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THE DIVERGENCE OF CULTURES:
Enlightenments and Conservatism in Europe and the Old World

By Jack A. Goldstone

MERCATUS CENTER
George Mason University

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In recent years, there has been a persuasive identification of common features among the major kingdoms and empires of the Old World in the 17th and 18th centuries, a period often labeled as the "Early Modern." These features include more formal and rational bureaucratization of state administration; the integration of previously separate or separately ruled territories under a single central authority; the spread of vernacular literatures; extensive commercialization and urbanization including long-distance profit-oriented manufacturing and trade; contention between heterodox and orthodox religions or sects; and technological improvements in agriculture, manufacturing, and transportation (Eisenstadt 2000, Eisenstadt and Schluchter 1998, Lieberman 1999, 2003/2009).

As a result of these similarities, scholars have moved away from seeing the early modern period as one defined by a contrast between a dynamic Europe moving from Renaissance and Reformation to Counter-Reformation and Enlightenment versus staid, traditional imperial societies in the Middle East and Asia. Instead, a similar degree of dynamism and progress is now seen everywhere from Holland to Japan. Extraordinary commercial and technical achievements are now recognized everywhere from Song China and the Baghdad Caliphate to medieval Southeast Asia and 17th century India. World historians of the "California School," including myself, have thus argued for a world of similar political and material capacities across Eurasia, with the 'Great Divergence' of their economies and military power coming only quite late, in the early nineteenth century (Goldstone 1991, 1998, 2002; Pomeranz 2000).

Yet I for one worry that perhaps the pendulum has swung too far, obliterating our view of important differences between Europe and other parts of Eurasia in the sixteenth and seventeenth centuries. I think in particular that the Scientific Revolution and the Enlightenment have been misunderstood in recent years. The

Scientific Revolution in the West has been virtually deconstructed out of existence (Harkness 2007, Shapin 1998), and shown to be more dependent on Islamic science than was formerly recognized (Saliba 2007). While there has been much recent interest in the Enlightenment (Israel 2001, Robertson 2005, Mokyr 2009), the emphasis has been on radical irreligion, political economy, or the rationalization of knowledge. All are important, but not matters that separate Europe from other major civilizations – there were major heterodox movements, analyses of trade and commerce, and even rationalization of core texts (as with the historical philology of Confucianism in Qing China [Elman 2001]) outside of Europe.

The question of what separated Europe from the rest of the world in the 19th century thus remains a puzzle, and will remain so if we focus on material factors, or on broad ideological trends. We need to be more specific and focus on particular elements of modernity that were unique to Europe, and search for their intellectual origins.

Several of these specific elements that emerged from the sixteenth to the eighteenth century were (1) a constitutional state based on citizen sovereignty; (2) a secular, pluralist state that does not enforce any religious practice or beliefs; (3) new energy sources and materials (coal, cast iron, machine-spun cotton); (4) unprecedented accelerating economic growth; and (5) a radical decentering and often repudiation of the classical tradition in regard to knowledge of the natural world. These trends seem so disparate – acting across the fields of politics, technology, economics, and philosophy – that they are almost always treated quite separately, as if the fact that they all arrived suddenly in the same two centuries and uniquely in Europe were almost a coincidence. Yet I shall argue that they were in fact all intimately related, and in particular focus on the last – a decentering and repudiation of Europe's classical religious and philosophical traditions in the study of nature that has no counterpart in any other major civilization prior to the 19th or even 20th century.

The Long Dominance of Classical/Religious Texts in most Major Societies in Eurasia

Despite the changes mentioned above—political centralization, commercialization, venacularization, and considerable technical innovation—throughout the early modern period the major civilizations of the world remained deeply attached to the traditional classical works that had defined their world-view for centuries, or even millennia. Whether we consider Confucianism in China, Confucianism and Shinto in Japan, Sanskrit culture in India, or the Koran in the Middle East and north Africa, most of the sixteenth through nineteenth centuries involved efforts to purify, promulgate, and save these classic texts and renew their importance as guidelines for ordering society and understanding nature.

Indeed, throughout Eurasia rulers of most major states and empires reacted to the political disorders and social upheaval that commercialization and heterodoxy brought to the sixteenth and seventeenth centuries by sponsoring or enforcing movements toward state-enforced religious orthodoxy and reinforcement of the traditional social order. In Europe, we know this movement as the Counter-Reformation, which was most successful in Spain, Poland, and parts of Italy, and we know its instruments of the Jesuit order and the Inquisition. The Counter-Reformation sought to restore social order by building a close partnership between Catholic rulers and a vigorous Catholic Church hierarchy, which together would root out non-Catholic believers and resist attacks on the authority of the Holy Bible and the Pope. In particular the Jesuits sought to take command of the philosophical and intellectual foundations of Catholic society, resisting the Copernican innovations and liberal political ideas of Enlightenment thinkers right up through the eighteenth century. Unsurprisingly, there were similar movements of Church-and-State sponsored religious and intellectual conservatism in most other major societies of Eurasia during this same period.

In the Ottoman Empire, the "circle of Equity" movement, espoused by religious leaders and political officials in the wake of the *jelali* rebellions of the late sixteenth and early seventeeth centuries, sought to restore social order through enforcement of traditional law and justice. This movement defined the role of law and justice not in terms of protecting individual freedom but in terms of protecting social harmony (Barkey 2008, pp. 100-101). Harmony in turn meant that every subject had to fulfill their duty to obey the sovereign (and his

officials) and not to harm fellow-subjects. The relations between the state and local notables was rationalized and recast to recognize the local power that the increasingly autonomous local notables wielded. Yet the legitimacy of the state was reinforced in traditional terms, through the role of the Ottoman ruler as head of a strict hierarchy of officials and commoners, and as the 'caliph' or head of the body of followers of Islam. In addition, religion was placed in an increasingly strict and conservative framing. As Barkey (2008, pp. 205, 225) comments, in the early 18th century "the coalition [that formed to reinvigorate the Ottoman state] aimed rather to reform the state and impose the rule of new sultans and new officials who would reinstitute the older and romanticized political rule of the past." … "an increasingly narrow Sunni orthodoxy would be protected and perfected by the increasingly centralized institution of the *ilmiyye* [the hierarchy of religious officials and scholars]." Even with the more explicitly westernizing reforms of the late 18th century, the sultans sought to balance the possible delegitimizing effects of introducing western military technology and financial institutions by stressing the traditional and religious justification for their absolute rule, while the *ilmiyye* reacted by condemning innovation in theology or philosophy and clinging ever more strongly to traditional Sunni orthodoxy as a guide to knowledge and law. It took the deliberately westernizing and secularizing revolution of Kemal Attaturk in 1922 to end the domination of Turkish society by the political and religious framework of the traditional caliphate and *ulema*, which had lasted from at least the early 16th century.

