



## Review Essay

# From West to East, from East to West? Early Science between Civilizations

**H. Floris Cohen**  
*Utrecht University\**

---

Arun Bala, *The Dialogue of Civilizations in the Birth of Modern Science* (New York: Palgrave Macmillan, 2006), pp. 244, \$ 89.00, ISBN 978 1 4039 7468 6.

Avner Ben-Zaken, *Cross-Cultural Scientific Exchanges in the Eastern Mediterranean, 1560–1660* (Baltimore: Johns Hopkins University Press, 2010), pp. 246, \$ 60.00, ISBN 978 0 8018 9476 3.

Sylvain Gouguenheim, *Aristote au Mont-Saint-Michel. Les racines grecques de l'Europe chrétienne* (Paris: Seuil, 2008), pp. 282, € 21.30, ISBN 978 2 02 096541 5.

Toby E. Huff, *Intellectual Curiosity and the Scientific Revolution. A Global Perspective* (Cambridge: Cambridge University Press, 2010), pp. xiv+354, € 71.00, ISBN 978 0 521 17052 9.

Jonathan Lyons, *The House of Wisdom. How the Arabs Transformed Western Civilization* (London: Bloomsbury, 2009), pp. xviii+248, £ 10.00, ISBN 978 1 4088 0121 5.

Is modern science a product of the West exclusively? To be sure, from Galileo to Newton and far beyond the pioneers were Europeans. But does it follow that what science sprang from their efforts deserves without any reservation a label 'made in Europe'? Survey histories of science still make us believe so, be it by commission or by omission. If a textbook starts with the ancient Greeks, these are treated in a self-evident sort of way as proto-Europeans—not *quite* us yet, but *almost* us already. Between c. 800 and c. 1200, during the European 'Dark Ages', 'the Arabs' are

---

\* Descartes Centre for the History and Philosophy of the Sciences and the Humanities, Janskerkhof 13, 3512 BL Utrecht, The Netherlands (h.f.cohen@uu.nl).

assigned the humble role of dutiful babysitters for the Greek corpus of nature-knowledge, until Europe takes up again these texts by the High Middle Ages and in a second run-up goes on from there to turn it into 'recognizably modern' science.<sup>1</sup>

Five recently published books have for their common theme this still rarely challenged, Eurocentric view. Three authors oppose to it another conception, that circles around mutual contact between civilizations and the fruitful exchanges made possible thereby. The Scientific Revolution, so they argue, was not of purely European making—other advanced civilizations contributed to the rise of modern science, too. Lyons, a British journalist who covers events in the Middle East, argues that Arabic science laid the foundations for medieval and, hence, for modern science; more than that, he attributes 'the invention of the West' itself to Arabic knowledge. Ben-Zaken, an Israeli/American historian of science, points out that around 1600 the Eastern basin of the Mediterranean was packed with European as well as Ottoman diplomats, merchants, soldiers, pirates and captives but also scholars, thus causing many a scientific insight to become a subject of 'circulation of knowledge'. Bala (Balasubramaniam in full), a Singaporean philosopher of science, argues that even if, in a specific case of actual transmission of knowledge from one civilization to another, material evidence for the feat is as yet lacking, we may still accept it as genuine when paths of transmission were in fact open.

In contrast, the books of the two remaining authors tend to reconfirm the Eurocentric conception. As they see it, for the growth of science in Europe and, thus, for the making of modern science as such, Islamic civilization and China, too, could just as well be missed. Gouguenheim, a French historian, argues that even during the 'Dark Ages' the odd Byzantine kept paying visits to Europe from time to time, and thus

---

<sup>1</sup> I have made a larger argument about this historiographical tradition in my *How Modern Science Came Into the World. Four Civilizations, One 17<sup>th</sup> Century Breakthrough* (Amsterdam, 2010), xxii-xxiv. One exception to the Eurocentric rule is James E. McClellan III & Harold Dorn, *Science and Technology in World History. An Introduction* (Baltimore/London, 1999)—a book I reviewed in *Early Science and Medicine* 6 (2001), 362-68, under the title "Global History of Science Comes of Age." The expression 'Recognizably modern science' was often used by Stillman Drake, as for instance in *Galileo: Pioneer Scientist* (Toronto, 1990), 98.

