

Christianity: A Cause of Modern Science?

The Duhem-Jaki and Merton Theses Explained

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When we think of Christianity's role in the rise of science, what do we think of? How it hindered it, such as the conflict between Galileo (1564-1642) and the Inquisition in the seventeenth century? Or, perhaps, do we think of Thomas Huxley debating evolution with Bishop Wilberforce in the nineteenth century? What we need to do now is take a deep breath, and take a step out of today's overwhelmingly secularized intellectual climate, and consider this: Modern science arose among avowedly Christian clerics, theologians, monks, and professors of medieval and renaissance Catholic universities and monasteries. Normally, the Middle Ages are regarded as having a world view very opposed to that of science by atheists and agnostics similar to the manner Leonard Peikoff, the literary and philosophical heir of novelist Ayn Rand, expressed himself: "For centuries, nature had been regarded as a realm of miracles manipulated by a personal deity, a realm whose significance lay the clues it offered to the purposes of its author." Yet, if science gradually arose during the medieval and Renaissance periods, but Christianity and science are seen as totally incompatible, how did this occur? After all, neither Galileo nor Copernicus (1473-1543), who maintained the sun was at the center of the solar system, not the earth, were skeptics or unbelievers, unlike such medieval predecessors as the Islamic poet and astronomer Omar Khayyam (1048?-1122) or Frederick II (1194-1250), Holy Roman Emperor? The remarkable truth is that the world view of Christianity was absolutely necessary for the rise of modern science, as shown by the Duhem-Jaki and (only secondarily) Merton theses.

The Duhem-Jaki and Merton theses are quite different in how they tie Christianity to the birth of science. Pierre Duhem and Stanley Jaki, respectively past and present professors of Roman Catholicism, see a direct tie between Christian metaphysics, its rejections of various classical Greek philosophical conceptions, and the birth of a self-sustaining science. On the other hand, Robert K. Merton, the sociologist who wrote Science in Seventeenth Century England, ties seventeenth century English Puritanism's ethics to the rise of English science much the same way the German sociologist Max Weber tied the rise of capitalism to Calvinism. Merton's approach is quite different from Jaki's and Duhem's, since Merton sees the rise of English science only as a relatively inadvertent product of Puritanism's values and beliefs, using an externalist approach that analyzes how religious beliefs and actions caused by them affect the larger society. By contrast, Duhem and Jaki take a more internalist approach by looking at the intellectual roots of science and by seeing theology and science as closely tied together in the medieval era since the same people often did both (such as the Frenchman Nicole Oresme). Merton only sees Protestantism as helping science along, and not as creating it, for Galileo, the discoverer of the inverse squared law of the acceleration of falling bodies in physics, and his predecessors were Catholics. Somewhat curiously, these two theses often seem to pass each other like two ships in the night without partisans or critics of one mentioning the other.

TECHNOLOGICAL ADVANCE DOES NOT EQUAL SCIENCE

We must avoid assuming technological advance proves a given civilization has science, or modern science, for most inventions that affected daily life in the pre-modern world economically were "empirical" discoveries by craftsmen and other pragmatic types, not true scientists meditating on the laws of nature. While the Greeks, Chinese, Indians, and Islam all had what can be fairly called "science," their science lacked the rigor and vigor that would characterize the West's science from Galileo onwards, and soon fizzled out on its own. In order to have some idea of what culture's science really qualifies as science it's best to introduce a definition here to avoid misunderstandings: The systematized collection of knowledge about nature through using only reason and sense experience in order to discover the underlying laws of nature, which explain how nature is organized and allow future accurate predictions about nature's processes or objects to be made. For all the world's civilizations, only Greek geometry fully met this definition, along with mathematics in general, prior to the time of Galileo, and that is only by excising the "sense experience" part of this definition.

Just what are the tenets of the Duhem-Jaki thesis? First, it denies that sociological non-intellectual, externalist causes are sufficient conditions to create modern science. As Jaki put it:

This historiography of science has still to face up honestly to the problem of why three great ancient cultures (China, India, and Egypt) display independently of one another, a similar pattern vis-à-vis science. The pattern is the stillbirth of science in each of them in spite of the availability of talents, social organization, and peace--the standard explanatory devices furnished by all-knowing sociologies of science on which that historiography relies ever more heavily.

All of these conditions may be necessary to allow a civilization to develop science, but we have to look to the intellectual climate to understand why only one particular civilization developed a self-sustaining, modern science. Peculiarly, this same culture had been in the immediately preceding centuries intellectually and economically quite backward compared to the great Eurasian cultures that rivaled it. Those influenced by Marxism may often be loathe to investigate how the intellectual climate can independently change on its own, and influence politics and economics. For we should realize that while the mode of production (the technology and system of economics utilized by a society) can and does influence the superstructure of ideology as Marx maintained, the reverse influence can and does happen also. "Ideas have consequences" is an assumption that won't be proven here, but it is a perfectly reasonable one when so much religious behavior is not tied to the economic self-interest of some class in society.

THE PHILOSOPHICAL IDEAS A CULTURE MUST AVOID TO DEVELOP SCIENCE

So now, according to Duhem and Jaki, what ideas are necessary to have (or, to be more precise generally, not have) in the intellectual climate of a civilization to keep science

self-sustaining, instead of dying out after a few centuries of progress? First, a linear, potentially quantifiable conception of time that clearly distinguishes past, present, and future promotes a scientific view of nature and its cause-effect relationships is necessary for a scientific outlook. In the Judeo-Christian tradition, this idea comes from the act of God in creating the universe from nothing at some specific point of time in the past, and then time is seen as progressing through the present on to the future with the second coming and the day of judgment. The alternative view of time, the concept of the "Great Year," maintains centuries-long time cycles exist in which the future repeats the past exactly or almost exactly, making progress of any kind theoretically impossible. This idea of time breeds a sense of complacency ("we know it all already") and/or hopelessness, hindering the development of science in a given culture. Second, if science is to exist, explanations of natural phenomena must avoid a priori, pseudo-scientific "explanations" that really do not describe the causes of events, such as astrology. Third, science is hindered by the organismic view of nature. This idea conceives all of the universe as alive, as if it was one huge organism which goes through the above mentioned cyclical process from birth, to maturity, then death, to be born again. The tie to pantheism--believing EVERYTHING is God, a standard Hindu view--is obvious here. This outlook sees what we moderns consider inanimate (and non-divine) objects, like rocks, the planets, the stars, the oceans, and other natural objects to have wills of their own, or intelligence of their own. Fourth, science is hindered if the reality of the basic orderliness of the universe ("the external real world") is denied. Humans will not often investigate carefully what is considered not to really exist, or that which will be changed at whim by the God(s), or nature herself. Fifth, the heavens (outer space) must not be considered alive, or divine, if a scientific astronomy is to exist. Sixth, a balance between reason and faith is necessary, without the religious people totally rejecting science or natural laws, and without the philosophers/scientists totally rejecting the claims of religious truth. Seventh, man needs to be seen as fundamentally different from the rest of nature, as having a mind that makes him qualitatively different from the animals, etc., not just quantitatively different. The foundations for this view are laid in the Judeo-Christian world view in Genesis where man and woman were made in God's likeness and image, and were told they had dominion over the animals (Gen. 1:26-29). So long as all or most of false ideas in these areas are believed by a great majority of the intellectuals/"wise men" of a given culture, a self-sustaining science will not come to exist in a given civilization, especially any true science of bodies moving in the external real world (i.e., physics, unlike math).