In China, the Manchu conquerors of the Ming dynasty sought to legitimize their rule in China proper by sponsoring a broad movement to strengthen the hold of Confucian political and religious beliefs. Scholars and officials were co-opted by support for an extensive scholarly effort to study, purify, and reconstitute the original meaning of the classical sacred Confucian texts, by a new scientific philology based on historical studies (Elman 2001, 2005). The Qianlong Emperor (1711-1799) sponsored an enormous effort to collect corrected editions of all the classic texts of China's Confucian tradition, in the "Complete Imperial Library in the Four Branches of Literature." It employed many hundreds of scholars, took nearly two dozen years, and the final product contained over three thousand titles, which were published in almost 80,000 volumes, reproduced for

distribution in all the major centers of the Empire. However, the process was combined with harsh censorship; any books critical of the Manchus or deemed too heterodox were banned and destroyed (Elman 2001).

To be sure, outside of China proper, in their territories of Manchuria, Mongolia, and Tibet, the Manchu emperors took on different roles. But in each region, they sought to legitimize themselves by taking on the mantle of traditional authorities, whether that was Buddhist/Lamaist in Tibet and Mongolia, warrior-chieftan in Manchuria, or good Confucian ruler in China (Rawski 2001, Perdue 2005). Indeed, precisely to secure such legitimacy despite the fact that they owed their power to conquest, the Manchus adopted something of a 'holier than thou' approach in each of their conquered realms, sponsoring and patronizing the local traditional orthodoxy with great vigor. Confucian orthodoxy thus remained the pivotal supporting ideology of Manchu rule in Han China until its overthrow in 1911. Although Jesuits and later missionaries from Europe brought information on 'modern' science and became influential in the Imperial observatory and calendrical ministry, they did not dislodge the dominant Confucian world-view, which stressed harmony and balance amidst constant change, rather than a universe that obeyed constant natural laws, in both nature and politics. Moreover, European divisions undermined their message. The Jesuits, who arrived on the Chinese scene still refusing to adopt a Copernican or Galilean view of the solar system, taught the Chinese the astronomical system of Tycho Brahe. Although Brahe's measurements of planetary motion were the most accurate in history, he still arranged the planetary motions with a stationary earth at the center, being circled by the moon and sun, with the sun in turn circled by the other planets.

This conservative system was challenged by later Protestant missionaries who brought the Galilean and Newtonian solar system to the attention of the Chinese court. But the result of these disagreements was to allow the Muslim astronomers, who had their own very advanced calendrical tradition based on centuries of original mathematical revision to the Ptolemaic system, to reassert themselves. The influence of non-Chinese natural knowledge thus was limited by this clash of systems; Chinese scholars appropriated bits and pieces of useful knowledge, but were not converted to any other system of knowledge.

Meanwhile, Chinese scholars developed their own approach to evidential knowledge and political economy based on their own empirical observations of history, nature, medicine, agriculture, and trade. Yet these empirical observations – including advanced astronomical measurements, remarkable achievements in botany and herbal medicine, and stunning hydrological and agricultural advances (Elvin 2004) – were nonetheless absorbed without altering the dominant Confucian views of an ever-changing but balanced and harmonious cosmos. Thus fundamental views of nature and political authority, both based on balance and harmony, embodied in the *Yi Jing* (*Classic of Changes*) and other classical texts continued and were in fact strongly reinforced by the Qing rulers, who relied on traditional Confucian legitimation of imperial and patriarchal authority (Elman 2005) for the ideological underpinnings of their rule.

Finally, in India, which like Europe had a long history of international conflicts and multi-state competition (with northern empires never quite ending the independence of distinct Southern societies [Lieberman 2009]), the Mughal empire gradually shifted from being a tolerant, multi-religious and open-inquiry society under the early Mughal leader Akbar in the sixteenth century to being an intolerant, fiercely Sunni orthodoxy-enforcing regime under the late seventeenth century sultan Aurangzeb (Asher 2006). While Aurangzeb sought to instill fidelity to the classical Sunni tradition in his empire, the southern India kingdoms and native Hindus in the north supported a vast movement of renovation in traditional Indian faith, called the *Bhakti* movement (Richards 1995, p. 34). This popular movement was more like the European Reformation than the counter-Reformation; its popularity was based on the use of vernacular languages rather than Sanskrit to spread its work, and it focused worshipers on the love of God and mystical faith, rather than caste rituals. Nonetheless, it was absorbed into mainstream Hinduism, which in turn retained its devotion to classical texts and the basic principles of caste but added personal spirituality.

By contrast, in many parts of Europe – and only in Europe – the classical texts (the Greek and Roman classics and the Christian Bible), which had remained the core defining works of the European tradition since Roman times, began to come under increasingly severe attack in the sixteenth through eighteenth centuries.

What began with the Counter-Reformation attack on the authority of the Pope, limited religious pluralism in a few states, and a growing skepticism regarding certain elements of the Bible and ancient philosophers' views of nature eventually became a full-scale contest between the 'ancients' and 'moderns' over priority in the creation and verification of knowledge about nature and the ideal social order. Unlike in any of the other major 'early modern' societies, in Europe the ancients lost this battle, creating pathways for modern science and modern revolutions unlike anything that occurred elsewhere prior to the nineteenth century. In all other regions, traditional world-views based on classic texts prevailed, or even increased in potency, well into the 'early modern' period.

The Great Disengagement: Europe's move from Dominance to Derogation of the Classical/Religious Synthesis

One of the paradoxes presented to readers of European history is that the fifteenth century Renaissance is heralded as a period of 'rebirth' of secular scholarship and knowledge, in reaction to the piousness of the religion-soaked Middle Ages. The art of Raphael, Michaelangelo, and Durer, the architecture of Brunelleschi, and the mechanics of da Vinci all seem to mark a new era of mathematical and observational approaches to the investigation and representation of nature. Yet this was in the sixteenth century, and it is only two centuries later that European historians speak of the 'Enlightenment' as the time when medieval superstitions and religious devotion were cast aside.

The paradox dissolves, however, when one treats the entire period from the 1400s to the 1800s as a period of gradual disengagement with the classical-religious legacy of the prior two millennia, and its replacement by a new system of knowledge acquisition and validation, a replacement that spurred changes in political and economic as well as intellectual life. This process was neither a smooth linear progression, nor a series of clear cut stages (e.g. Renaissance, Reformation, Scientific Revolution, Enlightenment.) Rather, it was a shifting, contentious process that moved irregularly across locations and times in Europe.

