Qur'an and Science

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On the topic of the Qur'an and science, I have the challenge of packing two semesters of course work into one paper. I must summarize some things and only allude to others. The problem is made more difficult by the fact I wish to expand the scope the discussion to explain how the concepts here addressed relate to all the other covered at the summer institute at which this paper was delivered. These relationships may not be self-evident, especially for those with no experience with the hard sciences.

Perhaps the best way to introduce the point is with an allusion to Thomas Kuhn's work *The Structure of Scientific Revolutions,*[1] which I recommend highly to any who have not read it. Kuhn talks about the obstacles to the acceptance of those new scientific ideas that are revolutionary in their nature, that is, that do not simply consist of a new theory, but of what he calls a paradigm shift. Such changes in our entire framework of thinking about things are not restricted to the hard sciences, but affect every aspect of knowledge and learning. This is especially true when we get so accustomed to the old ways of doing things that they actually narrow our perspective.

There is a famous optical illusion that I show students to make this point. At the right is a picture of a woman.[2] Is it a picture of a young woman or an old woman? Different people will give different answers. You must learn how to look at the picture in a different way in order to change your perception of the subject. (Hint: if you perceive an ear just to the left of what appears to be the line of the edge of headscarf, you will perceive the woman as young. If instead you convince yourself that this is not an ear, but one of her eyes, you will see an old woman.)

The important point is that you cannot see both at the same time. Even once you know how to see it one way or the other, you can't see both simultaneously. This is what happens with a paradigm shift. We must escape the prison of the old ways of perceiving. Perceptions are immediate; they are not like cognition. Cognition is a gradual process you labor over to understand something. Perception is instantaneous. You see something; it is what you see, and you cannot control perception in the way you can control the rational faculty. But when your rational faculty is trapped inside of a particular paradigm, you are locked into a narrow range of possible understanding. So, if we are going to have a new way of understanding our religion, if we are going to try and get new insight from the Qur'an, we must prepare to undergo a paradigm shift.

In speaking about the subject of the Qur'an and science, I argue there are three general approaches that we could take. Obviously, in any approach we take must adhere to the *tawhîdi* premise, which requires a rejection of the distinction between the sacred and the secular. In other words, for the Muslim, for the one who believes in *tawhîd*, there can be no contradiction between the revelations of Allah in the text, the Qur'an, and in the revelation of Allah in the

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[1] Thomas Kuhn, *The Structure of Scientific Revolutions* 3rd ed. (Chicago: Univ. of Chicago Press, 1996).

[2] This version was originally published in 1915 in *Punch*. http://mathworld.wolfram.com/YoungGirl-OldWomanIllusion.html.

phenomenological world. Nature is as much the book of Allah as is the Qur'an. Therefore any perceived discrepancy is a reflection of the shortcoming of our understanding.

I find there are three general approaches to categorizing and evaluating the variety of approaches to the question of the relationship of the Qur'an to science. One is the metaphoric, another is the literal, and the third is the procedural. We ask, what does the Qur'an have to teach us about science? We know without doubt the Qur'an has many allusions to natural phenomena in it. What are we supposed to take from these allusions? Some will say they are metaphors and we are to take from them some deep-seated spiritual truth. Others will say they are literal and we are going to get some knowledge of the phenomenological world. Without claiming that the first two approaches are completely without merit, I argue that they have their limitations and they can be dangerous. I believe the most important thing the Qur'an has to offer is its procedural guidance. I have argued elsewhere[3] that one of the most important impacts of Islam on science was its contributions to the development of the methodology of modern science, as we know it today. Understanding why science as it is done today is different from the way the Greeks did it is very important for Muslims to grasp. Even if you've never grasped science itself, I think you have to understand why modern science developed under Islam. I will only summarize that case here because I have two other points I want to address.[4]

The main thing to understand about science is that it is a procedure. This is in contradiction of fundamentalist Christian view of the relationship of science and religion, in which they treat science as if it's a belief system. They will say, "We Christians believe this and the scientists believe that," but what makes science is not the content of scientists' conclusions but how they got to those conclusions. There is a procedure to be followed and I would make the point that the Qur'an encourages that procedure. Furthermore, I argue that the Qur'an not only encourages that procedure in the natural sciences but, as far as epistemology is concerned, as far as the theory of knowledge is concerned, that the Qur'an argues for a similar epistemology in our approach to knowledge in general.

