

The Needham Question Today

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INTRODUCTION

The Needham Puzzle is part of a larger and very complex historical enigma. What explains the slow-down in scientific innovation in China about five hundred years ago? Also, after a recent forty-year period of growth not heavily dependent on spontaneous innovation, are such inherited influences returning to the surface as significant obstacles at a time when innovativeness is becoming more strategic?

Analyses of these issues tend to be in one of two categories. The economics perspective, with its specificity of data, tends to be narrow but optimistic; the sociology perspective, with its insistence on the embeddedness of social action, tends to be wider and so much more loaded with cautions and caveats and warnings of complexity. This division is visible in the China literature (Bergere, 2007: 366). The comments in this note lie within the middle ground of socio-economics. They are additionally designed to specifically bring in history, but only to the extent that some of it is arguably relevant today.

A starting assumption, not always given the attention it deserves, is that as societies move upwards in income per capita, the range, density, and specialization within the complexity they have to cope with expand exponentially, especially in recent decades under the influence of the information technology revolution (Boisot, Child, & Redding, 2011).

To deal with this, so far universally, any society that transacts mainly via interpersonal ties plus limited imposed order, moves to one that transacts mainly via institutionalized forms of order and trust, plus widespread and deep empowerment (Welzel, 2013). The rising complexity itself is both the price and the driver of being ‘modern’, in other words reaching levels of intensity in exchange that measure up to \$US 50,000 per capita income. The societal response has to be ‘modern’ because a central administration cannot handle the new volume, intensity, and speed of the complexity, at globalized world standards of adequacy. But as Latour (2012) points

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out 'we have never been modern'. This is the essence of China's dilemma and certain universal logics within it are inescapable. Behind the dilemma lie the new struggles emerging as the middle-income trap is approached, and as the central ordering instinct comes up against the partially released initiatives to innovate by the private-sector.

The paper (Augier, Guo, & Rowen, 2016) under discussion acknowledges China's tendency to exploit and refine existing knowledge, rather than to explore and develop new knowledge. It also acknowledges the long-term existence of political, institutional, organizational, and psycho-social barriers affecting China's system of technological innovation. It consciously avoids discussion of 'the grand governmental, institutional, or political issues' China faces. Instead the paper's review confirms certain widely accepted conclusions, and summarizes the answer to the Needham question in terms of three causes: the absence of deductive logic during enquiries; the conservatism stemming from the Confucian state ideal; and the self-imposed intellectual isolation of China in those times. An outcome of these combined forces is that knowledge was differently constructed and valued (compared to elsewhere) and that it tended to be used in the service of immediate application rather than wider discovery.

This brief commentary will suggest certain additional determinants and frameworks of argument, and will in the process adventure some comments on the excluded political territory. It will do so by looking at the Ming slowdown and by making comparisons with England in the same period. The wider questions of relevance of that today will then be considered, in the knowledge that transferring lessons across both historical periods and societies has to be done with great care. The search is for structures or processes that might be universally relevant even though they might be locally interpreted on the ground and at the time.

WHY DID CHINA'S INNOVATIVENESS SLOW DOWN IN THE MING PERIOD?

I was privileged to discuss this question once with Joseph Needham, as I had developed an interest in Chinese cognition and its possible relevance to the question. His position was very clear. Cognition was not the source. The answer lay in the structures of the society, and in the ways in which science was connected or otherwise into those structures. For Needham, (and now summarized in Fara, 2009), the answer lay in the inability of China to escape from being trapped in an essentially feudal economy run by a centralized state bureaucracy. The lack of individual initiative that was coupled with the restraints on the accumulation of private wealth were enough to prevent the full exploitation of the technical innovations sponsored by the bureaucratic feudalism. Such a system could sustain a lively commerce but it could not allow the evolving of a form of mercantile capitalism. Needham also noted the significance of a geographical feature available to Europe but not to China: the highly indented, long and complex coastline of Europe induced a tendency towards

mercantile trading by sea, affecting the entire continent. As E. L. Jones (1981) noted in his discussion of 'the European miracle', a key catalyst was the fusing together of ideas from the highly varied European societal and institutional experiments.

