey found it hard to compete with European buyers. And paper: this writing material was eagerly adopted in the Middle East (eighth century) from Chinese example; because forage was short, hides were scarce and so was parchment. The technology was slower to take root in Europe where parchment was relatively abundant, but once European makers
learned to produce paper, they far surpassed their Levantine predecessors and were soon selling large quantities in the east. Even substances (coffee and sugar) that had originally come to Europe from the east, were now going the other way—in the case of sugar, after refining and processing.

The most serious mistake was the Muslim refusal of the printing press, which was seen as a potential instrument of sacrilege and heresy. Nothing did more to cut them off from the mainstream of knowledge. The downhill slide continued to a nadir in the eighteenth century, when the Moslem world had sunk to the lowest depth of its decrepitude .... The austere monotheism of Mohammad had become overlaid with a rank growth of superstition and puerile mysticism. The life had apparently gone out of Islam, leaving not but a dry husk of soulless ritual and degrading superstition behind. Could Mohammed have returned to earth he would unquestionably have anathematized his followers as apostates and idolators.

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8 These are the thoughts of a rationalist non-Muslim and date back three quarters of a century: Lothrop Stoddard, *The New World of Islam* (New York, 1922). Are they too strong? Stoddard has no use for mysticism, which may have brought more people to Islam than military conquest. I have this thought from Leila Fawaz, who points out that mysticism is alive and well to this day. The Stoddard quote comes from Qadir, *Philosophy and Science*, p. 122, who adds his own thoughts on the subject. "What [the Muslims] had were superstitions, outmoded beliefs and ideas, literalism, conformism, clinging to the past, wrangling over words, hostile to whatever was new and deviated from the set path."
As a result of this intellectual segregation, technical lag, and industrial dependency, the balance of economic forces shifted inexorably against the Ottomans, while the experience of military defeat undermined their assumptions of superiority and paralyzed their ability to respond. A few far-sighted observers tried to warn the ruling elite and recommend reform, but to little effect. The evil was constitutional, founded in religious dogma and inculcated by habit, by the selective memory of past successes, by the voluntary blindness of a byzantine bureaucracy, by an inability to understand and learn from the outside world. Of course it was easier to look for new enemies and new conquests—easier to look, but harder to do. Victims learn to resist.

The effect was disastrous. "The Ottoman state was a plunder machine which needed booty or land to fuel itself, to pay its way, to reward its officer class." The Ottomans had filled a power vacuum—taken over a region once strong, now enfeebled—looting as they went. Now, having reached their outer limit, they had to find a way to generate wealth from inside, promote productive investment. Instead they resorted to habit and tried to pillage the interior, to squeeze their own subjects.

Jones, *European Miracle*, p. 185.
Nothing, not even the wealth of high officials, was secure; and nothing could be more self-destructive. The only thing that saved the empire from rapid disintegration was its inefficiency, the venality of its officials (corruption as lubricant), and the protective interests of stronger powers. (This decline, once taken for granted by contemporaries and then historians, has since become the subject of debate. See below, Excursion No. 1.)

In these circumstances, the continued transformation of European technology, in particular the Industrial Revolution, sounded the death knell for what remained of Ottoman industry. Except for some local specialties, nothing could stand up to cheap factory-made cottons and silks. The nineteenth century saw Britain stand up for the Ottoman empire and protect it from the territorial ambitions of its adversaries, while blithely killing off its manufactures. But from the British point of view, that was as it should be: British goods were cheaper, and the Ottomans could not possibly compete. They did not know enough; they did not have the capital; they could not count on political stability. Let them grow grapes and turn them into raisins; let them export nuts and opium. The British would supply them with industrial products.
What about India? Why no industrial revolution?

India had the world's premier cotton industry in the seventeenth and eighteenth centuries, unbeatable for quality, variety, and cost. This was an industry that not only satisfied the large domestic demand but exported roughly half its output throughout the Indian Ocean and indirectly to southeast Asia and China. Then, beginning in the seventeenth century, there came the stimulus of European demand--a huge shot in the arm that inevitably aggravated old and created new supply problems. Why, then, was there no interest in easing these difficulties by substituting capital (machines) for labor?