Now, the tie between the acceptance or rejection of such ideas and the rise of modern science may not be altogether obvious. Hence, a lot of explanation is needed to prove such connections, and this essay is only scratching the surface. Readers seeking more evidence should read Jaki's works in particular. Also, it should be noted that some civilizations had all or most of these false ideas, such as Hindu India, while other(s) had fewer of them (China), and other(s) still fewer (Islam). Correspondingly, the last progressed in science further as compared to the other two correspondingly to the acceptance of such ideas, and the second more than the first. For instance, the Chinese lacked the delusion the heavens were divine and/or living. Such an idea was found in On the Heavens, a very influential work by the ancient Greek philosopher Aristotle (384-322

B. C.), which hindered indigenous Islamic science permanently, and Christian science for many centuries before being finally cast off. On the other hand, Hindu science concerning the material world was crushed by almost all these faulty intellectual ideas: the external real world and its orderliness were denied, eternal cycles and the organismic view of nature were espoused, and the heavens were seen as divine. Islamic science would have become self-sustaining possibly, if its holy book the Quran (Koran) had not emphasized God's will and power so much as against His reason, and if Muslim philosophers and scientists had not become so mesmerized by Aristotle's physics and philosophy. Let's briefly consider each of these great civilizations in turn, and see how these faulty metaphysical concepts held their science back from continual development.

WHY DIDN'T CHINA DEVELOP SCIENCE BEFORE EUROPE?

When we look at the great civilization of China, and its marvelous wealth, population, and technological prowess during the ancient and medieval periods, it is easy to wonder why science did not occur there first. Paper, gunpowder, the compass, and moveable type were all Chinese inventions. China's sophisticated rice agriculture, improved by selective plant breeding, was much more productive than contemporaneous medieval European agriculture. Yet, such technological accomplishments do not prove China had modern science:

Nevertheless the accompanying assumption of Singer [who influenced Joseph Needham, the great Sinologist of Chinese science and technology] and of his era [the early twentieth century] that engineering innovation has almost always sprung from prior scientific discovery is not warranted by the facts. This certainly confused Needham about China's influence upon European science, and I suspect that it has not clarified his probing of the Chinese phenomena.

This distinction Abu-Lughod appears to have missed, which is why it was not mere time and chance China declined whilst the West rose, riding the back of the first modern science.

What were some of the science-hindering metaphysical concepts found in Chinese philosophy and religion? First of all, the concept of eternal cycles was most certainly present. One Buddhist monk attacked the Christian dogma of creation as follows:

Space, worlds, and beings have no beginning nor end if we consider them not in themselves and individuals but in their totality. They are eternal from this global point of view. They proliferate without end and during incalculable cosmic periods progress through successive stages of formation, stability, degradation and then a return to nothingness.

Such ideas were no mere individual eccentricity of this monk, but were part and parcel of Chinese intellectual life, having apparently been strengthened by the entrance of Buddhism from Hindu India, and were assimilated into Neo-Confucian thought. What are the problems caused by acceptance of such cycles of thousands of years in which the

world and its civilizations are repeatedly created and destroyed only to be created again? Such views create a sense of metaphysically-induced hopelessness and passivity since no matter how hard humans may struggle to achieve, work, and think, the results of all efforts will be destroyed. Also, a non-linear view of time makes careful, precise quantification (measurement using numbers) of time irrelevant. It also makes people tend to confuse the order of cause and effect since the idea of this-after-that (succession) is weakened. Yet science requires non-passive investigators of nature, precise quantification of time, and the correct knowledge of causes, so the above false ideas need to be firmly rejected for it to exist.

Jaki illustrates the consequences of the Chinese view of time as lacking of sense of succession, weakening their view of cause and effect with

the fact that the Chinese saw nothing inordinate in attributing the political failure of a certain prince to the sacrificing of humans at his burial. As both political impotence and cruelty evidence the absence of the same virtue, one could replace the other as explanation regardless of their sequence.

Jaki goes on to quote Granet's comment that cause and effect did not matter to the Chinese, but instead saw the world as consisting of manifestations whose order did not matter since being "Equally expressive, they appeared interchangeable." With the Chinese having such a conception of time, a true modern science would never have spontaneously arise among them--or any other civilization believing in eternal cycles so firmly, since it undercut the idea of succession in time which is so necessary to developing an idea of, and applying, the law of cause and effect.

