

**JOSEPH NEEDHAM'S GRAND QUESTION, AND HOW TO MAKE IT PRODUCTIVE
FOR OUR UNDERSTANDING OF THE SCIENTIFIC REVOLUTION**

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"For us the Chinese experience through the ages is a control experiment for Europe," Joseph Needham stated in 1961.

"If sometimes we overemphasize the Chinese contributions, it has been consciously to redress a balance which in the past tilted over much too far on the other side. We were out to redress a secular injustice and misunderstanding," he wrote at another occasion.

In the paper that follows I wish to show that Needham's contribution to our understanding of how modern science arose in 17th century Europe may usefully be thought of as situated in the highly charged field of tension between these two, widely dissimilar yet equally steadfastly held viewpoints of his.

Needham's celebrated 'Grand Question', as is well known, goes back to 1937, when three Chinese students in Cambridge addressed their Reader in biochemistry, asking him how it was that "modern science originated only in Europe." This innocent query came to mark the decisive break in Needham's life. You and I and everybody else would surely have shrugged off so vast and apparently speculative a question, yet Needham went ahead, quickly to turn himself into what he remained till his death — the far and away foremost expert in the history of global science. Whatever one may think of *Science and Civilisation in China* (and my own as most everybody's sentiments about this work and its numerous companion volumes are decidedly mixed), it is certain that it was set up by Needham as his chosen way toward finding the answer to that vaguely intriguing yet highly questionable question put before him now sixty years ago.

Why did Needham attach so much significance to the question?

One reason surely resided in the sheer attraction exerted by China's otherness. "Chinese culture," so he wrote, "is really the only other great body of thought of equal complexity and depth to our own ... Chinese civilization has the overpowering beauty of the wholly other, and only the wholly other can inspire the deepest love and the profoundest desire to learn."

Two further reasons stand expressed in those distinct sentiments I quoted right at the start — the idea that Chinese history provides an occasion to test our ideas on why modern science arose in Europe by counterfactual means, and the urge to set right the, at least in those times, widely spread notion that China never had any science worth mentioning let alone examining.

One more reason for Needham resided in the following consideration. Modern civilization is so profoundly shaped by universally valid, modern science, and the West, by virtue of the fact that that is where modern science arose, has since gained such a world-historical ascendancy, as to turn the question of why Europe, not China spontaneously produced modern science into no less than "one of the greatest problems in the history of civilization".

These sentiments of his taken together go far to explain the dual setup of the great work, which was

meant *both* to survey China's forgotten riches *and* to use that survey for arriving at a definitive answer to the original, Grand Question. Joseph Needham never did arrive at that definitive answer — he died with the final, seventh volume of the great work in incompleting state. Still, the Grand Question was so uppermost in his mind that numerous fragments of an answer are to be found strewn over both a variety of passages in *Science and Civilisation in China* and many an accompanying essay of his, with *The Grand Titration* serving as the principal yet hardly the sole focal point for all this (as he once called it) “thinking aloud” on the Grand Question. Some years ago, in chapter 6, ‘The Nonemergence of Early Modern Science Outside Western Europe’, of my book *The Scientific Revolution. A Historiographical Inquiry* (University of Chicago Press, 1994), I made a sustained effort to collect those fragments and put them together in as much of a consistent pattern as I think actually corresponds to what Needham must have had in mind. By way of a summing-up of results attained in that lengthy chapter,* I here present a brief outline of how Needham variously put his Grand Question, of his range of answers to it, and of how these hang together. I then conclude with a view of my own on what we can learn from all this if we share Needham's aim to arrive at a deepened understanding of the Scientific Revolution by comparative means.

To begin with, two major stages can be distinguished in how Needham posed his Grand Question. Asking originally why traditional China did not produce modern science, a deeper acquaintance with China's scientific riches convinced him of China's superiority over the West up to the late 16th century, so that his more pointed question became something like this: How is it that the science of traditional China, on a par, to say the least, in brilliance and depth with the West prior to the Scientific Revolution, nevertheless did not spontaneously produce modern science?

Now it is hardly the case that Needham came to his question with a blank mind over what caused modern science spontaneously to be produced in Europe. His favorite explanation soon became and always remained the one embodied in the Zilsel thesis. This thesis says that modern science came into being owing to the breakdown, around 1600, of an originally very wide social gap between university men skilled in formal argument (Galileo, Bacon, Gilbert) and those superior artisans (Leonardo, Stevin, Agricola) whose work in practical arithmetic, practical mining, practical navigation, and so on, actually embodied, though it did not formally express, such basic scientific laws as formed the heart of the Scientific Revolution. This is a rich yet (as I have argued in ch. 5 of my just mentioned book) highly overstated thesis. Needham always picked up for special emphasis the alleged tendency of merchants and the higher artisanate in late Renaissance Europe to foster physical science, in the sense of a supposed affinity between the merchant mentality and mechanical science, especially. At first upheld by Needham with primitive, orthodox-Marxist assurance, in later years the precise nature of this particular historical link became more doubtful to him. As he wrote in passing in 1964, “What the exact connection was between modern science and the merchants is of course a point not yet fully elucidated.”