Indian historians have tended to overlook or reject this issue. Some, especially Indian nationalists, feel they know the answer without seeking: it's all the fault of the Europeans, and most particularly the British. This was a prosperous, resourceful, developing economy until these intruders burst on the scene, began to mix into Indian politics, and fomented rebellion and conflict destructive of capital and industry. Some of this speculation is fantasy, and misdirected at that. One historian, for example, looks at the royal workshops (the karkhanas) of seventeenth-
century India and dreams wistfully of a technological revolution: "One is tempted to speculate if [they] might not have moved in the direction of mechanization and become the state model factories for the modern industrialization of India, had they not been terminated by the British conquest of the country."\(^{10}\) This, of an institution that could buy or command labor at will!

Other scholars have reacted against a picture of technological stagnation--yes, India too resents and decries its "black legend"--and have chosen to "accentuate the positive": the ubiquity of change, the movements of capital, the social and geographical mobility.\(^{11}\) Some of these look so hard at the overall economic picture that they manage to omit the textile industry from their discussion; focusing down on local and regional details, they sacrifice direction (trend) to diversity. And some scholars will not even talk about development, much less about mechanization and industrial revolution, because this would subject India to standards set by other societies. Heaven forfend!

One way to approach the problem of nondevelopment, which is worth taking


seriously, is to ask the critical question, *cui bono*, who would have benefited? Who would have gained from mechanization and transformation? Three groups or interests were involved: the workers (spinners and weavers); the middlemen, who typically advanced capital to the weavers against the promise of delivery; and the European traders and chartered companies, who wanted to buy for both the country (intra-Asian) trade and their European clientele.

It would be unreasonable to expect capital-using technological innovations from the first group. They had an obvious interest in improving the availability of materials (cotton fiber for spinners, yarn for weavers), but here they were simply dependent on merchant intermediaries. They had neither means nor the habit of command. A leading Indian economic historian cites as exceptional a "mutiny" of weavers in 1630 to protest against English competition for cotton yarn, and goes on: "Such instances of resistance were rare and have to be read together with the fact that the use of the horsewhip by the merchants' servants was accepted as a normal fact of life by most artisans."12

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12 Raychaudhuri, "Non-Agricultural Production," p. 286. The essay also makes the point that "mercantile profit, a major source of high income which contributed to the upward mobility of artisans in Europe, was virtually absent in the Indian case" (p. 285). Also that artisans in India, unlike those in Europe, did not (could not) invest in urban real estate as a source of rental income and a way of accumulating capital (p.289). The housing was in general too flimsy to serve as
If there was to be any initiative in the direction of technological change, then, it would have to come from the Indian middlemen, who had both interest and, some of them, means; or from the European chartered companies. Yet neither moved.

Why not? The explanations that have been advanced have been based on an implicit law of conservation of energy. The supply of labor was elastic, so it was easier and more economical to hire additional workers, from among untouchables and poor women for spinning, from agricultural laborers for weaving, than to look to change the technology; and that may well be the whole of the story. It was also possible within limits (demand was segmented and different markets wanted different goods) to shift goods among markets, from domestic to foreign and from one foreign to another.

It was even possible, though very difficult, to assemble large numbers of workers "under one roof" (in one place), to toil under supervision. This was the sort of thing the foreign trading companies tried to do, by way of ensuring prompt completion of tasks. In some instances such concentration yielded economies of security for mortgage loans.