SOME CHINESE PSEUDO-SCIENTIFIC "EXPLANATIONS" THAT HINDERED SCIENCE

Another metaphysical delusion the Chinese sadly suffered from (though they were hardly alone) were various a priori pseudo-scientific "explanations" of natural events. In Chinese thought the two best examples of this were the two forces of Yin and Yang on the one hand, and the book of Changes (I Ching) on the other. Yin (female) and Yang (male) were seen as the two forces pervading all of nature and its processes. As a result, the Chinese would not hesitate to assign "the changes of weather to the stillness of Yin." Yin and Yang were used to explain why magnets became attracted to each other, and describe the movements of the sun, moon, and stars. Likewise, the I Ching was a manual of divination that would line up various sayings and interpretations of natural events through various symbols such as lines, trigrams, and hexagrams. Through this book any observation in nature ("omen") would be given an instant interpretation as to its cause and significance. (Compare this to the Roman practice of examining animals' livers to make major decisions of state, etc.) Although normally very sympathetic to the claims of Chinese culture and science, Needham still was willing to say: "Yet really they [Han dynasty scholars] would have been wiser to tie a millstone about the neck of the I Ching and cast it into the sea." The most widespread of pseudo-scientific delusions was astrology. It plagued Islam, India, even Christendom to a great degree--and China as

well. At the Emperor's court, various "wise men" (astrologers, astronomers, and meteorologists) would interpret and blame on the emperor various portents and "signs." What are the costs of having such a priori "explanations" of natural events? They dull the human mind through thinking it DOES know why such events occur, when in fact the laws of nature are still unknown. To posit such metaphysical entities as Yin and Ya destinies, and then say they determine natural processes, creates the delusion of knowledge out of ignorance. Of course, the Chinese were hardly alone in embracing such science-hindering deceptions--see Aristotle's On the Heavens, and his four elements theory, for starters.

THE CHINESE VERSION OF THE ORGANISMIC VIEW OF NATURE

Another metaphysical conception that impeded Chinese science was an organismic view of nature, which sees all of nature as being one huge living creature that goes through a repeating cycle of birth, maturity, and death. Humans are considered to be part of it and fundamentally being like the animals, not basically different from them. Correspondingly, Taoism, which was espoused by the sixth century B. C. Chinese philosopher Lao-tzu, conceived of nature as "an all-encompassing living entity animated by impersonal volitions," was a source of trouble for Chinese science. True, Needham, sympathetic as always, strongly emphasizes how Taoists would contemplate nature and believe it had an underlying order. (Needham believed "Tao" could be best translated "order of nature"). However, the Taoists would not actively investigate nature as opposed to a mystically-inclined contemplation and inactivity concerning it: "He who practices the Tao, daily diminishes his doing. He diminishes it and again diminishes it, till he arrives at doing nothing. Having arrived at this non-inaction, there is nothing that he does not do." This attitude of non-activity (not intended to be taken literally, as even Jaki commented), is at least partly due to how Taoism would see man as totally weak and impotent compared to the majesty of nature, with which he should see an intimate organic unity. By seeing nature as a vast, single spontaneously acting organism (albeit as mystically inspiring as that may be for many in the New Age/environmentalist crowd), it kept them from developing the idea of natural law in the modern sense. Needham himself, although noting the tie in Chinese thought between the cyclical time and organismic concepts, failed to realize the negative consequences of such concepts by trying to put them in the most positive light. However, such ideas have negative effects on developing an active mindset towards nature, which was necessary to develop modern science, as Jaki describes:

The organismic concept of the world (not in the Whiteheadian sense) invariably fosters a state of mind dominated by a nostalgic longing for the primitive golden age, with its idyllic settings in which everything takes place in an effortless way. In that spontaneous dreamlike condition men live off nature without disturbing it [compare this thought with what some environmentalists believe today!], and carry out their social propensities without the sense of constraint due to authorities and laws.

In short, both belief in eternal time cycles and in nature as one huge organism encourage the passivity that opposes the mentally active, investigating spirit of science, such as

shown by Aristotle and Leonardo da Vinci (1452-1519) dissecting carcasses, instead of just meditating and contemplating passively deep within a forest about Nature.

CHINESE CONCEPTIONS OF THE LAWS OF NATURE

The Chinese believed nature both was orderly and had an actual existence (when not influenced by the rather pervasive, Hindu-derived Buddhist ideas of maya, the belief all is illusion). However, they lacked the concept of natural law, as ordained by a personal God, which assured nature was rationally understandable to mankind's mind:

It was not that there was no order in Nature for the Chinese, but rather that it was not an order ordained by a rational personal being, and hence there was no conviction that rational personal beings would be able to spell out in their lesser earthly languages the divine code of laws which he had decreed aforetime.

For a man who was a Marxist (and, admittedly, simultaneously, a very liberal Protestant), this must have been a very hard concession to make, as Jaki observed, for it points to an ideological cause for why modern science did not appear in China, not an economic or political cause. In contrast, the view of how Christianity's concept of the rationality of God was tied to the rise of science in the West is best stated by the English philosopher Alfred North Whitehead (1861-1947):

I do not think, however, that I have even yet brought out the greatest contribution of medievalism to the formation of the scientific movement. I mean the inexpugnable belief that every detailed occurrence can be correlated with its antecedents in a perfectly definite manner, exemplifying general principles. . . . When we compare this tone of thought in Europe with the attitude of other civilizations when left to themselves, there seems but one source for its origin. It must come from the medieval insistence on the rationality of God, conceived as with the personal energy of Jehovah and with the rationality of a Greek philosopher. Every detail was supervised and ordered: the search could only result in the vindication of the faith in rationality.

The rationality of God is implied through certain texts, although written specifically concerning church services, a broader application of these texts is still appropriate: "God is not a God of confusion but of peace," who wants activities to be "done properly and in an orderly manner" (I Cor. 14:33, 40). Since Whitehead was a pantheist, he would not be especially likely to concede too much to medieval Christianity about its sense of nature being rationally knowable and its role in causing modern science to exist.

WHY DIDN'T INDIA DEVELOP SCIENCE BEFORE EUROPE?

Moving westwards to the land of India, an equally perplexing problem with the lack of modern science seems to present itself. Hindu civilization on the subcontinent was ancient, well-settled, and extremely rich materially by the standards of the time. India routinely ran surplus balances of trade with the West, as China did. As late as 1770, after the industrial revolution had begun by some dating schemes in England, the British wool

industry tried to prohibit the import of Bengali calicoes into the United Kingdom. And enormous credit should be given to the Indian mind for the momentous invention of the Hindu-Arabic numerals, with their place notation and the concept of zero. For without this system of enumeration, the (easy) quantification of natural events and substances, so necessary to the development of modern science, would never have occurred. (If you doubt this, try multiplying using Roman numerals alone, without any mental use of the Hindu-Arabic numerals, MDCCCLXVIII by CCLIX!)