Let me be clear about my argument, because I have written extensively about the similarities – economic, political, social, and demographic – among the major states and empires of Eurasia (Goldstone 1991, 2002). What I am saying is that despite these similarities, which were evident up to 1850, there was one significant difference that separated western and northern Europe from all other parts of Eurasia, and that was an intellectual shift that began around 1500, which then had a very shifting and uncertain trajectory, limited for centuries to a small circle of scholars and theologians, but nonetheless by 1660 started producing significant changes in the way elites acquired and validated knowledge. Over the next century and a half, roughly by 1830, the new empirical and sometimes theoretical knowledge gathered by these new methods led to the wide application of steam power in Great Britain, and a host of other technical and industrial innovations, that transformed the economies and then the societies of northwestern European countries over the course of the nineteenth and twentieth centuries.

I am still arguing vigorously against the older view of Europe as a more dynamic society, in all respects, than other Eurasian societies. The older view of Europe's rise tended to put *all* aspects of society – economic, intellectual, political, social – together in lock-step, with early economic progress via agricultural improvement and commercialization in the High Middle Ages or Renaissance leading to intellectual liberation, exploration, innovation, and political change, in contrast to other Eurasian societies that persisted in traditional patterns of agricultural economy, political authority, and stymied intellectual inquiry (Landes 1998). I now wish to emphasize that trends in intellectual life could, in fact, move somewhat independently (still dependent, of course, on patronage, resources, and a social and political context tolerant of innovation) of changes in other spheres of society. In particular, while in all major Eurasian societies, the period from 1200 to 1800 saw increased commercialization and urbanization and economic growth, population increase, rationalization and centralization of political administration, exploration and territorial expansion, agricultural improvement through new productivity-raising techniques, and substantial intellectual growth in empirical knowledge and new ideas, the broadly dominant trends after the social and political disorders of the seventeenth century were

to seek a restoration of order by reinforcing traditional ideals of religious and political authority and civil and social order. Yet in one region, Europe, and more particularly northwestern Europe, skepticism regarding traditional justifications of knowledge and authority which had begun to arise c. 1500 continued to grow and shift the foundations of knowledge and authority after the seventeenth century. While this shift had no immediate effects on the economy, political organization, or social structure, being confined to small numbers of often-persecuted thinkers (much like the Christians of the first and second centuries AD), the long-term effects were to prove enormous. Indeed, by the late eighteenth century, this intellectual shift had led to a radical reorganization of economy, society and authority, propelling those twin engines of modernity – the Industrial and the Atlantic (mainly American and French) Revolutions. It was these two transformations – a shift to fossil-fueled manufacturing and transport with technology based on scientific engineering, and a shift from traditional authority based on hereditary claims and religious sanction to popular sovereignty based on written constitutions – that had absolutely no counterpart outside of Europe.

Given the magnitude and radical character of these two transformations, it has been the prevailing view to explain them by pointing to long-developing and widespread changes in European societies that rendered them distinct from other Eurasian societies in their political, social, and economic trajectories from a much earlier period. Yet I am still arguing that such explanations must be wrong, simply because in regard to their political, social, and economic structure European states of the sixteenth through eighteenth centuries were in fact very similar to other major Eurasian societies. All had about the same level of economic productivity (ranging from lower peripheral regions to higher-productivity core regions); all had religiously supported hereditary absolutist governments with trained bureaucracies; all had privileged elites who dominated the holding of land and political and military officialdom; all had experienced conflicts driven by religious heterodoxies and schisms; all had vibrant intellectual and theological traditions invigorated by legions of scholars, artists, poets, and writers; all had thriving long-distance and local markets and trade linked through

large urban centers and networks of ports and sea-voyaging (Goldstone 1991, 1998, Pomeranz 2000, Lieberman 2003/2009).

Thus my aim is to explain the eventual transformation and rise of Europe not through broad changes, but through a very narrow, and at times weak and barely successful intellectual movement of skepticism regarding classical methods and claims about the natural world, that began about 1500, and that by the early 1600s remarkably grew into a broad attack on traditional religious and philosophical claims of knowledge and authority, and by the mid-1700s had blossomed into a wide intellectual and technical movement to renovate economic, political, and social structures, all of the latter having been maintained in a similar state to that of other Eurasian societies in this period.

Europe's Peculiar Intellectual Path

Prior to 1000 AD, Europe had lost much of its pre-Christian classical heritage; what remained were mainly Latin texts, including Cicero's *On the Nature of the Gods,* Pliny's *Natural History,* and translations of Plato's *Timaeus* that formed the basis for natural history. During the Middle Ages, however, first from Spain, then Italy, then from Byzantium, a flood of classical texts were recovered, often from Arab translations but increasingly in the original Latin and Greek. These led to a rediscovery of Aristotle's logic and metaphysics and politics, Galen's medicine, Euclid's geometry, Ptolemy's astronomy, Dioscoride's botany, and a host of other works. By the thirteenth century, Europe had recovered most of the major Greek and Roman philosophical, scientific, and artistic achievements (Lindberg 2007: 217-218).

From the twelfth century onwards, for the next four hundred years, these rediscovered texts became the core curriculum at the dozens of universities which sprung forth during this period. Yet they also needed to be reconciled with the demands of Christian faith. Critical in this for medieval scholars were the works of the Church fathers, above all St. Augustine. Theology remained the most prestigious subject in the university curriculum, but this now meant not merely the analysis and explication of the Bible, but the use of Aristotelian

logic to explore the newly discovered classical heritage (as revised and commented upon by Arab and Jewish scholars) and reconcile their arguments with revelation.

This work of reconciliation and synthesis peaked with the work of Albertus Magnus and his greatest student, Thomas Aquinas, whose *Summa Theologica* was published in the late 1200s. By 1300, expertise in Greek and Latin was so great in Europe that a movement developed in Italy among European scholars to try to purify and recover the true masterworks of the classical tradition from centuries of scribes' and translators' errors, and moreover to emulate them in their own works. In this Renaissance of classical learning, the art and science of ancient Greece and Rome became the model for the highest aspirations of European artists, scientists, and scholars. At this point, as in China, India, and the Islamic lands with their respective core texts, the foundation of knowledge and the highest authorities in intellectual matters in Europe were the thousand-year old classical texts – the Bible, Aristotle, Ptolemy, Galen, Euclid – regarded as the core of the Western tradition.