13 Cf. Raychaudhuri, "Non-Agricultural Production," p. 295. "If necessity is the mother of invention, its pressure in the Indian case was not insistent."
scale and materials—in fuel-using branches, for example, or in assembly work such as shipbuilding. Technological change, then, in the form of organizational innovation, was not unknown. Such enterprises, however, remained the exception; "the small-scale family-based unit [retained] its position of primacy."^{14}

Hardware—instruments, equipment, machines—was another matter. This is what it took to make an industrial revolution, and India was not ready. "In India it is seldom that an attempt is made to accomplish anything by machinery that can be performed by human labour."^{15} One reason for this "general indifference": limited division of labor and specialization. No one seems to have thought much about simplifying and easing tasks. Both worker and employer saw hard labor as the worker's lot, and each in his own way saw this as appropriate. Indifference, moreover, was promoted by functional segmentation: it was not the merchant's job to find, assemble, and deliver the raw materials. He advanced capital, and it was up to weaver and spinner to do the rest. This was significantly different from putting-out as practised in Europe, where the merchant was directly linked to the


preparation and processing (preparing and finishing) of the materials.

In India, then, the final buyer was cut off from the means of remedy. The worker did what he had always done, and so did the merchant. The Dutch records tell us that merchants kept weavers "on a short leash," paying them by the day so that they could not get ahead and run off, presumably with the goods. \(^{16}\) And some merchants hired agents to keep an eye on the weavers and check their progress. The aim here was to prevent the weaver, who invariably consumed his advance by the time he finished the work, from selling his finished piece to another buyer. We hear of agents who would enter the weaver's house and cut the cloth from the loom, even though not completely done. Come back a day later, and it might be gone, and nine tenths of a piece was better than none.

The European companies in turn learned to accommodate to these irregularities. Cotton markets failed at times, but both Indians and Europeans seem to have viewed these lapses as a fact of life. Like famines: This too shall pass. The industry seems to have followed its own leisurely pace, which was not irrational. (It is ends that determine which means are rational.) In the Coromandel, for example,

\(^{16}\) Brennig, "Textile Producers," p. 86. The words in quotes are his.
the raw cotton was moved from the interior to the spinning and weaving villages on and near the coast by huge trains of bullocks numbering in the thousands and tens of thousands, the whole shapeless mass feeding while shambling along at a rate of a couple of miles a day. Since the trek covered some three hundred or more miles, it took about half a year to deliver the goods.17

Meanwhile the European companies' own rhythm of purchases and shipments was spasmodic because of the constraints of navigation and availability of capital, to say nothing of fluctuations in supply. Data, for example, on shipments by the East India Company of textiles from Bombay show an extraordinary variance, ranging from a few thousand (zero in one year) to almost a million pieces.18 The companies' remedy was to keep large stocks and time their auction sales to match fluctuations in European demand. (Their merchant purveyors meantime did their best to divert to them shipments normally destined to other markets.) All of this was costly enough without engaging or investing in the transformation of technology.

Besides, it was not obvious to these companies—certainly not to the East

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17 On these Banjara (a nomadic caste) caravans, Habib, *Agrarian System*, p. 62, and Brennig, "Textile Producers," pp. 68-69. As Brennig puts it, "time was of little importance."

India Company—that direct assistance to the Indian industry was politically wise. British manufacturing interests would have seen that as an act of treason. Toward the end of the seventeenth century a pamphleteer denounced the prospect that merchants would send over to India “Cloth-Weavers, and Dyers, and Throwsters, as well as Silk.” Do that, he warned, and “I question not but we shall have Cotton-Cloth and Knaves enough to make it a fashion and Fools enough to wear it.” The Company made haste to deny the charge. The EIC was under constant attack as an exporter of bullion; it did not need the additional onus of being tarred as an exporter of jobs.

Finally, where were the ideas and concepts of mechanization to come from? It was not that Indian society was unfamiliar with technological change: the most important in the textile manufacture came with the substitution of the wheel for the distaff (though not for the finest muslin yarn). But these changes took place within the conventional manual context, and a big conceptual and social difference separates machines and hand tools, even improved tools. One must distinguish further between all-purpose tools and specialized: Indian artisans, however skilled,
had scarcely started on the path to instrumentation. Here is Major Rennell, the first surveyor-general of Bengal, on a visit in 1761 to the Bombay shipyard: "... the work is performed by Indian artificers, who are observed to use but two kinds of edged tools, tho' their work is durable and neat."\(^{20}\) The skill was all in the hand, then, and not so much in the eye as in the feel--not surprising in a society innocent of corrective lenses. The contrast could not be greater with the diversity of specialized tools and instruments used by an English shipwright, much more the complex devices of a European clock- or watchmaker.