Unfortunately, Hindu civilization as a whole was weighted down with almost the most anti-scientific metaphysics imaginable. The Hindu concept of maya, the view that sense data tell only of illusion, not a real external world, was anti-scientific in the extreme. Generally, you do not systematically investigate that which you think is a mirage. Hence- -the Hindu mind turned inwards, and progressed in math by leaps and bounds, but failed utterly to come up with a science of the external real world, such as physics. The concept of eternal cycles, with its view of universal destruction and recreation, saturated Indian culture as well. The sense of hopelessness and passivity caused by this latter concept is aptly illustrated by the comment of king Brithadratha in the Maitri Upanishad as he contemplates an endless series of the transmigration of the soul: "In the cycle of existence I am like a frog in a waterless well." Or, consider what the god Vishnu told the god Indra in the Brhamavaivarta Purana: "I have known the dreadful dissolution of the universe. I have seen all perish, again and again, at the end of every cycle. At that terrible time, every single atom dissolves into the primal, pure water of eternity whence originally all arose." Our modern minds, which presumably automatically reject such concepts, unless influenced by New Age mush, etc., may see their deadening effects on constructive activity by how some today react to the fear of nuclear war: "let us eat, and rink for tomorrow we die" (I Cor. 15:32). Worse yet, death is no escape, for that will bring only another rather meaningless life by a rebirth, unless you have reached the final necessary stage of perfection before being absorbed into Brahma and the end of your individual existence.

THE HIGH COST OF PANTHEISM AND THE ORGANISMIC VIEW OF THE UNIVERSE FOR INDIA

Hindu pantheism caused problems in developing a scientific astronomy, for the heavens were seen as divine and animate. Here the organismic view of the cosmos levies a terrible tax, for then the heavens are seen as alive with a will of their own, instead of being merely inanimate, inorganic matter. In contrast, eventually, in the West, Aristotle's view of the heavens being divine and/or intelligent was extinguished, but only after many centuries of the Christian era:

. . . [D]uring the twelfth century in Latin Europe, those aspects of Judeo-Christian thought which emphasized the idea of creation out of nothing and the distance between God and the world, in certain contexts and with certain men, had the effect of eliminating all semi-divine entities from the realm of nature. Thus nature tended to become a mechanistic entity, running according to the characteristics with which it had been endowed and powered by the forces it had been given in the beginning.

Left to itself, Hindu pantheism never would have eliminated the divine, organismic view of nature since it saw no ultimate difference between God and the universe.

The most widespread pseudo-science in Eurasia was (and is) astrology, and to this day it plagues India with its influence. Tying a person's destiny to an arbitrary interpretation of a given position of the stars and planets on some given day is a denial of the scientific outlook. It encourages a passive, fatalistic attitude in individuals through its complete denial of free will. Why bother to know or try to change the world, when your destiny has been decreed by the heavens? Even today, India is saturated by this nonsense, and far more people take the predictions made far more seriously than in the West. As Jaki observed: "Call for such conversion [that is, an acceptance of science and modern technology by a changed mindset] will hardly be heeded as long as the voice of astrologers is not on the wane but on the rise (in spite of science and education) and carefully listened to by higher government [Indian] officials." True, astrology attained a grip upon much of the Islamic and Christian worlds in the medieval past, and even devotees in modern, twentieth century America such as Nancy Reagan. Nevertheless, the culture of Christendom had built-in limits to its broad cultural acceptance since it is seen as an idolatrous system that also denies moral responsibility. Hence even as astrology grew in the West with the recovery of the Greek classics and the growth of interest in science, the Church continued to condemn it. Unfortunately, India had nothing intrinsic to its culture that frontally assaulted astrology--hence, the former remains deeply in the latter's thrall to this very day.

WHY DIDN'T THE ISLAMIC/ARAB WORLD DEVELOP SCIENCE BEFORE CHRISTENDOM?

Now the failure of the Islamic world to produce modern science is much more curious than India's or even China's. The flourishing of Islamic science and scholarship under the Umayyads and early Abbasids, using the ancient Greek classics, was simply remarkable. The medical works of al-Razi and Avicenna (980-1037) were used by Christendom deep into the sixteenth century, more than 500 years after their deaths. The fact such English words as astrolabe, chemistry, alcohol, algebra, algorithm, and azimuth are derived from Arabic shows the influence Islamic science had on the West. Islamic mathematicians made immense contributions such as al-Khwarizimi (the algorithm and algebra), Thabit ibin Quarra (studied irrational numbers), Albatagnius and Abu al-Wafa (trigonometry), Umar Khayyam (works on analytical geometry), and Nasir al-Din al Tusi (trigonometry). Furthermore, believing in a single God who created the universe at a definite point in time, with time linearly proceeding to judgment day, Muslims were not obvious, easy prey for eternal cycles, the organismic view of the universe, or astrology. Orthodox Islam did not deny the reality of the external world, nor was it apt to think the heavens were divine/alive since they emphasized the monotheistic nature (oneness) of God so strongly. So why did Islamic science mostly fizzle out after 1200?

Unfortunately, for the Islamic world, its leading philosophical, theological, and scientific figures made some very serious wrong turns. The key problem was a lack of balance between faith and reason, which ultimately extended from the Quran's emphasis on the

absolute (and arbitrary) will of God. No Islamic equivalent of St. Thomas Aquinas appeared on the scene to systematically reconcile and integrate the theology of Islam with the rationalism of the Greek classics, without unduly bending one to fit with the other. Hence, the two most important Islamic theologians, al-Ashari (873-935) and al-Ghazzali (1058-1111) were very mystically inclined, and both stressed God's will as opposed to His reason. Al-Ghazzali's work, Incoherence of the Philosophers, sharply assaulted the Aristotelian philosophers called the mutazilites. It asserted the doctrine of occasionalism, which sees the law of cause and effect as only occurring due to God's continual, direct intervention in the universe. Hence, to al-Ghazzali, if a rock lands on my big toe after I release it, the resulting pain is only due to God putting it there in me, not due to the properties of the rock and toe themselves. The direct consequences of such a concept against the idea of a scientific law of nature can easily be imagined.