It is of course true that the masters of late Medieval and Renaissance art and science began to make significant advances over the materials that they had inherited. da Vinci's machines, the refinement of perspective in painting, and the Merton College mathematicians' analysis of velocity and quantities of characteristics such as heat and motion went beyond the classical models (Lindberg 2007). Yet they nonetheless were simply refinements of those models – as were the Islamic scientists' mathematical innovations in Ptolemaic-based astronomy (Saliba 2007) – not fundamental challenges. The main theological and metaphysical foundations of medieval science remained wholly intact: the universe had an intrinsic divine order; each object and person acted in accord with their 'nature;' the universe was earth-centered with linear and irregular motions while the heavens had a wholly separate nature of ethereal crystalline spheres and uniform circular motions; and the foundations of knowledge lay in religious or ancient texts, and logical and mathematical demonstration, supplemented by extensive human observations of the natural world. In 1500 A.D. in Europe,

Aristotlean logic, Euclidian geometry, Ptolemaic astronomy, Galenic medicine, and Biblical cosmology remained the starting point for advanced studies.

All this began to change in 1492, with the discovery of the New World. By the1530s, when it had become clear that Columbus had not merely found a different route to East Asia, but had found an entirely new and heretofore unknown continent, with new peoples and flora and fauna, this discovery presented a major shock to Europe's world view. For the Ottomans and China, for whom Britain, on the one hand, and India and Japan, on the other, were well-known but distant lands with diverse peoples and environments, learning that there was another such land further away was easily assimilated knowledge. But for the Europeans, who had very particular ideas about history and geography based on the authority of their ancient religious and philosophical texts, the discovery of peoples unknown to ancient geographers or Biblical authors suggested very clearly that something fundamental might be missing from the ancient sources.

Also in the 1530s and 1540s, the research of the Belgian anatomist Andreas Vesalius revealed that Galen's knowledge of human anatomy was in many respects inaccurate or deficient. The surgical and anatomical faculties of the universities, undertaking new research on human cadavers, brought major changes in understanding how the human body functioned. New evidence on the structure of bones, the heart, blood vessels, and the liver demonstrated that many of Galen's claims (based on dissections of apes, as research on human corpses was forbidden in Galen's day), which had gone unchallenged for centuries, were simply wrong.

Then in 1543, Copernicus published his new methods for calculating the movements of the planets, based on a solar system with a moving earth circling the Sun. While Copernicus was convinced his system was not only cosmologically simpler but also physically correct, his followers and colleagues feared to attack Ptolemy and Aristotle head on, preferring to remain quite vague as to whether his calculations were merely a useful tool or an argument for re-thinking the physical universe. Yet his method suggested that the system of Ptolemy and Aristotle, with the earth as the center of all motion, might be in error. If Ptolemy had been dramatically wrong

about the existence of the New World, might he not also be mistaken about the placement of the sun and planets?

A few decades later, in 1573, the Danish astronomer Tycho Brahe published his account of the supernova that had suddenly appeared in the heavens in 1572. This was a phenomenon that had never been recorded in European astronomy – indeed since the time of Aristotle, it was assumed that the heavens were unchanging and constant in their perfection. Comets and meteors were known, of course, but they were considered Earthly weather phenomenon, like lightning, occurring close to the Earth rather than in the celestial heavens. But this was not a comet or meteor because it showed no motion; it was a new body that behaved like a fixed star, something that was, according to Aristotle's philosophy, impossible.

Five years later, Brahe showed by careful observation of the movements of the great comet of 1577 that this comet must be further away from the Earth than the moon, and thus was moving through the celestial heavens, not the atmosphere, striking yet another blow against Aristotle's cosmic system.

Supernovae that can be observed from earth are quite rare, but as chance would have it, in 1604, yet another supernova made its appearance, thus showing conclusively that the heavens were not unchanging after all.

By the late 1500s and early 1600s, therefore, the wisdom of Aristotle, Galen, and Ptolemy, which had stood for over a thousand years, was coming under widespread attack. European scholars sought out new observations and new instruments for studying nature that could help determine who was correct, or incorrect, in their description of nature and the universe.

In 1609, Galileo turned the new spyglass or telescope, invented by Dutch lens-grinders and then improved by Galileo himself, skyward to observe the heavens. The results of looking at the skies with a telescope, instead of the unaided human eye, as all astronomers throughout history had done, were remarkable wonders, which could scarcely be believed.

Galileo found what looked like giant mountains and craters on the surface of the Moon, which through the telescope looked positively Earth-like. Galileo found that Venus showed phases like the Moon, something that would be impossible if it simply made daily circles around the Earth along with the Sun. Jupiter was found to have its own moons circling it, so that the Earth could not be the center of all celestial motions. And even the sun (observed through dark glass) was seen to have defects, black spots ('sunspots') that moved across its surface. Finally, in every direction were new stars, previously unknown, and even the Milky Way was revealed to consist of thousands of tiny stars. In short, while many dismissed the views through the telescope as false magic or trickery, enough people acquired their own telescopes and confirmed Galileo's discoveries that people came to realize that the universe in which they lived was nothing like that described by the ancient Greek authorities.

From 1600 to 1638, a series of books presenting new knowledge or proclaiming the need for a "new science" made a compelling case that the knowledge of the ancients was seriously flawed. Notable examples included:

1600: William Gilbert: *On the Magnet*

1620: Francis Bacon: *Novum Organon (A New Method)*

1620 Johannes Kepler: *The New Astronomy*

1626: Francis Bacon: *New Atlantis*

1628: William Harvey: *On the Motion of the Heart and Blood*

1638: Galileo: *Discourses on Two New Sciences*

Gilbert argued that compass needles pointed north because the whole earth acted as a giant magnet. Francis Bacon argued that Aristotle's deductive logic could not be trusted as a guide to understanding nature; instead he argued for a program of experiment and observation based on inductive logic to rebuild natural knowledge. Kepler, using the measurements taken by Brahe's improved instruments which plotted planetary movements more accurately than ever, showed that the planets actually traveled in elliptical orbits around the sun, not in

circles. And William Harvey showed that, contrary to Galen's teachings, instead of blood moving back and forth in separate venous and arterial systems, the heart pumped blood through a single, recirculating system linking the heart and lungs.

Still, a most vexing problem remained. Kepler's plotting of planetary orbits and Galileo's own telescope argued for a world in which the earth rotated on its axis every 24 hours, and circled the sun at great speed. Yet if this was so, why weren't all the people, animals, and the water in the oceans spun off the Earth and into space? Why can we not feel the motion of the Earth? This led Galileo into a careful study of motion. Borrowing the mathematical approach of the Alexandrians and the use of the water clock in experiments from the Muslims, he determined to apply both of these techniques to the study of *bodies in motion*, something that had never been attempted before. Galileo's experiments led him to discover that all bodies – regardless of their size or weight – fall at the same speed, and that the speed of descent increases at a steady rate (constant acceleration). Thus everything on the surface of the earth is being pulled to its surface by a powerful force that operates in the same way on all bodies. That is why nothing 'spins' off the planet. He also developed the principle of relative motion, that is, two bodies moving at the same speed in the same direction will appear – to each other – as if they are not moving at all. These principles allowed Galileo to argue that we do not perceive the motion of the earth because everything on the earth is moving together at the same rate of speed. These principles also allowed Galileo to make calculations of the motion of projectiles (like cannon balls) that helped convince his critics of the value of his findings.