Worse yet, Indian craftsmen avoided using iron, and iron (and steel) is indispensable to precision work. This was not a ferruginous society. Irfan Habib contrasts here Persian irrigation technique, which used iron wheels and gearing, and the Indian system using wood, rope, and earthen pots; and like a good believer in substitutability, he explains the difference in economic terms: "... a tool of lower efficiency can be used to manufacture the same commodity by employment of cheap

\(^{20}\) Spear, *The Nabobs*, p. 75. Indian shipbuilders, be it noted, were highly reputed and built vessels not only for locals but for customers in other parts of Asia. The Europeans relied on them almost exclusively, not only because their work was good (teak was better than oak) and cost less, but also because European-made vessels were already in well-used condition by the time they reached the Indian ocean.
skilled labor." He might also have noted the ignorance of the screw in India: the metalworkers did not have the tools to cut a proper thread; or the rarity of the iron nail, whose absence made a difference in shipbuilding techniques. European ships were nailed and spiked; Indian vessels tied the planking to the hull with cords and ropes and rabbeted and glued the boards end to end.22

This manual mode explains as much as anything the failure of non-European craftsmen to make clocks and watches of a quality comparable to those made in Europe. They had the hands, the "matchless ingenuity"; but not the tools. They were capable of extraordinary work, witness for example their long experience of musket-making. "Even today, 1786," wrote a French convert to Islam named Haji Mustafa, "Colonel Martin, a Frenchman, who has greatly distinguished himself these twenty-two years in the English service, has at Lucknow a manufactory where he makes pistols and fuzils better, both as to lock and barrel, than the best arms that


22 Raychaudhuri, "Non-Agricultural," p. 292, speaks of Indian shipwrights' riveting planks and says this was superior to European caulking. Is this a misreading for "rabbeting"? On Indian techniques, see Barendse, "Shipbuilding," and Bhattacharya, "A Note on Shipbuilding."

This ferruginous temper was an old story in Europe. Gimpel, Medieval Machine, pp. 65-66, cites the number and variety of nails kept in store: half a million in Calais in 1390; tens of thousands in a dozen different sizes (listed with their prices) at York Castle in 1327. The specialization of nails by use is indicative of the sophistication of this technology.
come from Europe. The comparison has been repeatedly made... But these
gifted craftsmen made each piece differently, because they could not or would not
rationalize and refine the instruments. When the aforesaid Colonel Claude Martin,
one of the most enterprising agents of the East India Company, wanted to buy a
watch for himself, he sent to Paris and bought it of Louis Berthoud, the finest
chronomètre in France; and when, as often, he sold clocks and watches to the
court of Aoudh and other Indian clients, he got them too from Europe. Where else?
The Indians, like the Chinese, were not doing anything in this area.24

Under the circumstances, the move to machinery in India was not to be
envisaged. Such a leap would have entailed a shift away from hand skills nurtured
from childhood, in some instances linked to and reinforced by caste identity and sex
and age. It would also have required an effort of imagination that lay outside the
Indian cultural and intellectual experience. As Chaudhuri puts it: "In eighteenth-

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24 Habib, "Potentialities," p. 62 and n.4. citing J. Ovington, A Voyage to Surat in the Year
1689 (London, 1929), pp. 166-67. Ovington says that Indian craftsmen found it hard to make
clocks because dust clogged the wheels. Implausible. That may have been a problem, but not
insoluble with Indian technology. As for Chinese clocks, they were poor imitations of good
European work. On Claude Martin, who left an enormous estate that still finances schools called
La Martinière in Lucknow, Calcutta, and Lyons, see Landes, Revolution in Time and L'heure qu'il
est.
century India the empirical basis for an Industrial Revolution was conspicuously lacking. There had been no marked progress in scientific knowledge for many centuries, and the intellectual apparatus for a diffusion and systematic recording of the inherited skills was seriously defective.\textsuperscript{25}