Let us now see to what extent Needham did indeed use the Chinese experience as a ‘control experiment’ for the European Scientific Revolution.

* For the provenance of all previous and following quotations, and also more generally of all Needham's pertinent views discussed in the present paper, I refer the reader to the notes appended to that chapter. I further wish to thank Dr Peter Engelfriet for his comments.

If I have counted well, there are six answers to his Grand Question Needham more or less consistently adopted, four more he quite firmly rejected, and two he somewhat deliberately avoided.

The rejected ones first. Needham had very little time for explaining the absence of a Chinese Scientific Revolution out of some alleged inability of the Chinese to think scientifically, or out of differences in climate, or out of features of language and script (a thesis, by the way, recently defended by Derk Bodde), or out of an allegedly predominant conception of time, not as unilinear but as recurrent (the latter thesis being the sole one he found worthy of a sustained rebuttal).

Now for Needham's six explanations of why China had no Scientific Revolution. Quite early on, while roaming through Yunan province in the midst of the Second World War, Needham's pertinent thoughts began to center on *democracy*. Modern science could only emerge in a democratic environment as provided by then progressive, early merchants' capitalism, so he argued in a very general sort of way; hence, China's feudal bureaucratism, despite some democratic access to officialdom through the examination system, precluded the rise of modern science. A second, somewhat more thoroughly argued answer centers on the alleged *opposition* between establishment *Confucianism* with its concern for social rather than for natural order, further text-oriented, rationalist, conservative, rigid, and masculine, and mostly suppressed *Taoism* with its favorable impulses for science and technology, its receptivity and lack of prejudice, its antifeudal collectivism, its worship of the feminine and more generally its democratic progressivism. In that sense Galileo was a Taoist and those adversaries of his who refused to look through his telescope Confucians, Needham remarkably remarked in passing, going on at a later stage to amend his own argument by pointing at the fact that, in the end, the Tao in the sense of the cosmic order was held to be inscrutable, thus setting serious limits to what Chinese science, for all the stimulus received from Taoist impulses in alchemy and elsewhere, could accomplish even in the best of cases.

A third explanation puts those *merchants* of Zinsel at the center. Never in Chinese history did the reigning bureaucracy allow the merchant class to attain a position of some social autonomy. Hence, the very merchant mentality could not arise without which modern, mechanical science is impossible, as stands confirmed by the relative poverty of Chinese physical thought as compared to the extensively documented richness of virtually all other scientific work in ancient China.

In answer n° 4, on China's *bureaucracy*, Needham began to acknowledge that, for instance, seismology was greatly fostered by the bureaucracy for obvious, utilitarian reasons. He went on to focus on the many ways in which China's feudal bureaucracy nonetheless hampered scientific pursuits. It did so primarily in that, as noted, it prevented a merchant class from coming into its own, but also in that its general posture of political nonintervention stood athwart the kind of interventionism embodied in modern scientific experiment.

Incidentally, the aura of facile, somewhat far-fetched and certainly empirically underargued speculation likely to be exerted by my very brief summaries is not, in my own view, too far removed from those arguments as they appear in full in Needham's original essays. Such is emphatically not the case, however, with his fifth answer, the *laws of nature*, which is set forth in a very exciting, intellectually daring, and richly detailed argument. Once again starting from an idea of Zinsel's, Needham here concluded that no Chinese philosophy offered a counterpart to the late Renaissance European notion of things natural being ruled by law. Order is certainly recognized, yet, quite unlike the inexorable regularities imposed by the Divine Lawgiver of the West, natural order in Chinese thought is held to be one of interdependence and

spontaneous cooperation. In the end, Needham reveals himself to be sympathetic to that point of view: "One feels that the Taoists would have scorned such an idea [of natural law] as being too naïve to be adequate to the subtlety and complexity of the universe as they intuited it."

A sixth answer may be called that of *Chinese homoeostasis*. It was no more than sketched by Needham in one extraordinarily inspiring passage in *The Grand Titration*. Here the self-regulating equilibrium characteristic of Chinese society, which adopted many a home-grown technological feat and many a scientific finding without significantly altering thereby, is set off against the restless roving of dynamic Europe; against the pluralist divisions of a subcontinent ready to allow itself thoroughly to be transformed by many a scientific insight or labor-saving tool.