To look at surrounding structures, rather than to concentrate on scientific behavior *per se*, is to acknowledge the embeddedness of scientific action in a context that might either (a) amplify its significance and encourage its progress, or (b) suppress its status, its outcomes, and its resources. It is in this field of enquiry that we might reconstruct the 'problem' of Ming science. The issue is not science *per se*: it is science as applied. Science itself might well continue, and there was still intellectual flourishing in the Ming (Twitchett & Mote, 1998). Our question then is not 'Why did science come to flourish in the Atlantic states?' but 'Why did it do so to a point where it became a foundation for the waves of industrial revolution that followed there?' How did it come to play such a key role in the new societal amalgam? Can anything be learned that would apply to China now?

The dimensions of societal workings over which Ming China and seventeenth England may be compared for our specific interest are here discussed in three categories: ideas, institutions, and material circumstances.

IDEAS: Improvement; a bourgeoisie; individual freedom; rationality.

INSTITUTIONS: Information access; coordination processes; government participation.

MATERIAL CIRCUMSTANCES: Skills; national market; global exchange of ideas.

It is only possible in a short account to note evidence of differences in these domains, but they are used here to point towards the totality of connections in which scientific inventiveness can be immersed. This then brings to the surface the power of the society's essential political rationale in shaping behavior on the ground. It also raises the issue of adjustability (and non-adjustability) in such features. Other important concepts such as path dependency, co-evolution, and evolutionary adaptation, are left as implicit.

Ideas

The concept of improvement. Most of the world's people still live in circumstances where the notion of growth in surrounding total value shared is simply unimaginable. There is 'limited good' (Foster, 1967). In the Ming period most Chinese people saw life as essentially stable. Life went on under organized, strong government and the idea of societal 'growth' was not conceived. Conformity and conservatism ruled (Fairbank, Reischauer, & Craig, 1965; Mote & Twitchett, 1988). As noted by Wilhelm (1982: 22) in his study of traditional Chinese economic psychology, for the predominantly agricultural life in China 'The only thing to be feared was any kind of innovation, the effects of which were as yet unknown . . . there was neither time nor desire for arbitrary innovation and experiment'.

The contrast with England in the same period is informative. As described by Slack (2015) there took place there ‘the invention of improvement’, most of which was stimulated by scientific and profitable improvements in agriculture. Although at earlier times, and in other places, it had been possible for innovation to make individual people wealthy, it was not until the 1600s in England that the idea of national improvement based on material progress and the creation of new kinds of knowledge, could take the place of other unifying ideals such as ‘reformation’ or ‘revolution’. This new collective mentality made Elizabethan England distinct. It was crucial preparation for the country’s later entry to the modern condition. A particular trajectory of progress in ‘social good’ had first to become widely imagined. Good had to be seen as not limited, and as common.

The bourgeois virtues, commerce, and supporting institutions. A bourgeoisie is a body of citizens, often people of business, with enough assets, enough acquired civilized behavior and virtuous ideals, and enough initiative to bring orderly change to the workings of a society. It is common in the history of this class of influential actors, wherever, and in whatever guise, they appear, to see them taking responsibility in the structuring and running of forms of benevolent order, as for instance initiating professions and learned societies. Such bourgeois are the original catalysts for civil society, as it crystallizes out at ground level.

McCloskey (2006, 2010), in explaining societal progress in detail and chastising Economics for missing the point, argues that the greatest externalities, have been the dignity and liberty of the middle class. A new rhetorical environment – ‘the bourgeois revaluation’ had evolved in the Atlantic states from around 1600 onwards, and ‘From all this imperfect but unique free speech came innovation and the modern world’ (2010: 392). Liberty had come to be seen as freedom within accepted order. And the order was made by them.