And so it was still in the nineteenth century: the British engineers who built the Indian railways understood that Indian labor, cheap as it was, would move earth and rock by hand, but they also took for granted that the Indians would use wheelbarrows. Not at all: the Indians were used to moving heavy burdens in a basket on their head and refused to change. We even have one report of Indian laborers placing barrows on their head rather than wheel them. Presumably such resistance reflected a desire to spread the work and increase employment, especially to women and children.\textsuperscript{26} All the same it represented a very different reaction from that of European workers, who would have been happy to gain higher pay through greater productivity; also easier labor. (But of course, part of the explanation lies in the assignment of such tasks to women and children, that is, to people who could


\textsuperscript{26} Kerr, "Colonialism and Technological Choice," pp. 95-97. Kerr sees the Indian choice as quite rational, but rationality is a function of ends as well as means.
not say no. One finds similar patterns elsewhere, thus in southeast Asia, where women harvested rice with a finger-knife, one stalk at a time, rather than with a sickle. This was said to honor the rice spirit, but then, it is not uncommon to sanctify women’s toil with pious myths. Had men done the cutting, the rice spirit would have been honored by a quick sickle and a symbolic handful of the harvest.)²⁷

On the other hand, if Indian cotton producers of the seventeenth and eighteenth centuries were content to work as before, the Europeans were not. The influx of Indian cottons was a shock to producers of other textiles, who saw these imports as a threat to profits and pleaded the need to defend employment. The result in England was a number of so-called “calico acts,” designed not only to keep cottons out but to ban the wearing of some of these un-British fabrics. But whereas the aim of these acts was to protect existing industrial interests, that is, wool and silk, the effect was to promote the development of an indigenous cotton industry—unanticipated consequences again. Wool, to be sure, still dominated into the last quarter of the eighteenth century, but cottons appealed to an ever-growing domestic market, to say nothing of exports to warm areas overseas. In particular, the British

²⁷ On finger-knife harvesting, Reid, *Southeast Asia*, 1, 5.
sold growing amounts to Africa to help pay for slaves, and to the West Indies to clothe them, along with the European residents of these islands. In warm climates, nothing could match the comfort, coolness, and washability of cotton.

So it was that when attempts to mechanize the spinning of wool failed, English inventors turned to the vegetable fiber, more uniform and manipulable by the insensate motions of a machine. The Indians could not and did not; the British did, and changed history.
CHINA

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. 28

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

28 Cited in Welsh, A Borrowed Place, p. 33.

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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 on both counts.

The first failure has elicited much scholarly inquiry and analysis. And yet it
remains an abiding mystery—in spite of a monumental effort by the late Joseph
Needham and others to collect the facts and clarify the issues. 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 five hundred 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
seven hundred years later. In general, one can establish a long list of instances of

Elvin, *Pattern of the Chinese Past*, p. 85. Elvin 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. Subsequent work by Robert Hartwell, "Markets,
Technology, and the Structure of Enterprise," p. 34, also advances the higher figure. In John
Hall, *Powers and Liberties*, p 46, this becomes "at least 125,000 tons."
Chinese priority: the wheelbarrow, the stirrup, the rigid horse collar (to prevent choking), the compass, paper, printing, gunpowder, porcelain. But not the horse-shoe.

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 dominate 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, and cotton spinning was never mechanized; and coal/coke smelting was allowed to fall into disuse, along with the iron industry. Why? asks Mark Elvin:

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

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.
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. 30

That is not an answer. Why indeed? Sinologists have put forward several
partial explanations. Those that I find most persuasive are the following:

1. The absence of 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

Elvin, Pattern, pp. 297-98.
concerns, as a divisive force and source of income inequality in the ecumenical
empire, and worse yet, as an invitation to exit. Matters reached a climax under the
Ming dynasty (1368-1644), when the state attempted to prohibit all trade overseas.31
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, to divert talent from commerce and industry.