THE COST OF LACKING BALANCE CONCERNING THE IDEAS OF THE GREEK CLASSICS

On the other hand, the Islamic philosophers Avicenna and Averroes (1126-1198) clearly subordinated their Islamic faith to Aristotle's metaphysics. Indeed, Averroes' concept of double truth--of saying what was true for religion was not necessarily true for philosophy--denies the metaphysical unity of the intellectual and sensible world. This view allows him to avoid having to deny Aristotle's On the Heavens when it conflicts with the Islamic faith. These two philosophers, much like the mutazilites, fell nearly completely under the spell of the ancient Greek classics, and could not conceive how these classics could be wrong. They did not try to reconcile the conflict between Islam and the Greek classics, but basically ignored or denied it. Yet, as we will see, such a conflict between the teachings of Christianity and various pagan Greek ideas, combined with the clear rejection of some of the latter, was necessary in order to strip the latter of metaphysical falsehoods that would have prevented the rise of a self-sustaining science. Here, these Islamic philosophers fell into the trap of accepting easily gained a priori concepts about the physical world. It's much easier to read and accept what someone says rather than to do experiments or think carefully in original ways. A true science of physics could not develop until Aristotle's On the Heavens and Physics were junked. That only occurred in the West due to the tenets of Christian theology conflicting with these two works, and individual philosophers and theologians pointing out such conflicts without ignoring or denying them. The rejection of such errors in the Greek classics in the culture around him made it much more possible for someone like Galileo to boldly say "Aristotle was wrong!" concerning some point of his physics which didn't conflict with Christian theology. Unfortunately, this process of partial rejection and partial acceptance in an overall synthesis like that of Summa Theologica, the master work of probably the single greatest Catholic theologian, St. Thomas Aquinas (c. 1224-1274), did not occur in the Islamic world. Putting it in crude, exaggerated terms, Avicenna and Averroes seemed to think Aristotle could think no wrong, and al-Ghazzali and al-Ashari seemed to think Aristotle could think nothing right. A balance was necessary here, within the culture and individual intellectuals as a whole to have a self-sustaining science occur, using the insights of the ancient classics yet being willing to point out their errors,

theological and scientific, something which occurred in Christendom but not the Islamic world, which is why modern science arose in the former and not the latter.

In addition, and rather strangely considering the tenets of orthodox Islam definitely conflict with such concepts, the Muslim world had a wide acceptance of eternal cycles, astrology, and the organismic view of nature as reflected in the belief that the heavens were alive, or even divine. For instance, al-Kindi vehemently attacked alchemy, the crude, "magical" forerunner of chemistry, but promoted the ideas of eternal cycles along with ibn-Khaldun (1332-1406), the famous north African Islamic historian. Both tried to fit historical events into 20 and 240 year time cycles. Abu-Mashar, in his Book of the Revolution of Birth Years, said the Deluge would recur every 180,000 years. The Brethren of Purity's encyclopedia that summarized knowledge (Rasa'il) was saturated with astrology, the occult, and contained even the view that 3000 year time cycles corresponded with the rise and fall of civilizations as determined by the Zodiac. Avicenna did not see God as directly creating mankind (versus Gen. 2:7), but the latter was the emanation of a series of higher intelligences, each of which grew weaker, until the final, weakest one made humanity. Astrology ran surprisingly rampant, due to the influence of the Persians and Hindus the Muslims had conquered, as well as the Greek classics themselves. Even such a critic of eternal cycles as al-Birundi still wrote a book espousing astrology. The end result of these concepts running amuck, despite they plainly conflicted with Islamic theology, helped to strangle science in the Muslim world. No equivalent of the 1277 condemnation by Bishop of Paris Tempier against pagan Greek concepts (or other such condemnations or cultural acts of resistance) occurred in the Arab or Islamic world.

HOW MUHAMMAD'S VIEW OF GOD'S WILL UNDERMINED ISLAMIC SCIENCE

However, the Muslim failure in creating a self-sustaining science has a deeper root: Muhammad (c. 570-632), the founder and prophet of Islam, in the Quran emphasized God's will and power at the expense of His rationality. It is common for people to think of the God of the Bible as being just like the God of the Quran, especially the non-religious who think, "All religions are the same." However, this assumption can be seriously questioned once the texts and accompanying history of the Bible and Quran are compared. Drawing upon a list of comparisons made by Morey, some evident differences arise. The God of the Quran is not active directly in history in the same manner as Jehovah, since He did not enter history personally as Jesus via the Incarnation did, but used angels and prophets as messengers. He is totally unlimited in his possible choices, but the Christian God is limited by His essence, as illustrated by Titus 1:2, which says He cannot lie. He is less knowable. Islam's condemned applying positive predications to God; humanity's knowledge of God consists really only of negative stated attributes such as, "He is not limited," or "God is not mortal." He is less personal. Allah is seen as so transcendent men cannot know Him personally or as personally. Consider the following sobering comment by Morey, when investigating the impact of the Quran's theology on science:

6. Because the God of the Bible is limited by his own righteous nature and there are certain things He cannot do, he is completely consistent and trustworthy. But when we turn to study the actions of Allah in the Quran, we discover that he is totally capricious and untrustworthy. He is not bound by his nature or his word.

Hence, when al-Ghazzali condemns the concept of the laws of nature as restricting God's freedom to act, he is perfectly in line with the Quran: It is not just his personal idiosyncratic interpretation of Islam's chief holy book. The consequences of such a view were well described by the great Jewish scholar, Maimonides (1135-1204). He saw the Mutakallim (orthodox Islamic theologians) as only willing at most to concede the laws of nature were like the customary riding habits of the caliph going through a city: subject to change at whim if desired. Maimonides put it thus: "[T]he thing which exists with certain constant and permanent forms, dimensions, and properties (in nature) only follows the direction of habit . . . on this foundation their whole fabric is constructed." Hence, the metaphysics of the Quran, by emphasizing God's arbitrary and changeable WILL, as opposed to His reason, helped to sink Islamic science through creating a weak view of the laws of nature and an orderly universe.

THE CONFLICT BETWEEN CHRISTIAN THEOLOGY AND ANTI-SCIENTIFIC PAGAN IDEAS

In the West, pagan beliefs in eternal cycles, the organismic view of nature, astrological speculation, the divinity/aliveness of the heavens and the illusionary nature of the external world ran into the hard rock of Christian theology. Hence, although the classical corpus (as elucidated by Muslims like Avicenna and Averroes who were not truly orthodox) strongly encouraged belief in such anti-scientific concepts in the West, there was always enough intrinsic cultural resistance in the Christian intellectual community as a whole to keep such pagan concepts from totally mesmerizing Christendom. Most likely, Christianity by itself, without the Greek classics (or Hindu-Arabic numerals) would not have created modern science. However, the dogmas of Christian theology allowed a certain intellectual community to strip the classics of antiquity of the disastrous influence of these anti-scientific concepts due to their conflict with their religious ideas, allowing a true modern science to eventually blossom. Of course, if Catholic Christians had not believed in concepts opposed to these pagan ones due to their theology, such a conflict would not have occurred and science would not have reached a modern, self-sustaining form in the West. Duhem, in his Le Systeme Du Monde, maintained that modern science was made possible by the Bishop of Paris Tempier's condemnation in 1277 of 219 propositions, which blasted these anti-scientific concepts of antiquity.