By the mid-1600s, therefore, European philosophers and scientists found themselves in a world where the authority of ancient texts was clearly no longer a secure foundation for knowledge. Other major civilizations did not suffer such blows. For the Chinese, Indians, and Muslims, accustomed to operating in a vast intercontinental trade sphere from China to Europe, and generally seeing themselves at the center of all that mattered, the discovery of new, lightly-peopled lands far to the West made little difference. Similarly, Chinese and Indian astronomers had observed supernovae before (as accurately recorded observations of the heavens

went back thousands of years in China), and had long ago developed philosophies of nature that were built around ideas of continuous change as the normal course of things in the universe. Unlike the Greeks and Europeans, they had no rigid notions of 'perfect and unchanging' heavens separate from the Earth that would cause their classical traditions to be fundamentally challenged by new observations of comets and stars.

Thus the Europeans, perhaps more than any other major civilization, suddenly found that the classical tradition that they had sought to embrace now had to be escaped if they were going to understand the true nature of their world and their universe. This led Europeans to undertake a systematic search for new systems of philosophy and new ways of studying and describing nature.

Searching for New Directions in European Science: Cartesian Reasoning and British Empiricism, 1650-1750

Prior to 1700, all major civilizations drew on four basic sources to justify knowledge and authority (which were generally closely connected). These were:

1. Tradition – knowledge that was revered for its age and long use
2. Religion or revelation – knowledge that was based on sacred texts or the sayings of prophets, saints, other spiritual leaders
3. Reason – knowledge that was obtained from logical demonstration, either in arithmetic and geometry or by deductive reasoning from basic premises
4. Repeated observation and experience – knowledge that was confirmed by widely shared and repeated observations and every day experience, such as that day follows night, the sun rises in the East, objects fall, heat rises, and including various agricultural and manufacturing techniques that were proven in use.

Most societies reacted to trauma (the Black Death, conquest, rebellion) by returning to, and even reinforcing, the first two sources of knowledge – tradition and revelation. These were generally seen as privileged or higher sources of knowledge and authority, sanctified by time and divine inspiration. Logic and

experience were, for the most part, seen as lesser sources of authority, useful for interpreting and filling in the gaps in traditional and religious teachings, but dangerous if relied on by themselves.

From the tenth to the fourteenth centuries, Europeans had worked mightily to unify the insights from all four of these sources of knowledge. However, from the fifteenth to the seventeenth centuries, the evidence of logic and observation was coming very severely into conflict with the authority of classical and Biblical texts. Philosophers and students of nature were thus being forced into the uncomfortable situation of having to choose whether to downplay these empirical discoveries and their logical implications, or to dethrone the classical and religious authorities from their long-dominant role as arbiters of knowledge.

While the seventeenth century was a time of great scientific discoveries, it was, of course, also a period of sharp religious schism and conflict, capped by the Thirty Years' War (1618-1648). During these years Catholics, Lutherans, Calvinists, and other sects all claimed to be correcting the errors of others' interpretation of Christian faith, and various religious groups rebelled and embroiled Europe in massive civil and international wars. The lack of accepted religious authority, and any way to choose between competing claims, seemed to offer nothing but the prospect of endless conflict. There were thus powerful political as well as academic reasons for philosophers to struggle to find a new basis for certain knowledge.

European thinkers therefore turned away from the first and second major sources of knowledge and authority – tradition and religion – to seek new systems of knowledge. These would be based mainly on revised and expanded forms of logical reasoning, using new foundational assumptions, or more sophisticated mathematics, or inductive rather than deductive logic; and on new approaches to observation and experience, more reliant on increasingly sophisticated and specialized instruments for making observations as opposed to common-sense, unaided empiricism.

I do not have space to go into detail here on the growth of Rene Descartes' mechanical system, or Isaac Newton's optics and physics, both of which dramatically altered the view of educated Europeans regarding nature and decisively displaced Aristotelian physics and Ptolemaic astronomy. Although both Descartes and

Newton developed their work on diverse foundations – Arab commentaries, the Merton mathematicians, and Islamic astronomy all can trace some continuity with the 17th century advances – the impact of their work was to turn the world of the Renaissance upside down. If at the dawn of the sixteenth century the highest aspiration of European artists and philosophers was to emulate classical models, two centuries later the aspirations of European thinkers were to escape from those models and replace them.

The intervening centuries, we should note, do not mark anything like a smooth progression from reverence to dismissal of Biblical and classical authorities. Rather, there were major local and temporal variations. In Britain, the Royal society, led among others by Robert Boyle's work with air and vacuum pumps, Newton's work on optics with prisms, and Robert Hooke's work with microscopes, pushed research in the direction of instrument-driven observations as the basis for valid knowledge of nature. By contrast, on most of the continent, Cartesian physics, based more on mathematical reasoning than on experiment, grew dominant (Henry 2002). In Southern and Eastern Europe, the Counter-Reformation staged a counter-offensive, absorbing non-threatening elements of the new knowledge – such as Tycho Brahe's revised earth-centered universe where all other planets circled the sun but the ensemble circled a stationary, central Earth – but steadfastly resisting Newton's gravity-bound sun-centered system, and such other new findings and principles as the possibility of vacuums or the atomist view of nature. From 1500 to 1700, we find a turbulent contention of diverse philosophical and scientific systems, with skeptics, proponents of new natural philosophies, and defenders of revelation and classical authorities engaged across Europe.

Still, by 1750, with more detailed geographic studies of the shape and curvature of the earth confirming Newton's claims for an oblate Earth (flattened at the poles and bulging at the equator due to the effect of its own rotation on its axis), the correctness of the new mechanical model of nature became beyond dispute for the intellectual elite. Evangelista Torricelli's measurements of atmospheric pressure and Boyle's work on the properties of vacuums, Joseph Priestley's discoveries that the atmosphere was composed of distinct gases, and Lavoisier's proofs of how different substances combined to form compounds and his listing of various pure

'elements' which could not be broken down (oxygen, hydrogen, nitrogen, mercury, sulfur, zinc, phosphorus) further confirmed that at least in regard to natural science, the ancient authorities represented a largely obsolete and error-filled body of knowledge.