2. The larger values of the society. The great Hungarian-German-French
sinologist, Etienne Balazs, sees China's abortive technology as part of a larger
pattern of totalitarian control. He does not explain this by hydraulic centralism, but
he does recognize the absence of freedom, the weight of custom and consensus, of
what passed for higher wisdom. His analysis is worth repeating:32

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, compare the European 50-50 split. The traders presumably sought to conceal gains, but
in the long run trade had to suffer.

32 Balazs, La bureaucratie céleste, pp. 22-23.
... 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 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 [paperasseries et tracasseries], 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'État. 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, no one was trying. Why try?

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. Elvin 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.\textsuperscript{33}

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.\textsuperscript{34}

The Europeans knew much less of these interferences. Instead, they entered during these centuries into an exciting world of innovation and emulation that


\textsuperscript{34} Max Weber argues 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. Weber, \textit{The Religion of China}, p. 134, cited Hall, \textit{Powers and Liberties}, p. 41.
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 nowness a virtue and a source of delight.

Important in all this was the role of the Christian church 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, 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, 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 exults in this versatility:

"coquendis, cribrandis, vertendis, terendis, rigandis, lavandis, molendis, moliendis, suum sine contradicione 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.35

Why this peculiarly European jote de trouver? this pleasure in 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:

1. 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," He says, and Noah builds an ark to divine specifications.

2. The Judaeo-Christian subordination of nature to man. This 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 would 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.

3. 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, it was the progressive view that prevailed.

4. 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 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.

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Then the second chance. 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. 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," 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

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. See his Travels.

36
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.

The irony is that 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, *The Chan's Great Continent*, p. 42.) By doing this, "the Westerners were unwittingly shoring up the Qing court's views of China's superiority." (Spence citing Wills Jr., *Embassies and Illusions*.)

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.37 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.  

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, depend on it, and 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 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

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On the morning ceremonial, Landes, *Revolution in Time*, pp. 51-52, also Huang, *1587, a Year of No Significance*.  

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clock was the key that unlocked the gates. This, we saw, was a European megainvention 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 clockmaker.

No question 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 as well. Here is Gottfried Wilhelm von Leibniz (1646-1716), mathematician (coinventor of the calculus) and philosopher:

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.39

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. 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:

... even 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—the Chinese trivialized them as toys, which for many they were; or as nonfunctional symbols of status, unaffordable by or inaccessible to most. Premodern imperial

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40 On this story, see Cipolla, Clocks and Culture; also Landes, Revolution in Time, ch. 2.
41 Spence, Emperor of China, p. 74.
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. Cannon 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.

And yet the Chinese never learned to make guns—not 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 *cum* regression, step-forward, step-back, signaled an entirely different process. (More on this in a moment.) The Chinese, we are told, had a proverb: He who does not go forward will go backward.\(^42\) It must have been more observation than prescription.\(^43\)

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 seem to have been among the best they had, so good compared to the run-of-the-foundry product that some were still in use


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, but they would do better then to ask why the subsequent retreat and loss.

\(^43\)
in the nineteenth century, some 250 years later. (See Excursion No. 2.) 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. 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 purpose of war was to kill the enemy and win; the Chinese, strong in space and numbers, thought otherwise. Here is Mu Fu-sheng (a pseudonym) 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

On all of this the best source is still Cipolla, *Guns, Sails, and Empires*, especially pp. 116-19. Cipolla 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. A remarkable book.
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.\textsuperscript{45}

Along with indifference to technology went imperviousness to European science. The same conditions applied. The Jesuits and other Christian clergies brought in not only clocks but knowledge (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; 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