True, Jaki and Duhem mistakenly overemphasize the contribution of Christian theology relative to the ancient Greek contribution to the rise of science. The mindset exemplified by the Elements of Euclid (living c. 300 b.c.) in using general propositions in geometry as proofs and building upon them through demonstrations, and Aristotle's Prior Analytics, which stated the laws of logic, the idea of the syllogism, and how to analyze an argument's form for its soundness, was necessary for the rise of science. The Greek mind always had an authentic respect for reason even in the works of Plato (c. 428-348 b.c.).

He was an irrationalist, but still couched his beliefs in dialogs and arguments that purported to be a dialectical process of reaching the truth, and not as a mystical revelation. Nevertheless, an important contribution was made by Christian theology that is normally TOTALLY overlooked. Imagine--the dogmas of Catholicism promoted the rise of science! We must not let Galileo's fate at the hands of the Inquisition blind us to Christian theology's contribution in sweeping away the rubbish of these pagan beliefs from science, which kept science from becoming self-sustaining and modern. These beliefs, if accepted, turn the human mind inward, causing it to accept too blindly what occurs in the real external world, making it impossible to develop the most basic science of moving bodies (physics). However, notice that the Christian contribution is not so much as creating a broad respect for rationality, or the discovery of the basic laws of logic used in scientific reasoning (as found in the Organon, Aristotle's body of logical works). Rather, Christian theology (by chance conflict, someone could argue) shot down the false, self-inhibiting ideas of pagan Greek science, absorbed much of its respect for reason from them, and then allowed science to blossom forth. However, since the God of the Bible operates in a much more rational manner than the stories of the pagan gods non-Christian cultures believed, Christianity helped promote rationality to a degree as well. (Doubters of this should carefully read Genesis 1-2, and then compare read the bloody battles among the gods involved in the creation of the world in the Babylonian myth Enuma elish, which is absurdly asserted to have influenced Moses/the writer(s) of Genesis). Christian theology removed the intrinsic stunting inhibitions of Greek science. It did not create science by itself mostly from scratch. However, neither could have the philosophy of the Greeks without the theology of Judeo-Christianity have created modern science by themselves either, for it took Christianity to remove various science-inhibiting false metaphysical concepts from the former's philosophy to have modern science born.

CHRISTIAN THEOLOGY'S LINEAR TIME CONCEPT OF TIME VERSUS PAGAN ETERNAL CYCLES

Because it would involve repeating exactly or almost exactly the events of the Bible's history, Christians fundamentally could never accept the idea of eternal cycles. To a Christian, the thought of his savior God dying horribly on a stake repeatedly again and again is too horrible to contemplate: ". . . because this He did once for all when He offered up Himself" (Heb. 7:27). Hence, even when some Christians influenced by pagan thought accepted by idea of eternal cycles, who include the rather unorthodox Catholic church father Origen (185?-254? A.D.) and even St. Thomas Aquinas, the concept was accepted in a highly mitigated, attenuated form that greatly lessened its ill effects. Origen and St. Thomas both still believed in an absolute starting point (creation), and ending point (judgment). They still believed free will existed, which mean the passivity and sense of hopelessness induced by the treadmill of meaningless alterations of catastrophes and golden ages in ages past and to come was largely removed. Some early Christian theologians, such as Jerome (c. 374-419 A.D., translator of the Latin Vulgate Bible) and Hippoclytus, condemned eternal cycles totally. St. Augustine, the greatest of the Catholic Church fathers (354-430 A.D.), was more equivocal, but was willing to forcefully condemn the more literal forms of eternal cycles, and still believed in creation and judgment. He denied reincarnation as well. This allowed him to maintain a basically

linear concept of time with the two end points between God beginning everything and judging everyone. Bishop Tempier's condemnations in 1277 helped put a limit on the acceptance of such anti-scientific doctrines through an attack on eternal cycles in proposition 92, and against the eternal existence of the universe (a belief necessarily tied to the former) in propositions 83-91. These condemnations helped keep many philosophers/theologians in Christendom from totally capitulating to Aristotelian thought, as had happened with Islamic culture with Avicenna Averroes, and the mutazilites. Oresme (1323?-1382), a direct forerunner of Galileo in developing physics freed from Aristotelian conceptions, condemned belief in such cycles. Hence, the Christian belief in creation and judgment kept Christendom off "the treadmill of the Yugas" (Jaki's phrase), killing a sense of passivity caused by helpless hopelessness, by promoting a linear conception of time that made its precise quantification and cause-effect relations to be more easily conceived.

Astrology, that prime example of an answer-giving a priori pseudo-science, ran into repeated condemnations by church fathers and theologians in the West. St. Augustine, as noted above, blasted it in the Confessions. Hippolytus hit it hard in The Refutations of All Heresies. While the early medieval Church fought astrology very successfully, the increasing interest in science due to the recovery of the Greek classics, made interest in astrology surge as well. Correspondingly, a condemnation of astrology figured in proposition 105 of Tempier's list. Oresme told the king of France, his patron, in a booklet to ignore astrology. Isadore of Spain in the early medieval church attacked it also. Roger Bacon (c. 1220-1292), famous for his predictions of future human inventions, agreed with astrology to some degree, but still rejected its control over individuals' destinies as opposed to that of nations. Astrology did have some major influence in Christendom, but as even Bacon's case shows, there were limits to the acceptance of this pseudo-science that allowed science to eventually develop independently of it.

CHRISTIAN THEOLOGY VERSUS THE DIVINITY OF THE HEAVENS

The divinity of the heavens, normally closely allied to the organismic view of the natural world, was gradually eliminated by the medievals. The mesmerizing power of Aristotle (384-322 b.c.), who propounded such views in On the Heavens, was felt in Europe too, which was why this process took so long. Jerome denied the heavens were alive, but St. Augustine remained in an anguished uncertainty. St. Thomas entertained the notion, but only to a limited degree. Even Kepler, the discoverer of elliptical orbits of the planets, still believed intelligences controlled the movements of the heavens. However, due to an already developed concept of natural law there were natural limits on accepting this idea. "The overwhelming majority of European thinkers accepted the reality of the order of nature [unlike the Hindus], and most considered nature to be a self-sufficient creation of God, containing all the powers necessary for its operation without God's direct intervention [unlike al-Ghazzali's concept of occasionalism concerning the universe's natural laws]." Of course, the Christian rejection of pantheism, which says the material world is God also, was instrumental in destroying the idea of the heavens being divine as well.