maintained connections that furthered the direct translation into Latin of original Greek works pertaining to science; hence, no Arabic detour was at all needed. Finally, Huff, an American sociologist of science, argues that the explosion of astronomical discoveries that the invention of the telescope speedily brought about in Europe struck hardly a chord in China or India or the Ottoman Empire. Jesuit fathers and European diplomats might offer telescopes as gifts at court, yet next to nothing constructive was done at those various Oriental courts with either these or any other contemporary discovery of a revolutionary-scientific nature—indeed, all those non-Western civilizations were lacking in ‘intellectual curiosity’.

Reader, have you already taken sides? Are you inclined to go along with the threefold ‘cultural exchange’ party, or rather with the pair that seeks to reaffirm the ‘everything-from-Europe’ picture? Not necessarily each individual argument among those that have caught your broad sympathy may sound plausible to you without more ado, and yet I suspect that my ultra-brief summaries have already moved you in either the one or the other direction. We are after all dealing here with an ideologically heavily charged subject. A broad sense of European superiority, or alternatively shame felt for a backward state incurred at the time and not made up for still, lies ready to be mobilized as soon as the question of ‘why Europe?’ comes up. Since we, historians, are human, too, our sentiments are bound to have an impact upon our thinking on the question. And yet we should seek to decouple our judgment on the achievement of the five authors here reviewed from those sentiments, and rather make it depend on questions like: How does each author seek to make his argument clinching? How does the empirical material advanced in each case stand related to the interpretation built up with its help? On what academically acceptable grounds may we choose between these conflicting views? It is questions like these that I shall now direct at each of these five books, which I handle in an order of increasing empirical content. I complete my review by adding a brief conclusion of my own.

Bala’s concern is primarily methodological. When a certain insight comes up in one given civilization and the historian notices its somewhat later appearance in another, what criteria allow us in such a case to speak of actual knowledge transmission? For the sciences the man to raise the

question on the grand scale about half a century ago has been Joseph Needham, the formidable scholar who pioneered cross-culturally comparative history of science. He felt that, in identifying cultural transmission, the burden of proof does not rest with those who *posit* it in a given, plausible-looking case, but with those who *deny* it—a view that has naturally provoked the objection that such a rule opens the floodgates to sheer speculation.<sup>2</sup>

Bala's point of departure, too, is that in the history of science a 'dialogue of civilizations' is *a priori* plausible and is not in any given case in indispensable need of empirical evidence. He gives body to the point by means of the following criterion, meant to be more strict than Needham's apparent 'everything goes' in this regard:

If, shortly after a new corridor of communication opens between a culture A and a culture B, and great interest [is] shown by A to understand B, a theme becomes dominant in A similar to a dominant theme in B, then we can presume that the development of the theme in A was due to the influence of B, even if the new theme had existed as a recessive theme in A prior to contact between the cultures. (49)<sup>3</sup>

In practice Bala has now given himself sufficient leeway for what he goes on to do in the remainder of his book. Without a shred of empirical evidence he allows critiques of Ptolemy in the Arabic world to affect Copernicus' thinking, or fifteenth/sixteenth century Indian mathematicians to contribute to Newton's discovery of the calculus, or Shen Kua's late-eleventh century discovery of magnetic declination to culminate in Kepler's laws.<sup>4</sup> Not only does Bala curtail but little Needham's really unlimited freedom to speculate, but empirical counterexamples present themselves at once. How often do we not, even at the level of individuals, observe that the route was fully open, the interest not just similar but nearly identical, and yet we cannot speak of influence, let alone

<sup>2</sup> I have discussed these views of Joseph Needham in my *The Scientific Revolution. A Historiographical Inquiry* (Chicago/London, 1994), 431-39.