\textsuperscript{45} Mu, \textit{The Wilting of the Hundred Flowers} (New York, 1963) pp. 76-77, cited in Cipolla, \textit{Guns}, p. 120.
Song dynasty (10th-13th centuries) and proclaimed that the Jesuits had not brought in much in the way of innovations. Later on, his manuscripts were published by his grandson under the title "Pearls Recovered from the Red River." 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 knew (though still well behind the frontier). Here, however, they 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."47

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


all Chinese were hostile to European ideas and innovations. We know that a few far-sighted officials and at least one emperor understood that the empire had much to gain by learning these new ways. They were thwarted, however, not only by the studied complacency of an insecure superiority—also by a sense of completeness—by but by the intrigue of a palace milieu where innovations were judged by their consequences for the balance of power and influence. No proposal that did not incite resistance; no novelty 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. The Jesuit missionary Louis Le Comte (1655-1728) deplored this conservatism:

"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

Though the curse of foreignness remained. 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 in used only by those who want to belittle us."


69 Cf. Crone, *Pre-Industrial Societies*, pp. 172-73: "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..."
with nothing but what is new." George Staunton, Macartney's secretary, disheartened by Chinese indifference to suggestions for improvement of their canals, lamented that, "In this country they think that everything is excellent and that proposals for improvement would be superfluous if not blameworthy." And a half-century later a Christian friar, Evariste Huc, 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.

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50 Cipolla, Guns, Sails, and Empires, p. 120 f.

Peyrefitte, L'empire immobile, p. 286. The Staunton quote is from the French edition of his travels: Voyage en Chine et en Tartarie (6 vols.; Paris, 1804), VI, 6. The Huc is from his Souvenirs d'un voyage, IV, 81. Eric Jones, "The Real Question," pp. 12-13, dismisses such personal recollections of stasis as "snapshot impressions." I think he is wrong. These witnesses do concur; they report a state of mind, and their testimonies do fit what we know about technological change in China. Jones recalls similar conservatism in England after the war (worker rejection of American technology), and England, he says, "soon adopted many American practices." Bad example.

This is one of the major contribution's of Peyrefitte's 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. A valuable case study.
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 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 such a happy exit should encourage entry, and the 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, while the
withdrawal of successful merchants into land and office is seen not as a logical
promotion but rather as an 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 powerful contribution to
otherwise inhibited economic development.

In any event, 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: "Chinese
society, though stable, was far from static and unchanging. . . . the pace was slower
. . . the degree of change less . . . "(True, but the issue remains.) Others would
dismiss the question as unanswerable or illegitimate. *Unanswerable* because it is

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Fairbank and Reischauer 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.
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 advances by practitioners. What difference, then, to Chinese 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

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Cf. Eric Jones, "The Real Question," *Austr. Ec. H. R.*, 30 (1990): 8-9, who is equally nonplussed by these *a priori* objections to this line of inquiry: "I cannot see why, [the sinologists] are not being blamed and the question does not seem tendentious with respect to a society that had achieved so much and then passed so many centuries without achieving it again."
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 it 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. 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.55 On the other, they 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.56

The history of Chinese advances, then, is one of points of light, separated in

55 Taton, General History, II, 590.

And this 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, Search for Modern China, 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.
space and time, unlinked by replication and testing, obfuscated by metaphor and pseudo-profundity, limited in diffusion (nothing comparable to European printing)—in effect, a succession of ephemera. Much of the vocabulary was invented for the occasion and fell as swiftly into disuse; so that scholars today spend 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. "With the microscope you see the surface of things... But do not suppose you are seeing the things in themselves."^5^  

The effect was discredit or indifference, the greater for the want of mutual verification and support. It is this want of continuing intellectual exchange and reinforcement, this subjectivity, that more than anything explains the uncertainty of 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

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From a poem, early nineteenth century, by the son of the then prime minister, himself a high state dignitary. Quoted in Taton, ed., *General History*, II, 593. 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. Which does not stop people from using it to bad purpose.

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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 genius.