As Heilbroner (1985) has observed, this allowed for the evolution of a more benevolent form of domination than anything preceding it, and became a universal foundation for the various successful forms of capitalism that follow. Without such a legitimate ideological base any country’s attempt at modern industry is likely to fall victim to the dysfunctions of authoritarianism or personalism, as McGregor (2012) has recently pointed out for China in his book *No Ancient Wisdom, No Followers*.

It is sobering to see the argument being updated by Bergere (2007) in a study of present-day Chinese economic society when she suggests that China is attempting to construct a form of capitalism without capitalists (i.e., without reliably empowered and independent initiators).

In China, given its history, the emergence of a bourgeoisie has always been problematic as a potential threat to the state in terms of influence. So it has always been controlled, co-opted, and in recent times simply wiped out. Our concern here is with the stimulus to science and it is clear that China historically was not fertile ground for a flourishing bourgeoisie to act as a catalyst by investing in invention. As described by Braudel (1982: 588) both the traditional Chinese nobility (another

catalyst in England), and the business men or manufacturers, were supervised by a 'lynx-eyed administration . . . controlling and confining their activities'. Neither 'the merchants, the usurers, the money-changers, nor the manufacturers . . . had much in the way of power'. They could be subjected to sudden punishment, non-negotiable taxation, and could be condemned for excessive wealth. Here accumulation could only be achieved by the state. Trading was more or less safe and so there was a flourishing of mainly local markets, but it is not surprising that Elvin's (1973) summary of business historically in China was that commerce substituted for management. Taking a free-standing organization upscale was not worth the risk of confiscation. In such circumstances innovative science was separated from market stimulus and support by the smothering intervention of state control. The merchants remained consigned to the lowest position in the Confucian hierarchy of respect and influence. In the modern period, despite decades of private sector success, the Party remains a powerful controlling influence by coopting business leaders into its ranks as their wealth brings them into view.

Political autonomy, property rights, and individual freedom. Political autonomy is most easily visible in 'free' towns and cities. Europe is full of cities that for centuries were responsible for their own affairs and taxes, some of the more significant of them being city-states. So too were such cities connected through fairs held in a particular place for a particular type of commodity. The significance of such gatherings for our concern with science is that they were places where foreign ideas, techniques, inventions were brought in and studied. In some places such as Toledo, the exchange of scientific knowledge became highly institutionalized, with libraries containing the translations of texts between, in this case, Arab, Jewish, and Christian forms of science.

The situation in China at this early period was different. Clearly there was a flourishing commerce with local markets all over the country. But exchanges of ideas with other cultures were prevented until the later influence of Jesuit missionaries. As Braudel (1982: 131) points out 'Once unity was restored under the Mings, and maintained by the Tsings, China's windows and lookout posts were to be found only on the circumference, turned to the outside world'. Caravans from the West got no further than the border towns. China saw itself as self-sufficient.

An efficient government administration undertook the running of the state as a whole. The *li-chia* system of the Ming, officially promulgated in 1381, was not made of democratic units. It was there for tax collection, rural control, and community self-maintenance. As Heijdra (1998: 460) points out this was 'at heart a structure to use local leaders to serve government interests and not the interests of the community's members'. In such circumstances the kind of individualism and assertion of rights emergent in mediaeval England not surprisingly had no place. A Chinese person's rights over property and intellectual property were weak. Such a conformist system could not adequately foster the curiosity brought by new things and unconventional ideas.

Calculated rationality to counterbalance personalism. In Weber's (1930: 26) description of the workings of the Protestant Ethic, he writes of 'the specific and peculiar rationalism of Western culture'. He further notes how rigorous calculation, foresight and caution underpinned early Western capitalism. This should not be seen as implying a societal difference in the use of calculation by individuals as good practice, but more to suggest that being conscious of the salience of calculation may vary with the ease, extent, and familiarity of its adoption in the wider society. As Slack (2015: 163) points out the adoption of improvements in England in the 1600s relied on a process of knowledge diffusion, partly through extensive literacy, and partly through influential new societal bodies that brought together 'men of numbers' to grapple with policy questions.