<sup>3</sup> The expression 'theme' refers to Gerard Holton's 'thematic' approach to the history of science (e.g., *Thematic Origins of Scientific Thought: Kepler to Einstein* (Cambridge, Mass., 1973).

<sup>4</sup> In the third case, that of Shen Kua, Joseph Needham preceded Bala: see my *Scientific Revolution*, notably 432-33.

transmission? Huygens and Newton knew each other, they were over a prolonged period and in at first very much similar ways at work on the problem of orbital motion, Huygens even played for two days with a conception of force Newton was to arrive at a decade later, and yet we quite rightly attribute the discovery of universal gravitation to Newton, not at all to Huygens, who even opposed it from its very inception. Also, Bala's criterion really implies the promotion of scholarly sloth. Why should genuine experts like F. Jamil Ragep keep exerting themselves as much as they do to uncover, for instance, the missing link between the Tusi couple rediscovered more than half a century ago and the tantalizingly similar figure in Copernicus' *De Revolutionibus*, if Bala's criterion allows them to fill the evidential gap without even getting out of their armchairs?

There are also less incidental grounds than the Tusi couple for at least taking seriously 'Arabic' claims to co-authorship of modern science. After all, Europe and the Islamic world have shared a great deal—not only the worship of One Deity but also the Mediterranean sea, mutual trade, lengthy borders, much warfare, and most of all an important portion of the corpus of ancient Greek conceptions of nature. Lyons quite rightly emphasizes in his book that, among those who between c. 800 and c. 1000 AD translated that portion into the language of the Quran as also among those who kept working on it since, were numerous creative minds who enriched these texts with important new insights. Large segments of the corpus thus enriched were then translated from Arabic into Latin, during an impressive episode of intercultural cooperation (eleventh/twelfth century) in the border region between still-Islamic and again-Christian Spain, with Toledo for center. To be sure, all this has been known for a very long time, but it does no harm if a journalist in his catchy style emphasizes it all over again for the benefit of a broad audience.<sup>5</sup> Only, to Lyons this is not nearly enough. Time and again he covers up the veritable chasm that separates Aristotelian doctrine—the

---

<sup>5</sup>) Authoritative survey histories are still most regrettably lacking entirely, so the experts have left their field wide open to more journalistic efforts, such as Lyons'. Two more of the kind have recently appeared. The physicist and science writer Jim al-Khalili wrote a book under the same title *The House of Wisdom*, with the pretty alarming subtitle *How Arabic Science Saved Ancient Knowledge and Gave Us the Renaissance* (New York, 2011). Luckily the author is less than Lyons given to wild exaggeration. This is even more true

predominant natural philosophy in the Cordoba of two Islamic Berber dynasties and, hence, of medieval Europe, too—from modern science, which was to take shape in no small measure as a large-scale revolt against that very doctrine and the dogmatic mode of thought behind it. Lyons systematically adopts far too speculative-dogmatic modern terms; in connection with Aristotle he speaks of ‘natural laws’, no less, and by means of his suggestive vocabulary he creates with his readers an impression as if at the courts of the khalifs entire teams of white-coated scientists came up with one ‘breakthrough’ after another.

Whereas Lyons blows the episode of the Arabo-Latin translations up beyond all reasonable proportions, Gouguenheim is rather concerned to deprecate it with about equal force. In *The House of Wisdom* medieval Europeans are portrayed up to far into the twelfth century as semi-savages, kept dumb and subservient by backward clergy—with Gouguenheim it is rather the Arabs and Persians who bear the brunt of his pervasive criticism. What little creativity he is prepared to allow them is due chiefly, so he argues, to Jews and Christians. Biographically speaking this is true up to a point, yet it makes little difference for the much more significant circumstance that it was a civilization wholly perfused by Islamic values that made possible, endorsed, and colored in its turn a surely significant contribution of its own. Gouguenheim’s harangues culminate in his trotting out an Aristotle translation that has definitely not escaped the attention of the specialists but that so far failed to excite them particularly. The contacts between Byzantium, where the original Greek texts were housed, and Western Europe were never broken off completely, so Gouguenheim rightly asserts, and that is how already around 1125 a certain Jacob of Venice could prepare a translation of Aristotle’s work directly from Greek. Hence, the entire later translation effort in and around Toledo, which of course used Arabic as the mediator between Greek and Latin, was superfluous: this is what Gouguenheim’s message comes down to, in tandem with his final conclusion that medieval science remained untainted throughout by Islamic influences. In France his argument has met with more indignation than real exper-