So the years passed, and the decades, and the centuries. China saw Europe leave it far behind. At first it was unbelieving and contemptuous. Later it became increasingly anxious and frustrated. From asking and begging, the Westerners became insistent and impatient. The British saw two embassies dismissed. The third time, in 1839, they blew the door down. Other Western nations followed suit, and then, after the Meiji restoration, the Japanese, with their own pretensions to dominion, moved to secure their place alongside Britain, France, Germany, and Russia.
Excursion No. 2. "There is nothing we lack."

The Chinese policy of superior indifference to Western things has been traditionally summed up in the dismissive letter (rescript) of the Qianlong 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.

That is what I would call potent prose. It was by no means the only such contemptuous dismissal or trivialization of foreign art and artifacts during these centuries of active contact (1550-1900). Thus the Qianlong 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."58

Coming as they did from the emperor himself, these explicit expressions of contempt leave little room for extenuation. The historian, even the apologist, must deal with them—as the British had to. (They came back in 1838 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. (The 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.\(^5^9\)

The 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

\(^{59}\) Cf. Waley-Cohen, "China and Western Technology."
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 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.60 Too bad the victims of these devices could not be told of their potent, magical, awe-inspiring names; they might have surrendered on the spot.61

Nor can one demonstrate a sustained and effective interest in European military technology by pointing to occasional instances of recourse to advice and technique from Jesuit missionaries. These good clerics were ready, in the cause of

60 These examples are from Needham, "The Guns of Khaifeng-fu."

61 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." Elvin, Pattern, p. 94. Cf. critical comments by Sivin, "Imperial China," 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.
propagation of the faith (O Lord, what great things are done in thy name!), to teach the Chinese how to found cannon; also how to aim them. Adam Schall did this for the failing Ming dynasty, producing over five hundred pieces of light artillery; and his successor Ferdinand Verbiest made another five hundred over a period of fifteen 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.  

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 production engineers and the finest mathematicians (among others, Leonhard Euler), underlines not simply the backwardness of Chinese technology

62 Waley-Cohen, "China and Western Technology," pp. 1531-32
but, more important, the fundamental difference in attitude and approach. 

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, as we have seen, learned little from the West other than the making of heavy cannon, and even there they continued to be dependent 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 to that technology. Imitation of Western clocks showed a similar pattern: one copied objects at or near the prevailing frontier, but one 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 effective and continuing interest 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

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: Steele, "Muskets and Pendulums."
of superiority they derived from their scientific and technological dominance. But it does not change the fact of dominance or 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 is historiography handicapped by an ideological agenda:

In the late eighteenth century, well before the Western incursion brought a new immediacy to the need for military reform, the Chinese were extremely interested in technological advances and in what the West had to offer. The evidence was readily available to Europeans who chose to grasp it. Yet when 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.64

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 European 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.65 On balance, however, European opinion tended to rest on performance

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64 Waley-Cohen, "China and Western Technology," pp. 1543-44.

and achievement. The scientist rarely refused to learn or copy, and he was only too ready to revise his judgment when presented with the facts. (He could be ferociously dismissive, however, in disputes over priority.) The same for 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 we 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, the historian plays the role of comforter and strokes 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.66

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66 The anthropologists have a déformation professionnelle of the same kind. Not only do they have an affection for their subjects, but now they feel a need to enhance their status by stressing their autonomy in the face of abusive European power. So whereas political correctness long consisted in blaming the European for native crimes and misdemeanors, here is Dorothy Shineberg denouncing this condescension. Enough of exculpation by right of retaliation: the "retaliation-only theory," she says, imputes a passive role to the native, "for it implies that there must be a white man before every brown." The native is thereby diminished: "... [he] may not have his own independent good reasons for killing Europeans--motives emanating from his own desires and customs--but must wait for the European to offend him." Shineberg, They Came for Sandalwood, p. 214, cited in Sahlins, "Cosmologies of Capitalism," p. 2, n. 1.
Imperial China open-minded, curious? You must be kidding.

Bibliography