While so far we have focused on changes in scientific methods and knowledge, the new view of a mechanical universe, atomistic and driven by persistent natural forces, amenable to analysis by reason, had major repercussions for the political and social order as well. As in all major civilizations, political authority and social status claims had become intimately bound up with religious and classical authority. The religious and social elites rationalized the absolute powers of monarchs from divine right and Roman law, while the monarchs in turn enforced religious orthodoxy and established laws to preserve the social hierarchy.

Seventeenth century thinkers thus debated the meaning of a new approach to political authority, based only on reason and empirical facts. Yet while Hobbes, Locke, Spinoza and Pascal discussed how reason should shape power and ethics, the impact of their thought on the actual power of princes remained slight. Similarly, while seventeenth century scientific pioneers from Galileo and Toricelli to Boyle, Christiaan Huygens, and Newton reshaped physics and chemistry, their work had essentially no impact on economic conditions or practical technology. The technical and political consequences of the scientific revolution would only appear in the 'twin Enlightenments' – technological and socio-political (Mokyr 2009) – of the 18th century.

Let us therefore move ahead a few decades, into the eighteenth century, to see how the rejection of traditional authorities fed into the Enlightenment, and the implications for broader political and economic change.

Variations on a Theme: Enlightenments in Europe

One aspect of the Enlightenment, often less remarked upon but now emphasized by Mokyr (2009), was a technical enlightenment, based on what I have labeled an 'engineering culture' that emerges in the 18th century (Goldstone 2009). This new 'engineering culture' spread beliefs wholly different from those behind

Renaissance, Medieval, or Classical approaches to knowledge and craft production: First, that the most reliable knowledge of the material world was to be gained not from pure reasoning or mathematics, nor from the study of regularities in nature as it is directly observed, nor from knowledge imbued with authority from traditional or religious texts of long antiquity, but from empirical research programs using increasingly precise instruments to carefully measure and test isolated events and relationships. Second, that these research programs and new instruments allow us to measure such previously abstract quantities and qualities as 'energy,' 'work,' 'power,' 'heat' and 'motion.' Third, that possessed of these measurements, and of knowledge of fundamental relationships revealed by such research programs (such as the relationship between atmospheric pressure and volume, or the rate of gravitational acceleration at the earth's surface, or the amount of work required to lift a given weight through a certain distance), one can design and build ever-more powerful and efficient machines, develop new sources of energy, and discover new materials and processes. Fourth, that these possibilities would lead to a future age of greater well-being than was ever known; in the words of the 18th century English chemist Joseph Priestley: "Nature, including both its materials and its laws, will be more at our command; men will make their situation in this world abundantly more easy and comfortable, they will prolong their existence in it and grow daily more happy. . . the end will be glorious and paradisiacal beyond that our imaginations can now conceive" (quoted in Niebuhr 1952, p. 45).

This was a radical departure from the belief held by almost all civilizations (including that of the classical and medieval West) that humanity's golden age lay in the past. Instead the new engineering culture proclaimed that an earthly paradise lay in man's future, and that it would be brought about by mankind's own progress in developing and applying new scientific knowledge rather than by divine redemption.

But this was not enough; such knowledge would do little if it remained confined to laboratories and academic societies. It had to be married to an elite belief in the value of technological entrepreneurship, meaning not merely respect for the accumulation of wealth by astute business practices, but the belief that applying engineering knowledge and skill to practical problems of production, transport, and communication

would be a superior way to make profits in a competitive market environment. This belief was embodied in the work of James Watt and Matthew Boulton, their compatriots in the Lunar Society, as well as their customers, contemporaries and successors from John Smeaton and Richard Arkwright to Richard Trevethick and Robert Stephenson and many others.

The European Enlightenment thus had two, mutually reinforcing streams that came together in the 18th century. On the one hand, scientific advances in the sixteenth and seventeenth century paved the way for the development of steam engines, and machinery for mining, manufacturing, agriculture, and construction that produced huge increases in productivity and new sources of energy and materials, promising a radical improvement of material conditions. On the other, the decay of traditional authorities undermined the rationale for divine kingship, orthodox religion, and hereditary differences in social ranks and privilege, all of which were contrary to reason in an atomistic, mechanical universe. The mutual reinforcement arose in that the material gains from the technical enlightenment (new pumps, machines, and industrial processes) demonstrated the value of a worldview that reduced the dominance of religious and traditional authorities; the reduction of royal and ecclesiastic power then allowed new intellectual space and resources to support scientific innovation and the engineering imagination.

Figures such as Benjamin Franklin and Voltaire (the former a scientist and political revolutionary, the latter a virulent critic of traditional religion and advocate of Newtonian science) epitomized the blending of the two Enlightenments. Whether by acts of enlightened rulers (as in Denmark and Prussia) or popular revolution (as in America and France) or political compromise (as in Britain) political rulers came to abandon the notion that it was one of their chief responsibilities, and integral to their own power, to enforce the knowledge claims of religious and traditional authorities. This process, which led to state-approved religious pluralism and open education, arose first in the smaller states of Europe – Britain, Holland, Prussia, Denmark – in the wake of counter-Reformation efforts by the major European land-empires to enforce just such claims. These smaller

states found they gained more trade and resources by embracing inhabitants with a wide variety of beliefs than by enforcing strict conformity (Zagorin 2005).

Larger states and Counter-Reformation monarchs, by contrast, were willing to pay a high economic price, as with France's expulsion of the Huguenots and Spain's expulsion of its Jews, in exchange for the political stability they believed they would gain by enforcing conformity to the state-allied religion. The major Asian empires –despite earlier periods of religious pluralism, as with Tang China, the Mauryan empire under Ashoka, or Mughal India under Akbar – responded to political disorders in the 17th, 18th, and 19th centuries by reinforcing the dominant religious and cultural beliefs that they believed were the best supports for state authority and suppressing heterodoxy.

To be sure, the Ottomans, Chinese, and Japanese were eager to absorb western tools and military equipment. They acquired western weapons, trained in western military tactics, and emulated or commissioned western naval and artillery construction. Yet what they resolutely resisted was the new western methods of validating knowledge, based on elevating reason and experiment at the expense of classical and religious authority. For the Ottoman sultans (especially since they had gained control of the Holy Sites of Mecca and Medina) and Chinese emperors, Koranic belief and Confucian cosmology, respectively, were the essence of their authority. They would not allow these to be overturned. Quite the reverse; the more they imported western technology and struggled against western superiority, the more they sought to reinforce their own authority and social status systems with state patronage and enforcement of their historic philosophical and religious traditions.

The principles of reason and an individualistic/atomistic universe not only clashed with the divine right of kings; they also clashed with all kinds of traditional group privileges that obstructed innovation and progress. Thus Adam Smith's (and the whole Scottish Enlightenment's) view of free competition among individuals and individual firms as superior to the traditional privileges of trading and craft guilds meant that political rulers had to give up attempts to control production and trade. This meant reducing rather than supporting the authority

and regulations of various guilds and urban governments, who believed that market success came from tight political control of supply, products, prices, and producers to ensure smooth meeting of what was believed to be a relatively fixed demand.