Now how do these six answers hang together? We address that question, first, from Needham's own inferred point of view, and then from structural likenesses and differences we may perceive to reside at the respective cores of those answers.

Needham's own mode of thought (very much directed toward higher syntheses and the overcoming of apparent contradictions) was such as to allow one to infer that, in his own view, his six explanations complement one another nicely — no most-favored-explanation status for any one among those six answers to the Grand Question, nor even a definite hierarchy between them. Still, one can see that the early, extremely schematic 'democracy' answer soon receded very much to the background in his work, as (to a lesser degree) did the 'Confucianism vs. Taoism' answer. Further, regrettably, and for reasons I come back to, the 'homoeostasis' answer never made it beyond that one inspired passage. Next, we may note that the 'merchant' answer and the 'bureaucracy' answer are very much two sides to one and the same coin. Jointly they read something like: 'no modern science without an autonomous merchant class which China's feudal bureaucracy forever prevented from coming up'. Thus we are in essence left with two full Needham answers. Of these, one ('the merchants') is on the societal and the other ('the laws of nature') on the intellectual level, and Needham, for all his broadly conciliatory view of things, never wavered in his Marxist conviction that, ultimately, societal circumstances are decisive. Altogether, then, it seems safe to say that in Needham's view, in the end, its lack of an autonomous class of merchants is what mostly prevented ancient China from giving rise to modern science.

Now one big problem with that answer is the scarcity of empirical evidence advanced by Needham over the decades to underpin it with — nor is it easy to think how such evidence could possibly come forward from the Chinese case. Rather than providing an independent control experiment, we actually have here little more than projection — little but the mirror image of a particular conception (Zilsel's) thought up for Europe and provable only for the European experience, not the Chinese. More than that, Needham's answer in consequence suffers fatally from the weakest point in Zilsel's thesis, which is precisely its widely overstated claim that merchants had some uniquely privileged connection to the very kind of science that came to the fore in the early stages of the Scientific Revolution. Hence, to the extent that a control experiment has been carried out here, it has failed.

But let us now dig a little more deeply below the surface of Needham's six answers. For starters, we consider those two possible further answers he can be seen consistently to have *avoided*. One concerns the possibility that the edge China had in Needham's view gained over Europe in matters scientific got lost, *not only* due to the magnificent passing maneuver of the European Scientific Revolution, *but also* to an overall

movement of retrenchment under the Ming. If one screens the fine print, so to say, of Needham's detailed treatment of mathematics, or astronomy, or navigation, in distinct tomes of *Science and Civilisation in China*, enough indications can be assembled for such a broad picture of overall scientific and other decay in late Ming society to arise. But Needham steadfastly avoided drawing his lines together that way, rather going on to insist forever that ancient China, instead of obeying the Western cliché of its scientific stagnation, displayed throughout its history ongoing, rectilinear progress in scientific thought. Here as at many other places in his work we can see that there were really two Joseph Needhams – one, the cautiously balancing, surely one-sided yet eminently reasonable scholar, the other the somewhat outrageous proselytizer and historiographical extremist. And my main message on this score is that, notwithstanding the reasonableness and the many qualifying statements of long stretches of *Science and Civilisation in China*, the simplified, radicalized picture that arises from most of the essays never ceased to govern Needham's mind whenever he directed it toward his Grand Question. Overall, his better insights on this score are strewn over the large work, and very unfortunately, under the probably semi-conscious influence of a range of respectable and less respectable, yet from a scholarly point of view jointly pernicious sentiments, he never bothered to make these better insights of his cohere.

What if he had done so? That is, what are the best insights on the origins of modern science to be distilled from Needham's life's work, and how can we make them serve in the most fruitful way the goal of a deepened understanding of how modern science came into the world?