Here evidence and logical argument began to replace traditional authority as the basis for decisions. The slow dismantling of such authority by this means was historically crucial. Bacon's 'inductive reasoning' brought with it the spread of the 'scientific method' and as Gellner (1992) has noted rationality became a way of life. A new form of civilization emerged based on this powerful ideal. Claims had to be matched with evidence. Reason had to be provided. Relations come to be based on free choice. Traditional authority was replaced by contract. The result was one social order among others but it created a new force as its effects spilled over into wider social structures in a limited number of compatible societies. For China today a prophetic general comment was made by Gellner (1992: 156) as follows:

Rational production and commercialization, unaccompanied by a major scientific and technological revolution can raise living standards, but before long runs up against the Principle of Diminishing Returns, and does not have that world-transforming potential which a joint productive *and* cognitive rationalization did have.

Institutions

Access to learning, useful knowledge, and scientific understanding. In traditional China the job of the ruling elite was to maintain the status quo. Knowledge consisted of preserving ancient wisdom. Science that might involve change was seen as potentially threatening. In a sense, interest in scientific enquiry was driven into the corners of society and hidden away. As Eberhard (1957: 67) describes the scene:

New ideas were conceived as new tools for the political struggle and therefore suspect. Science was therefore hampered in its development. What was achieved, over and above applied 'political science', was the result of the hobbies of certain individuals; it remained hidden in their occasional writings, as a curiosity, and it was not systematized, discussed, clarified, enlarged, or applied in non-political fields.

Bringing together science and application. As I have implied there were in Ming China significant inhibitions to the fusing of (1) scientific enquiry with (2) the incentive to invest and exploit through application. By contrast the English example is revealing in two aspects: first the initiative came from the very top of society; second it spread throughout the entire country via its independent towns and cities. The Royal Society for Improving Natural Knowledge was founded by King Charles II in 1660, and remains highly influential to this day. It later sponsored a sub-unit devoted to 'the encouragement of the arts, manufacturers, and commerce', a body that played a major part in the first industrial revolution.

The local extensions of such initiatives were visible in the widespread national network of 'literary and philosophical societies'. Each city and major town had such an institution and membership was open to all with an interest in learning and its application. In these meetings took place much of the initial blending of science and industry.

Government participation. It must be acknowledged that much invention in China historically emerged inside industries controlled by the state, so the role of government must be seen as positive in stimulating technical innovation. But this is not the same as saying that the state encouraged widespread inventiveness across the society, and it is here that the industrial histories of Britain and China diverged early. In Britain, as we have noted, the state became a stimulator of widespread innovativeness and it did so largely because of its interest in commerce and the licensing of organizations to be merchant venturers. The pursuit of the new was of course wedded to the pursuit of the profits and revenues attached. In contrast China's Ming voyages, although technically astonishing, were made to establish tributary relations, and not trade or conquest. This did not work, and they stopped. In more recent times China's state-owned enterprises and foreign investments have caused it to behave as a 'mercantile' state, but its formula has not been nearly as liberal in devolving business authority as the formulae adopted elsewhere.

Material Circumstances

Available skills. Early in its industrial history Britain spontaneously produced a large number of highly skilled craftsmen, and it is these innovators and perfecters who account for much of the technical creativity seen in the first industrial revolution. But Mokyr (2009: 111) suggests that account also needs to be taken of their 'agenda'. The state left them free to follow their own fates. It did not interfere. Instead it fostered the flow of interaction between elements, of which the skilled artisans were one. What came together were then (a) the useful knowledge generated by scientists, engineers and inventors, (b) skilled craftsmen to interpret it, and (c) entrepreneurs with incentives in a supportive infrastructure.