The twin Enlightenments thus demanded something new – a limited state that would protect the acquisition of private property and allow the development of new knowledge and new enterprises, but not dictate religious beliefs nor confine economic activity to a few privileged corporate monopolies. But a state could only be kept limited if older ideas of absolute royal authority were overturned, and the unfettered spread of new knowledge and new enterprises could only be maintained if hereditary and guild privileges and the need for religious conformity were cast aside.

It was thus no accident that the political and social revolutions of the 18th and 19th centuries coincided with the rise of European scientific and material advantage. This is not by any means to say that these revolutions were fought for the purpose of making the world safe for science-driven entrepreneurship. Such a connection would never even have occurred to most of those fighting on either side of these revolutions. Rather, the development of new scientific knowledge from 1600 onwards undermined confidence in the authority of religious beliefs, while the growth of Europe's national and international trade from 1500 onwards created new claimants to political power and social status who competed with the hereditary nobility, and often directed wealth more towards the enterprising elements in both the older nobility and newly-risen urban and professional social groups rather than increasing the resources of the central state. These trends combined to weaken traditional political and religious authorities, while leading enterprising nobles and commercial and professional groups to seek greater voice in how the state accessed and distributed society's wealth and status. When a surge in population from 1730 to 1850 had the effect of greatly increasing the opportunities and scale of action for enterprising nobles and businessmen, substantially augmenting the size and relative power of urban professionals and workers, placing great strains on the capacity of the land to support peasants and depressing real wages, and overburdening the administrative capacities and resources of monarchical states, the overall

effect was to touch off a series of revolutions aimed mainly at limiting the power of states and of traditional status and religious hierarchies (Goldstone 1991).

To be sure, the major civilizations of Asia had experienced similar dynamics – commercial expansion brought new groups to aspire for power, population expansion strained state administrative capacities, and expanding cities and land-starved peasantries combined to give rise to massive rebellions against weakened states. Yet only in eighteenth and nineteenth century Europe was the ideology of such rebellions one of creating a new world based on reason and ending the absolute power of monarchies. Elsewhere the rebellions (of Muhammad Ali against the Ottomans, or the Taiping Rebellion), though they incorporated some novel Western elements, still aspired to renew or reform the Empires but not to end the power of Sultans or Emperors.

The revolutions of Europe and America from 1776 to 1848 were often only partially successful, but they did have the effect of permanently denting traditional religious and political authority, and spreading claims for a new structure of society. In this new structure, the sources of society's progress and happiness lay not in the glory and power of the state nor in the honorable virtues of its political and social elites, but in the free thinking and free economic activities of its citizens (what Deirdre McCloskey [2007] has recently labeled the 'Bourgeois Virtues' to distinguish them from the virtues of the warrior elites that characterized Western societies from the Roman Empire up through the French monarchy). The purpose of the state was to enable and protect those free activities insofar as possible, limited only by the need to provide for the safety and security of the society.

This was an almost wholly new conception of society, not a logical outgrowth of prior Western culture. This fact has been deeply confused by apologists for Western imperialism and advocates of Western culture, who claim that this conception was somehow implicit in the democratic (but slave-holding) city-states of Greece and the Republic of Rome, or the freedom of medieval Germanic tribes or the impartial laws of Imperial Rome; or the oligarchic trading republics of sixteenth-century Venice, Genoa, and Holland. Yet in fact none of these societies would have recognized, nor probably even been able to conceive of, these radical principles.

Greece and Rome recognized citizenship, but as a privileged status granted by the state and quite compatible with the widespread practice of slavery and the treatment of women and children as chattel. The notion of the inalienable rights of all competent individuals to freedom of thought and freedom of economic and political action is radically different, and is deeply hostile to any kind of slavery or the oppression of women. It is thus only with the rise of claims for individual-based freedoms that both abolitionism and women's rights – concepts previously scarcely known or considered in two thousand years of Western culture – rapidly developed.

The 'freedom' and 'equality' of Frankish tribes who chose their own leaders were simply the common characteristics of relatively unstratified nomadic societies found in many diverse cultures, from the Mongols of Asia to Native Americans, and left little imprint when these tribes were absorbed into the stratified agrarian societies that succeeded Rome. The law of Imperial Rome posed the very antithesis of a limited state, and led naturally to the absolute imperial and monarchical rule that characterized all major European states from the Renaissance onwards. The oligarchies of the Hanseatic, Italian, and Dutch city-states and republics similarly recognized no natural rights of man, preserved hereditary status as far as possible, and sought to protect entrepreneurial activity chiefly by obtaining tight political control over their markets and trade routes. They adopted religious pluralism as a matter of practical convenience, not of principle (even in Holland religious freedom was heavily restricted outside Amsterdam, and the Dutch Reformed Church nearly drove out all other religions as soon as it became strong enough to do so). Venetian glass-blowers, Flemish tapestry weavers, and Dutch windmill and boat builders innovated in certain products to be sure – but no more so than Indian producers of highly varied printed and woven cotton textiles, or the makers of Chinese ceramics, who dominated international markets for their products even more effectively than the Europeans. None of them had any notion of scientific research programs driven by free thinkers as the basis for future material progress.

In short, what arose in the late seventeenth and early eighteenth centuries in Europe, during what we now call the Enlightenment, was not so much a logical outgrowth or recovery of prior Western traditions and

beliefs, but an effort to overthrow most of what was deeply woven into the fabric of European history, culture, politics, and society. That it succeeded was due to a host of locally contingent factors present in Europe but absent in other major civilizations that it would take too long to list here, including Europe's relatively backward and peripheral position relative to the major Asian empires and the consequent shock to its culture and politics from knowledge flowing in from the discovery of the New World and direct contact with East Asia after 1500.

What I believe is most critical to insist upon is the degree to which Europeans had to repudiate central elements of their own history and culture – the absolute authority of hereditary rulers, the prohibition of diverse religious beliefs in any one society, the elevation of the rights and needs of political and social status elites above those of ordinary inhabitants – in order to develop and implement the idea of society as a community of free individuals sovereign over a limited state. Yet this was necessary if modern science and the engineering culture were to survive and flourish, and produce the economic and technological miracles of the last two centuries.

An Old Story or New?