The West began to develop the idea of the universe being rationally knowable since God made it:

The cosmologists [of the twelfth century] felt certain that all of nature was fundamentally rational because the all-knowing God had made it so. . . . William of Conches writes that "the world is an ordered aggregation of created things". And Thierry of Chartres says: "The world would seem to have causes for its existence, and so to have come into existence in a predictable sequence of time. This existence and this order can be shown to be rational."

The clock maker metaphor for the universe by used by Oresme. Bacon felt all branches of learning had basic unity, interdependence, and interconnectedness since only one God made them all. With the approval St. Thomas gave to reason in Summa Theologica, science could go forward as secure in the existence of natural law, which was a concept al-Ghazzali and al-Ashari denied to Islam by emphasizing God's will and power too much relative to His reason.

THE IMPORTANCE OF BURIDAN AND ORESME IN BUILDING THE FOUNDATIONS GALILEO USED

The first key steps in totally discarding Aristotle's physics were done by Buridan and Oresme. For Galileo and Leonardo da Vinci had leaned upon them indirectly for many of their seemingly totally new ideas in physics or in other fields. Ancient Greece had developed a science of geometry that could be called "modern," but this concerns mental entities, not material objects. Its physics remained hopelessly backward by comparison due to pagan ideas about eternal cycles, the irrationality of the universe, and the divinity of the heavens. The second century astronomer Ptolemy, whose work the Almagest espoused an earth-centered solar system, as well as Plato, believed the heavens were divine, which prevented belief that the laws of motion on earth applied to the stars and planets, and in developing correct conceptions of these laws to begin with. By contrast, the medieval Christian Catholic Buridan, in a crucial passage, anticipated the idea of inertia (the idea an object once in motion continues to move in the same direction until it encounters resistance) through his discussion of impetus. Notice the reference to God not directly making the laws of nature operate:

Also, since the Bible does not state that appropriate intelligences move the celestial bodies, it could be said that it does not appear necessary to posit intelligences of this kind, because it would be answered that God, when He created the world, moved each of the celestial orbs as He pleased, and in moving them He impressed in them impetuses which moved them without His having to move them any more except by the method of general influence whereby He concurs as a co-agent in all things which take place; 'for thus on the seventh day He rested for all work . . .' [Gen. 2:2] And these impetuses which He impressed in the celestial bodies were not decreased nor corrupted afterwards, because there was not inclination of the celestial bodies for movements.

Also note this additional statement as a nascent form of the idea of inertia:

But because of the resistance which results from the weight of the [waterwheel of the] mill, the impetus would continually diminish until the mill ceased to turn. And perhaps, if the mill should last forever without any diminution or change, and there were no other resistance to corrupt the impetus, the mill would move forever because of its perpetual impetus.

While these passages are only halting steps on a long road to repealing Aristotle's physics, they do show a move to break out of his conceptions of how moving bodies move. These men show that the Church never uncritically accepted the Greek classics as many in the Islamic world had done earlier. True, it tied itself and lent its authority to the Greek classics excessively, which set the stage for its eventual disaster resulting from it using force that made Galileo recant his belief that the earth moved. With the later discoveries of Galileo, Hooke, Kepler, Torricelli, Boyle, Newton, and others, Europe's science took a vast qualitative leap, but we should not overlook its origins and these men's predecessors in the Middle Ages.

THE MERTON THESIS STATED

Now Merton's thesis does not claim as much for Christianity as the Duhem-Jaki thesis does, for the former merely sees seventeenth century Puritan ethical values as being conducive to engaging in scientific endeavors. One partial critic of Merton's thesis pointed out how some values of Puritanism opposed science even as some promoted it:

If seventeenth-century science grew in harmony with Puritan values of utility, reason, empiricism, and the glory of God, it also grew by distancing its activities and goal from other values or sentiments displayed by Puritanism: intolerance, dogmatism, enthusiasm.

Also, since Merton is a sociologist, he is approaching science through its relationship to the rest of society, which is an externalist approach, instead of looking at science from inside its own history.

Merton lists various values that helped promote science among Puritan Englishmen in the seventeenth century. One is to glorify God and serve Him through doing activities of utility to the community as a whole, as opposed to the contemplative, monastic ideal of withdrawal from the community. Through "the drive for the conviction of one's election, . . . the Calvinistic doctrine of predestination escapes any drift toward an apathetic pessimism." Through emphasizing a vocation (again, something useful to the community as a whole) this created diligence, industry, and hard work in Puritans. As the Quaker leader Baxter put it: "No: no man should do so without a special necessity or call: for there are general precepts on all that are able, that we live to the benefit of others, and prefer the common good, and as we have opportunity do good to all men." The result is the individual chooses the vocation that is best suited for his abilities. Reason and education were both praised, the latter needing to be practical in nature, not highly literary in content, and definitely not consisting in the philosophy of scholasticism, with which the Catholic "Angelic Doctor" St. Thomas Aquinas is identified.

VARIOUS ENGLISH PURITAN SCIENTISTS

The religious values and beliefs of many English scientists of this period are easily documented. For instance, Charles Boyle (1627-1691), the deviser of the namesake law concerning the compression of gases, the English chemist and physicist wrote in his last will and testament: "Wish [the Royal Society, a group of scientists] a happy success in their laudable Attempts, to discover the Nature of the Works of God, and prayer that they and all other Searchers into Physical Truths, may Cordially refer their Attainments to the Glory of the Great Author of Nature, and to the Comfort of Mankind." John Ray (1627-1705), the great biologist, told a friend that sparing time to investigate nature was good: "What time you have to spare you will do well to spend, as you are doing, in the inquisition and contemplation of the works of God and nature." Although not a Puritan himself, Francis Bacon (1561-1626), who some have thought wrote Shakespeare's plays, had a Puritan mother who (as mothers tend to do!) influenced him. His emphasis on the utility of scientific discoveries, as opposed to gaining knowledge for its own sake, which was Aristotle's tendency, has a Puritan ring to it. Forty-two of the 68 founding members of the Royal Society (starting through meetings in 1645 unofficially) for which their religious background was known were Puritans. Such a high proportion is very much out of whack compared to their proportion in the total English population, which was mainly Anglican. Sir Robert Moray, Sir William Petty, Robert Boyle, John Wilkins, John Wallis, and Jonathan Goddard were all prominent leaders of the Royal Society--and all Puritans.