Competitive national market. China clearly has now moved to foster a national market and to seize its inbuilt advantage of scale. This raises questions about the risks of decentralization, as for instance with corruption. And it raises also the question of dependence on the state for continued direction and investment, and the effect of that on freedom to innovate. For a social system to evolve and adapt, it may well need to combine simultaneous loose-tight properties. In economic systems at societal scale those two demands, in conditions of proliferating complexity, may well require the switching on of new forms of spontaneously engendered stability. The move to strong regional centers uses the obvious first option. No other society has faced such a challenge at this scale.

Imported ideas and techniques. In recent times China's doors have been re-opened and the flies are in. In the 1980s foreign firms were welcome to the extent that they demonstrably delivered 'technology transfer'. The facilitating of foreign investment under WTO rules has continued apace and has infused China with a great deal of imported technique, usually via business alliances. University alliances have been strongly encouraged. Another strong trend has been the extensive acquisition of foreign intellectual property, and a consequent mushrooming of legal concerns related to this. The interface in many such alliances remains a field of mistrust and misunderstanding (Feldman, 2013). What has not taken place is growth in indigenous basic science, despite continued official pronouncements about its crucial place in the national plan. To explain that means returning to identify the universals that affected the Ming, and that may still be affecting China today.

CONCLUSION

What is not on the surface in most accounts is the core lesson of history. Like all countries, China has never been modern before, and so has no experience of its own to go on. It is also a very proud society with a great deal to be proud about. But the game has changed, and it is now necessary to come to terms politically with the fact that a modern economy is vastly more complex and demanding of informed decision-making than any central government can handle. The modes of decentralization now in place, because they are essentially still modes of extending central control, may prove inadequate to the tasks of escalating adaptiveness at world standards. The middle-income trap is a very serious threat, as China clearly acknowledges (World Bank, 2013).

Shambaugh (2013: 154) has dug down to expose why China's power remains 'partial' and he confirms the legacies traceable to many of the historic features described above: first an unpredictable and predatory domestic environment with minimal trust or shared values, and a moral void, with individuals driven to self-seeking and power-maximizing; second a transactional culture in which everything is bartered all the time and where all dealings rest on a cost-benefit view seeking

tangible personal benefit, so eliminating the idea of public goods; third the persistent dependence on the strong state, and all the psychological outcomes that go with it.

The implications of this context for innovation are stark, and one of the victims has been basic research. This, in Shambaugh's (2013: 244) view, is because of: such research going beyond politically proscribed boundaries; academic corruption; the absence of intellectual open-mindedness; and weak linkages with the global scholarly communities. In the three decades of attempts to deal with this problem the imbalance between what comes in and what goes out reveals China as a persistent and large-scale importer of techniques and knowledge.

At the same time the world is seeing a shift in the forces that drive societal progress. Beginning in the 1960s, after centuries in which progress was driven primarily by the spreading of human freedoms, a new factor took over as the leading catalyst. It is globalization (Welzel, 2013). Societies that can integrate their economies with those in other countries are showing the best rates of progress. Now prosperous societies have to be both empowering and exchanging.

This does not simply solve China's problem of the middle-income trap. It suggests instead that China will remain constrained but capable of reaching a new plateau, the height of which will depend on two factors: the extent to which its firms can capture the value added by innovation, which means in turn the extent to which such innovation is indigenous; and the extent to which its social structures can foster forms of cooperativeness that allow the achieving of large scale and complexity of organization at global standards of efficiency. In other words, wean itself away from *guanxi*-based reciprocity as a basis for limited trust and build systems of trust that allow the doing of business with strangers. Can a new form of morally legitimate hierarchy evolve to foster new forms of innovativeness and cooperativeness?

China may stabilize in its resolution of this dilemma by resting content with being the world's biggest economy. In achieving that it may need to rely also on being a cooperative actor in global exchanges of capital, of products, and of knowledge.

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