Among the most exciting passages in *Science and Civilisation in China* are those which Needham devoted to expressions of what he called the perennial Chinese philosophy of 'organic materialism'. He saw organic materialism exemplified in neo-Confucian thought during the Sung period; he used it to speculate on the possibility of an alternative, organic Scientific Revolution in China in the sense of a short-circuit to Einstein bypassing Newton; its distinctive features can even be seen to underly much of his argument on 'the laws of nature'. 'Going with the grain of nature'; the spontaneous flow of things; their organic wholeness as opposed to their mechanical divisibility; 'correlative thinking'; causation taken as interdependence rather than as successive 'if/then' relations: all such and many similar notions were presented by Needham as a route out of primitive thought alternative to the one taken in the Graeco/Western approach to nature. And at that very point of his thought a conclusion seems to impose itself which Needham ever refused to draw. But if we discard the hopes he set upon such an organic philosophy as the required complement to modern 'billiard ball physics', and if we also discard his insistence that such a principal difference in respective approaches to nature has no independent interpretive validity but must in the end be reduced to allegedly overriding differences in Chinese and European society; if we discard all these *a priori* convictions Needham held over a lifetime, there is every reason to arrive at a conclusion like the following. There appear indeed to be at least two distinct roads leading out of primitive thought. Both of these were fully worth pursuing; neither possessed an apparent, built-in superiority. Just as Su Sung's water clock rediscovered by Needham was probably a more accurate timekeeper than its mechanical counterpart in medieval Europe, just so one may well, if one likes, call conceptions of nature in traditional China more advanced in several respects than natural philosophy in Europe prior to the Scientific Revolution. Only, as David Landes has shown for the case of those two distinct principles of time measurement, the one approach happened to contain a larger potential for further development than the other. Organic materialism, like Su Sung's clock, ultimately ran

into what Landes strikingly calls a ‘magnificent dead end’, whereas somehow out of some scattered, meanwhile enriched remnants of the Greek legacy a kind of science could be forged that went on to conquer the world.

Perhaps an outsider on matters Chinese like me is ill-advised to put forward such a view with any assurance, mostly dependent as it is upon data and interpretations advanced by Needham himself which I am in no position to check by direct means. If it does make some sense, though, it puts into a quite different perspective the historiographical status of Needham’s Grand Question. The short answer to it becomes something like this: China had no Scientific Revolution because such an outcome was not contained in the developmental possibilities of an organic approach to nature in the ‘correlative’ mode of the Chinese.

Now does this short answer thus ultimately derived from Needham throw us back upon the original problem put before him by those inquisitive Chinese students at Cambridge – the question of how it is that modern science arose in Europe only? In other words, has Needham’s very long detour over China, quite apart from what it has taught us about ancient China itself, been in vain?

I do not think so, for two reasons mainly, which I shall now sketch out by way of a conclusion to this paper.

For one, I believe that, in a wider sense, Needham did indeed use the Chinese experience as a control experiment for Europe. Few scholars ever acquired so perceptive and so thorough a sensitivity for structural differences between China and Europe – more specifically, for whatever it may have been that, in the ‘Old World’ of traditional civilizations, caused Europe to turn into the one exceptional civilization that in the end broke through its limits. As Needham clearly saw, this broad historical movement, while containing the rise of modern science as its most significant landmark, was even richer than that particular event signifies. We face here that major historical riddle of ‘the West and the Rest’ on which so much, and so little truly conclusive, has been written by so many a truly great historian, and to which this other, truly great historian, Joseph Needham, has contributed some precious insights, particularly so in that single, profoundly perceptive passage of his on Chinese homoestasis and European dynamism.

Why did he forever leave it at that? From the viewpoint of what we know more about China’s science, technology, and medicine than we knew before Needham decided to step in, his almost boundless sinophilia as expressed in the *second* quotation I used to open this paper with was of course an unmitigated boon. But in the end – as implied in the *first* passage I quoted – Needham was out to catch even bigger fish. Ultimately, he wished to understand something about his own civilization – he wished to understand nothing less than what is it that made Europe break out of the ways of traditional society. How did the Old World give way to the New World we live in? Needham felt sure – and this made him rather the exception among those historians concerned ever since Max Weber and before with finding answers to that question – that the Scientific Revolution forms the most outstanding (not the only, but surely the most outstanding) landmark in that world-historical process of incipient, global modernization. This is what lends an added urgency to his Grand Question; this is what stands behind this feeling of his that that Question forms “one of the greatest problems in the history of civilization”. And here, in this sense of what Needham perhaps less than fully consciously strove to accomplish, his sinophilia was a very mixed blessing, and his Marxism (however much toned down in the end) even less so. Needham had this (by itself, quite understandable) perennial urge to lean over backward; to forgo serious comparison in favor of his beloved method of historical ‘titration’ –

that is, to weigh priority and then, often with apparent justice but no less often implausibly and almost always irrelevantly, to grant it to China.