---

of a third recent book on the subject, by the science writer Ehsan Masood, *Science and Islam: A History* (London, 2009).

tise.<sup>6</sup> More importantly, once you descend to the small print of the paragraphs in which Gougenheim brings this translation up as his *pièce de résistance*, Jacob of Venice's work quickly turns out to have constituted translating at its most primitive. It is literal word-by-word replacement,<sup>7</sup> naturally producing near-incomprehensible arguments which left pretty opaque what Aristotle was really aiming at. So in and around Toledo there was still quite enough work to do for Gerard of Cremona and the other great translators at the time. The question that remains is whether their effort, so impressive on its own account, and surely instrumental in moving medieval-European nature-knowledge to a far higher level than before, may also sensibly be regarded as a contribution to the rise of modern science?

One way to take up the question is by moving the scene forward in time. How did the achievement of the pioneers of the Scientific Revolution actually work out elsewhere? How receptive did other civilizations turn out to be, once they were confronted with the first results? This is the viewpoint that Huff has adopted for his examination of the relation between East and West in the matter of science. His argument comes down to this. Even when the Scientific Revolution was on its way and its products began to reach Islamic civilization and China and India, these products (which in view of their speedy accumulation he calls a 'discovery machine') met with little enthusiasm or even comprehension. True, for chiefly political reasons the second Manchu emperor found it worth his while to appoint a Jesuit expert at the head of the imperial Astronomical Bureau, and to use the occasion of the proclamation of a new calendar for giving Father Verbiest a chance to demonstrate for the benefit of the court the superior predictive powers of European astronomy. But that is about how far its impact went—prior to the arrival of the fleets and armies of Western imperialism in the early 19th century, nothing came of truly adopting, let alone expanding, Jesuit astronomy or any other European field or discovery. Huff is surely right with his hardly novel observation that it was to take centuries for China and the

---

<sup>6</sup> See for the debate <http://lethiboniste.blogspot.com/2009/07/s-gougenheim-aristotele-mont-saint.html>.

<sup>7</sup> A very instructive account of various translation styles in early nature-knowledge is given by Scott L. Montgomery, *Science in Translation. Movements of Knowledge through Cultures and Time* (Chicago, 2000).

Islamic world to start adopting Europe-born science in more than incidental bits and pieces, yet the question is whether lack of 'intellectual curiosity' is really responsible.

Huff himself does not take the trouble to seek to substantiate his thesis. It looks as if he cannot even imagine any other cause of the phenomenon. He shows himself curiously blind to the circumstance that, in each case, these discoveries landed in quite another cultural context, that decisively colored its reception. This is even true of the cultural context from which these discoveries emerged in the first place—Huff fully ignores the quite substantial resistance, rooted in Christian values, that they quickly met with in Europe itself. So forceful were the conflicts some of these discoveries gave rise to that the entire movement of revolutionary renewal of the first half of the seventeenth century came very close to losing momentum for good in view of, notably, the formidable effects of Galileo's trial and of the conflicts in the Netherlands and in France over the works of Descartes.<sup>8</sup>