Furthermore, the scientific method needs both an empiricist and rationalist approach to nature to work properly, something which Jaki comes back to again and again. Curiously, Puritanism provided both by having the rationalism of St. Augustine's type of Neo-Platonism, yet needing empiricism in order to serve one's calling (vocation/occupation) and be useful to the community as a whole. The irony to this is that the man who sparked the Reformation, Martin Luther (1483-1546) had anti-rationalistic tendencies, and attacked the Copernican view of the universe. John Calvin (1509-1564), whose Institutes of the Christian Religion systematically set the doctrinal agenda of many Protestants, including the Puritans, was not enthusiastic over many of the scientific discoveries of his day. What this shows is the unintended consequences of the new religious values of Protestantism. Interestingly, even as the Counter-Reformation was damaging Catholic science (the Inquisition's effort against Galileo, for instance), Protestant science was taking off, helping to make up for the slack. Although we have only briefly surveyed the Merton thesis, partly because it overlaps the Duhem-Jaki thesis in pointing to religion as positively influencing science, although by a rather different means. However, it helps to show when pious Puritan scientists discussed thinking God's thoughts after Him and trying to know God's attributes better through studying His creation (compare Romans 1:20), they were not saying this as a rationalization to justify their activities, but really meant it.

WHEN CHRISTIANITY GETS BLAMED FOR SCIENCE: THE ENVIRONMENTALIST CRITIQUE

A supreme irony is that many environmentalists publicly concede the Christian origins of science, but in a spirit of condemnation, since various ecological disasters get blamed on the Bible's injunctions to multiply and subdue the earth. The reversion to ideas rejected by our medieval ancestors--in the "New" Age movement--involves reviving the ideas of eastern mysticism as found in Hinduism and Buddhism, and dressing them in some western garb. Of course, the Unity School of Christianity, "New Thought," and Christian Science have been at this for decades going into the last century. The religious outlook of Transcendentalist Ralph Waldo Emerson (1803-1882), American poet and essayist, was unquestionably pantheistic. Similarly, the United Nations' Environmental Programme's Global Biodiversity Assessment, some 1,140 pages long, explicitly condemns the Western (read Christian) worldview as being "characterized by the denial of sacred attributes in nature, a characteristic that has its roots in Greek philosophy [a basically false statement, as shown above--they weren't familiar with Aristotle's On the Heavens evidently], and became firmly established about 2,000 years ago with the Judaeo-Christian-Islamic religious traditions." Further, they condemn the abandonment of the organismic view of nature thus:

This perspective, especially as elaborated in the Judaeo-Christian tradition, set humans not as part of a wider community of beings, but apart. . . . Societies dominated by Islam, and especially by Christianity, have gone the farthest in setting humans apart from nature and in embracing a value system that has converted the world into a warehouse of commodities for human enjoyment.

They go on to condemn pagan cultures which converted to Christianity that "began to cut down the sacred groves [compare the KJV's translation for Canaanite Asherah poles!], to bring the land under cultivation"! Considering such attacks on Christianity for helping cause a rationalistic, scientific worldview that led to environmental destruction, it's then absurd to complain about Christianity or the Bible as the roadblock to science getting started in the late Middle Ages, or to make broad general statements about the necessary warfare of science and religion the next time evolution get attacked by various fundamentalists. As Jaki put it:

The argument would make some sense if it were accompanied by the recognition that the medieval state of mind nurtured by the Gospel has indeed been responsible for the rise of science. Responsibility for the effect, the misuses of science, implies responsibility for the cause. But the latter responsibility, which in this age of science appears to be the most coveted credit, the credit for the rise of science, is not attributed to Christianity when its mentality is blamed, for instance, by the noted historian of technology, L. White, for the ecological misuse of science.

Hence, if you're an environmentalist or New Ager who blames Christian worldview for creating the science and technology that is supposedly ravaging the earth, it's time to start admitting the facts of history showing how it helped to cause modern science to exist. It's time to stop repeating bromides about the warfare of science and religion that could have come from the 1925 Scopes "monkey trial" where the agnostic lawyer for the defense

Clarence Darrow embarrassed William Jennings Bryan, thrice-time presidential candidate loser for the Democratic party, who was assisting the prosecution.

Briefly above the Duhem-Jaki and Merton theses were surveyed, which show how Christianity led to the rise of modern, self-sustaining science in Europe by stripping pagan Greek thought of false metaphysical ideas that hindered science, or had values conducive to scientific endeavor practically. Generally the militant secular view that sways most western intellectuals has allowed the raw facts of the Christian role in the rise of science to be covered up, often causing intellectuals to leap some two millenia from ancient Greece to Galileo in their reconstructions of the history science, ignoring the influence of the culture filling the time in between as irrelevant to the rise of science. Christianity normally only gets "credit" for helping cause the rise of a scientific worldview when a whipping boy besides industry or the military is needed for New Age environmentalists. They, like famed science fiction writer H.G. Wells in The Outline of History, commit the error religious historian Christopher Dawson observed, by focusing on "the technical and mechanical achievements of modern civilization . . . [but lack an] adequate account of the movement of scientific thought that preceded those achievements and made them possible." What such intellectuals should now consider, with the rise of Eastern Mysticism, astrology, and the occult in the west in the form of the New Age movement, is whether and how long science can survive in a world increasingly reverting back to the ideas that had kept it from existing in the past and which Christianity had largely defeated, should they deny the second coming of Jesus the Messiah will occur, and will occur soon. If one, seeing mankind's past intellectually as a struggle between "witch doctors" and "attilas" as philosopher-novelist Ayn Rand did, thinking the medieval worldview dominated by Genesis 1 and the Cross was irrational, imagine what would happen if the Zen Buddhists and monist Hindu mystics dominated the intellectual scene (such as concerning the perplexities of quantum mechanics) instead. For, as Jaki observed, Jesus was the Savior of science--without His birth, life, and resurrection, it never would have existed in this world.