It always seems to testify to a profound lack of gratitude to a great man if, in response, we wish him to have been greater still. It does make sense to do so in Needham's case because it helps clarify what his unique achievement consisted of. If Needham had felt capable of reining in this sentimental side to his thought, he might well have become, not only the superbly pioneering historian of China's ancient riches in science and technology, but also the one comparative historian of Europe's setting the world on the path toward modernity fully to include into that event the seminal contribution made by modern science and its (at least on the face of it) miraculous rise in Europe in the first place. True, in order fully to make himself that as yet non-existent but – in my opinion – very much needed historian, Needham should in addition have given up those cheap formulae of Marxist provenance – reified Feudalism, Capitalism, Bureaucratism, and so on – he was in the habit of falling back on when addressing societal issues. His dauntless courage to go beyond the historical details that also held him captivated and to address major world-historical issues is very much worth sticking to when we seek to make up the balance of Joseph Needham's intellectual legacy; the way he actually used to address them, less so.

Finally, I wish to invoke the profound inspiration exerted by Needham's explorations in cross-culturally comparative history of science. As already suggested between the lines, I think there are few methodological traps in this particular field of study Needham did not fall into, loudly, clearly, and, with his characteristically generous disregard of covert ways, in a manner open for all to see. But his experience should serve only as a warning to us whose path, cleared of at least some pitfalls, may be easier because he pioneered it for us. It should by no means serve to give up the search itself. With unprecedented clarity of vision Needham saw that there is no better way to throw that uniquely European event of the rise of modern science into relief for the historian of science than to consider it, not only, obviously, from the inside, but also at one remove; to take a step backward and *compare*.

True, I do not think that, in the case of the Scientific Revolution, China offers the most fruitful source of comparison. Too much is truly incommensurable there; as Needham himself, in one of his less propagandist, more balanced moods wrote, "The sciences of the mediaeval world were in fact tied closely to their ethnic environment, and it was difficult if not impossible for people of those different environments to find any common basis of discourse." A far better 'common basis of discourse' and, hence, of comparison is provided by the several civilizations that successively made an effort to receive, and went on to appropriate in their partly similar partly different ways, the Greek legacy in science and natural philosophy. Sustained comparisons between what the Islamic world, medieval Europe, and Renaissance Europe successively and distinctly made of that Greek legacy before the latter went on to transform it so drastically as to usher in the Scientific Revolution, is what fills pertinent chapters in a book-in-progress of mine which at present goes under the title 'How Modern Science Came Into the World. Its Conditioned Emergence; Its Threefold Dynamics'. Still, in at least three major respects I have also found a comparison between China and, not so much Europe but rather Greece, helpful in seeking to answer the question of how modern science could arise where and when it did.

My first, partial answer is the one already mentioned, which would certainly not have been endorsed by Needham but still, I think, forms the gist of his own best answers. This is the seemingly trivial idea that

modern science could (not 'was bound to', just 'could') grow out of the Greek corpus, not out of China's organic materialism, because it rested as an unrealized possibility in the former, not the latter.

A second partial answer posits the immense fertility of processes of 'cultural transplantation', i.e., chances for novel things to happen to habits and ideas and modes of doing things grown stale, or otherwise worn out, in their original setting. Chocolate and the potato began to unfold their full potential upon transplantation from America to Europe; science in the Alexandrian mode, never followed up in the Hellenist world, similarly got new chances upon its entering novel environments. It is striking that for a potentially no less fruitful approach, the one embodied in the Mohist 'Canons and Expositions', which were just as marginal in China as Alexandrian science was in the Hellenist world, the one setback it received from the book-burnings under the Ch'in sufficed to make it wither away for good. Primarily responsible here seem to be the vicissitudes of China's political fate which, in forever keeping its cultural integrity intact, as one unintended by-effect made China by and large insensitive to the kind of drastic reinvigoration Archimedes in late Renaissance Europe was to benefit from in Galileo's hands.

A third partial answer (here to be rendered in even more schematic a way than all the others) rests in such distinct attitudes taken toward nature as Needham sometimes enjoyed pointing at rather in passing. No mere passivity lay in the aim of the Chinese to live in harmony with nature; yet Chinese activism in this respect was constrained by a consistent reluctance to 'go against the grain of nature' (to use Needham's favorite rendition of 'wu-wei'). There is good reason to suppose, with hindsight, that such an overall posture of world-acceptance, however admirable and (quite possibly) superior to that of the West in many respects, was not conducive to the emergence of modern science.

These three comparisons, to repeat, were not those of Needham, and he would not have liked them much. Still, whatever they may be worth they could not possibly have been thought up but for the inspiration received from the happy months I once spent with Needham's Grand Question and his tentative answers to it. Those months more than anything else have persuaded me that the business of clearing up further that decisive event in the history of humankind, the rise of modern science, can benefit from nothing quite so much as from broadly following in Joseph Needham's footsteps.