As Peter Engelfriet, a sinologist *cum* historian of mathematics, has shown, the incisive calendar reform that adoption of Jesuit astronomy entailed ran aground on the deep roots of the Chinese calendar system in court ritual as well as in the everyday life of every Chinese—small wonder that enduring adoption of so outlandish a system did not occur.<sup>9</sup> The literate upper layers of China, as also of Mughal India and the Ottoman Empire were curious enough, only, their curiosity went mostly in other directions. Surely the transfer of elements of culture and even of scientific findings belongs to the realm of the possible, witness the Baghdad and Toledo translation efforts, which do not stand alone in history. Only, for such an event to come about certain favorable circumstances, specific for each case, are indispensably required. If Huff had extended his argument to the Russia of Peter the Great, he would have been able to notice how smoothly basic aspects of the new Western science were adopted in a cultural environment that at least in this respect was a blank slate and was also run by an autocrat eager to import all kinds of Western products and ideas he deemed superior and also in

---

<sup>8</sup>) I have devoted ch. 12 of my *How Modern Science Came Into the World* to making the point *in extenso*.

<sup>9</sup>) Peter Engelfriet, essay review of Noël Golvers (transl.), *The Astronomia Europea of Ferdinand Verbiest*, S.J.; in: *T'oung Pao* 63 (1996), 206-20.

urgent demand. This ran from shipbuilding techniques and monetary systems to the latest science. The Czar ordered Huygens' posthumous book *Kosmotheoros* on the buildup of the solar system to be translated into Russian, and entire cabinets with pharmaceuticals to be shipped from Amsterdam to Saint Petersburg, where several pieces are on display to this day.<sup>10</sup>

What, then, were those favorable circumstances that made transmission or even exchange of nature-knowledge possible in a specific case? For Europe and the Ottoman Empire Ben-Zaken's book offers an intriguing approach, empirically richer and more innovative than any of the other books here under review. With him the concept of 'transmission', or 'transfer', of knowledge widens into what these days is called 'circulation of knowledge'. Cultural exchange, so Ben-Zaken seeks to demonstrate, need not be a one-way affair, nor was it so in the late sixteenth and early seventeenth-century Levant. His book consists of five mini-studies, each grouped around some obscure manuscript or printed book of which he has sniffed out its vicissitudes in the Eastern Mediterranean. With Ben-Zaken you keep encountering scholars who in search of early manuscripts roam in Egypt, Syria, or Istanbul and its surroundings. The 'urtext' of the bible book of Job is what they hope to dig up there, or lost treatises by Pythagoras, who after all is reputed to have picked up his wisdom in Egypt and Mesopotamia. Consultation of these early texts would then make it possible to decide all kinds of heavily disputed matters in the Europe of Copernicus and Tycho and Galileo, not only theological ones but also for example the question of whether the earth does orbit the sun, yes or no. Ben-Zaken fully makes good on his claim of mutual contact. But on closer look you find something he himself leaves unmentioned: of all these learned activities only two are attributable to non-Europeans, and even these go only so far.

One of the two cases concerns Taqi al-Din, the Egyptian founder of an observatory in Istanbul that the new sultan, Murad III, had built in 1574 but ordered dismantled already seven years later due to a horoscope with unlucky consequences. Ben-Zaken has dug up that the founder acquired part of his up-to-date astronomical knowledge during a stay in Italy, consequent on his being taken captive by Italian pirates. Later, at

---

<sup>10</sup> Valentin Boss, *Newton and Russia. The Early Influence, 1698-1796* (Cambridge, Mass., 1972).

work for the sultan, he in his turn employed a dozen Christian captives as assistants.

Ben-Zaken's other non-West-European protagonist is the Hungarian translator of a French astronomical treatise, who offers his Arabic translation at court in Istanbul, where it is first refused but accepted on second thoughts. Remarkably, the translator handles the ideas of Copernicus and Kepler that are worked into the French original fully in the traditional format of Ottoman astronomy, the *zij*, that is, more as updated tables than by way of large-scale conceptual innovation. Precisely this de-conceptualization of the revolution that has just taken place in European astronomy is what has in the end made the translation acceptable at court.<sup>11</sup>

At the end of his book Ben-Zaken concludes:

Early modern science, then, did not develop along separate, linear paths, with each culture drawing only on its own 'monadic' nature, but rather was cultivated by streams of fresh ideas and objects that came through exchanges at the cultural margins. The principle of the 'incommensurability of cultures' would, perhaps, best give way to a more continuative and dialogic approach that sets its eyes not on 'cultural centers' but on the hazy yet fertile 'cultural margins' that necessarily overlap with other 'cultural margins', creating a stimulating, mutually embraced zone where intensive cross-cultural exchanges transpire. (166)

Doubtless Ben-Zaken has demonstrated with much inventive ingenuity that during these first decades of the Scientific Revolution a variety of remarkable encounters took place in the Eastern basin of the Mediterranean between representatives of European and of Islamic civilization. Only, over lines like those just quoted hangs the artful suggestion that modern science was a product of both. For that, so Ben-Zaken's own findings make clear, the initiative was far too one-sidedly Western—time and again it is a European who wanders about in the Middle East, not the other way round. So the conclusion itself should also be drawn the other way round: if even so inventive a detective as Ben-Zaken has not been able to find more numerous and more weighty non-Western contributions to the turnabout that took place in the period between, on the one hand, Galileo, Kepler, Descartes, and Bacon, and, on the other

---

<sup>11</sup> In the Epilogue to *How Modern Science Came Into the World*, 725-29, I have discussed the matter at greater length.

hand, Newton, then in all likelihood there have been no such contributions.

Even Ben-Zaken, then, has not been able to shed to the full the irresponsibly wishful thinking that has marked the debate from Needham up to the present day. Such wishful thinking has worked both ways. It characterizes the extreme one-sidedness into which Gouguenheim and Huff have descended, but also the systematic distortions we encountered at the other side in Bala's methodological dilutions and in Lyons' journalistic blowing up of facts mostly real by themselves, and even in Ben-Zaken's calmer but still untenable generalizations.

Make no mistake: *transmission* of nature-knowledge between Islamic and European civilization has without any doubt taken place. It has been a creative process, and as one result a number of significant Arabic enrichments of the Greek corpus came to enhance and deepen European debates on the subject. But this is something else than to attribute at least in part to Islamic civilization the *revolutionary transformations* of the Greek corpus that took place in seventeenth-century Europe. Just so it is sheer wishful thinking to speak, with Ben-Zaken, of cross-cultural *circulation* rather than of *transmission* of nature-knowledge.

In sum, conceptions of nature and the traditions into which these get established and are passed on from one generation to the next are, albeit surely not fully, yet in large measure linked up with their own cultural environment. On this very point, around which the entire question here discussed can be seen to turn in the end, I wholeheartedly agree with no one but Joseph Needham himself. Much of his pioneering work is pervaded by wishful thinking, and yet I have not for nothing called him above a 'formidable' scholar. Just on and off he was *not* out to preach and, by means of systematic exaggeration, to win souls for his favorite notion, half a century later disputed by few, of the high level of Chinese thought about nature.<sup>12</sup> It is rather to this sober-minded, realistic Needham that I now give the final word:

---

<sup>12</sup> Joseph Needham, *Science in Traditional China: A Comparative Perspective* (Cambridge, Mass., 1981), ix: "Everyone who undertakes a big inter-cultural job like this must naturally project his own system of beliefs in doing so—it is his opportunity to preach (and I use the word quite advisedly) to his own and later generations. If sometimes we have written like barristers pleading a case, or sometimes over-emphasise the Chinese contributions, it has been consciously to redress a balance which in the past tilted over

The mutual incomprehensibility of the ethnically-bound concept systems did severely restrict possible contacts and transmissions in the realm of scientific ideas. This is why technological elements spread widely through the length and breadth of the Old World, while scientific elements for the most part failed to do so.<sup>13</sup>

... 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. For example, if Chang Hêng had tried to talk to Vitruvius about the Yin and the Yang or the Five Elements, he would not have got very far, even if they could have understood each other at all.<sup>14</sup>

---

much too far on the other side. We were out to redress a secular injustice and misunderstanding.”

<sup>13)</sup> Joseph Needham, *The Grand Titration: Science and Society in East and West* (London, 1969), 16.

<sup>14)</sup> Needham, *Science*, 9.