To some readers, my argument may seem strange, even perverse. Much of the progress in the history of science, and in world and non-Western history, has arisen through abandoning a privileged place for Western science or for the West in world history, emphasizing instead the degree to which science was a haphazardly synthetic blend of traditional, religious, mystical, and empirical approaches to knowledge, and the degree to which non-Western countries were similar to the West in their own commercial, bureaucratic, nationalist early modernities. My argument may seem to be, in essence, a return to older notions of Western history as a privileged domain in which scientific and rational advances created a dominant civilization while others stagnated.

I would object to this, and say that the argument I have sketched above repudiates most of the older notions of Western superiority, and gathers in key elements of the recent findings, although holding them up for a different perspective.

First, the older view of the scientific revolution is primarily one of intellectual history advancing from Copernicus to Newton, building on Greek and Renaissance achievements, and focusing on science, distant from both social and technical change. I argue that the scientific revolution was the crux of a vital transition, from a Renaissance view of veneration of classical and religious authorities to a modern view that decenters those authorities, with that decentering giving birth to twin Enlightenments, spawning both technological and socio-political revolutions. I certainly grant that Newton drew as much inspiration from religious mysticism as mathematics, that Descartes and Spinoza's central concern was a proof of the existence of God, that the scientific revolution as a whole drew more on Islamic advances and commentaries than on Greek sources, that few if any significant technological or political consequences of scientific advance arose until the late 18th and early 19th centuries, and that even the 'age of reason' was quickly overwhelmed by romanticism and a reaction against purely individualist rationality. Those facts simply demonstrate that the rejection of ancient authorities and the creation of modern societies was a contentious and multi-stranded process that took centuries, and not a simple triumph of reason that occurred at a particular moment in time. They do not diminish the fact that the effect of Newton's work, and that of other scientific and Enlightenment thinkers, was to create a devaluation of the Western classical and religious authorities to a degree unlike anything that could be found in other great world civilizations in the sixteenth through eighteenth centuries.

Most importantly, I am not relying on the theoretical advances of science as the main force of change. In fact, most technological progress was based on artisanal application of general principles derived from empirical study, and scientific theory did not become critical to technical and economic advance until the 'second' industrial revolution, based on chemistry and electricity, in the late 19th century. However, I do claim that even artisanal and businessmen' technological advances would not have been possible without the novel

empirical findings of 17th century science regarding air pressure, and the measurement of heat and energy. Inventors such as James Watt and John Smeaton and Edmund Cartwright (inventor of the power loom) gained a sense of new possibilities, and methods of controlled repeated observations, not to mention new instruments for measuring things they cared about such as energy efficiency, from the 17th century scientific revolution that they applied in their practical work. My argument thus does not focus so much scientific progress *per se* carrying Europeans forward. Rather, I stress the role of new approaches to knowledge and authority developed in the course of sixteenth and seventeenth century struggles over the nature and basis of scientific knowledge as opening new possibilities to Europeans in multiple fields, whether in practical technology or the formulation of political principles.

Second, and more importantly, the older view argued that the scientific revolution and all that followed was a direct result of the superiority of Greek science and its Renaissance revival to the natural history traditions of other civilizations. I take a very different view, arguing that the scientific revolution was much more a result of the relatively *weak and rigid* traditions of Europe in regard to beliefs about the natural world. That is, by the 16th century, the classical Greek texts did not so much embody a technique of innovative empirical science (that would be a highly anachronistic view), as a rigid set of authorities to be followed or emulated or at best incrementally improved upon, using the traditional means of logic and unaided empirical observation.

Europeans had lost most of their core classical texts between the fall of the Roman Empire and the beginning of the reimportation and rediscovery of those texts in the 11th century. European intellectuals thus focused on studies of the Bible and patristic theology during this period. This meant that when the classical heritage was rediscovered after the turn of the millennium, enriched with Arabic advances, it burst on the scene with the power of novelty combined with the hoary authority of antiquity. However, this also meant that there arose a struggle to reconcile the classical and Biblical world views. By the fourteenth century, Europeans had managed to integrate Greek science with Biblical revelation to form a theological/philosophical synthesis, such that Biblical references to planetary and celestial phenomena were firmly tied to the Aristotlean cosmology of

an unmoving Earth at the center of uniform celestial motions, whose alteration by divine acts in the Bible were thus true miracles. The very success of this process produced a rich but fairly rigid synthesis. Thus any challenges to the substantive content or method of ancient scientific and philosophical authorities could not help but also undermine the authority of the religious beliefs with which they were now closely linked. Powerful challenges then became unavoidable when European societies came into contact with the New World, encountered new astronomical phenomena such as supernovae, and had to cope with new observational data from telescopes and new calculations of the orbits of planets and comets.

By contrast, China and India and Islam never 'lost' their core texts. Indeed Islam during its height had full access to the classical texts of India and Greece and Rome as well as the Koran, as did Mughal India. Chinese scholars had access to its own legalist, logical, and Confucian texts but also to Indian influences via Buddhism. Their political and social traditions were created by their selective syntheses of elements from these traditions, and for most of their histories up to the 17th century they were more flexible – and more scientifically advanced – than Europe. By the sixteenth century, for example, Chinese scholars had computed the sidereal year and the value of pi more precisely than those of Europe, while Islamic calendars were far more accurate than those of the West (O'Connor and Robertson 1999). It was mainly after the seventeenth century, when internal disorders wracked the major European and Asian empires, that a more conservative enforcement of orthodox religious and classical authorities took over as a means to maintain order, in all the major Asian civilizations and Counter-Reformation Europe. Europe's exceptionalism lay not in the character of its traditional authorities, but in the fact that Europe's leading intellectuals undertook, and many of its major states permitted, an *overturning* of those traditional authorities and their replacement with new mechanical views of nature based on instrumental and experimental approaches to gaining and validating knowledge, at the very same time that other major societies were following the reverse course and reinforcing their enforcement of their traditional authorities.

Third, the older view of the rise of the West suggests that modern western success is a product of "Western society," as a particular historical and cultural configuration rooted in classical Greece and Rome,

medieval Christianity, and Renaissance Europe. Against this, I would argue that modern western success was due to the assault on that configuration under the banner of 'liberal society,' which although developed in parts of the West and eventually taking over most of it was in fact a radical departure from most of the Western past. In order to share in the economic growth trajectory of the West, it is therefore not at all necessary to adopt elements associated with the longer-term historical and cultural past of the West, but rather only to adopt the twin elements that made for European economic success: (1) Limited state authority, freedom of thought and action for individuals, and (2) support for scientific engineering and its application to market-oriented private entrepreneurship.

The history of the 'great divergence,' properly understood, is thus a history built on a great disengagement of the West from the dominance of its core classical traditions, and the birth of a new model of society. It was that new model, conjoining limited government and free inquiry, which had no counterpart outside of Europe, and propelled Europe forward relative to other major civilizations.

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