The strictly metaphorical approach to the relationship to the Qur'an and science causes one to miss the fact that, with the passage of time, the metaphors in the Qur'an have become more meaningful while the metaphors in, for example, the Bible, become harder to understand as time goes on. I am not saying they become false—because the spiritual truth of an allegory is independent of the truth or falsehood of the physical phenomenon from which it is drawn—but rather that as the paradigm from which it is drawn becomes obsolete, the metaphor becomes antiquated. For example, if I say that someone's reputation has spread to the four corners of the earth, the point of my assertion—that he is famous—may be true, but the phrasing is quaint compared to "his reputation has spread around the globe." When the Bible says that Joshua ordered the sun to stand still, we know what it means, but we have a problem with it in a way that people in Joshua's day people didn't, because they believed the earth stood still all the time and that the sun was going around the earth once a day, therefore he did not order the earth to stop moving but the sun to stand still.

In the case of the Qur'an, we have seen many of the allusions that would have been confusing in the prophet's time had that become meaningful in our own time. Maurice Buccaille has given an impressive example about the digestion of cows, that Allah makes pleasing and nutritious drink from "between" the regions of digestion and the blood"[5] If I lived in the time of Muhammad, I

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[3] Imad-ad-Dean Ahmad, *Signs in the Heavens: A Muslim Astronomer's Perspective on Religion and Science* 2nd ed. (Beltsville: amana, 2006).

[4] For a detailed analysis of Islam's contributions to the development of the modern scientific methodology see *Signs in the Heavens* op cit.

would have no idea what the Qur'an is talking about, and indeed the scholars of the past offered bizarre interpretations of the meaning. But Buccaille, a modern physician says, as a matter of fact, that the membrane of the intestine allows the nutrients to pass from the partially digested matter into the blood stream where of course they carry it to the mammary glands and where it is made into milk. The allusion becomes very easy to understand in the light of modern knowledge.

A strictly literal approach, on the other hand, ties the eternal truths of the Qur'an to the changing models of science. Scientific theories are changing all the time. Science provides intellectual models by which we understand the natural world, and those models are never absolute truth. They are always our best understanding at the moment, and they keep changing. Once you take a verse in the Qur'an and say this means this scientific theory, then you put yourself in a very dangerous position because when that theory is proven wrong, and a new theory comes along, those who tied it to religious doctrine will accuse those who rejected the theory of *kufr*. We have seen this in the Christian world. At the time that Christians embraced the Bible they ignored the four corners of the earth statement because they knew the earth was round. Their own Greek science taught the earth was round, and they had no problem accepting the phrase four corners of the earth as an antiquated metaphor. Today, virtually all Christians understand that Joshua could not order the sun to stand still to extend the daylight because the cycle of night and day is due to the turning of the earth, but at the time the Bible was adopted by the Christians Greek science said the sun did move around the earth. Thus, when Galileo gave the argument why it is not literally true, he was accused of heresy. That is a dangerous way to proceed.

The Qur'an is not a scientific textbook. It does not instruct us how Allah created the Universe. It instructs us that it *is* He who designed it and Who *urges us to investigate its construction*. That's what makes the Qur'an pro-science. Not that is says anything about how the world is made but it tells us to look at it. It encourages us to examine His signs in the heavens and the earth. I shall demonstrate my points by looking at particular paradigmatic shifts in the sciences and ask how these approaches affect the perception of the relationship of religion and science. I don't want to spend too much time on the role of Islam played in the development of modern sciences simply because the matter has been explored in great depth elsewhere.[6] However, I do want to emphasize the conclusion from my book, *Signs in the Heavens*, that there are seven attributes of Islamic civilization that encouraged the development of modern science. Of these seven, six are at least partly from the Qur'an. (The seventh is related to the development of Hadith science and I will acknowledge it in passing.)

Before I detail these factors, let me be clear about what the development of modern science was, that is, how it differs from Greek science. Westerners often assert that Muslims "preserved Greek science." This is a half-truth. What they don't seem to understand is that Muslims *transformed* it. Modern science and Islamic science in its later phases are very different from the way Greeks did science. The Greeks were rationalists. They believed that one can know scientific truths by reason alone. Aristotle said that a scientist is one who grasp that everything is the way it is because it could be no other way. The problem that some Muslim scholars have with scientists getting involved in religion is they mistake modern scientific methods with the Greek method of learning. **They think when you talk about natural law you're saying everything is the way it is because it could be no other way.** This at the very best makes Allah kind of a slave to nature and worse throws him out of the picture entirely. If everything is the way it is because it could be no other way, then what is the function of a creator? Things just are and always have been. Indeed there were many Greeks who believed that things always had been as they are, but the

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[5] "And verily in cattle (too) will ye find an instructive Sign. From what is within their bodies between partially digested matter and blood We produce for your drink milk pure and agreeable to those who drink it." Qur'an 16:66.

[6] See, e.g., Imad-ad-Dean Ahmad, *Signs in the Heavens: A Muslim Astronomer's Perspective on Religion and Science* 2nd ed. (Beltsville: amana, 2006).

Muslim view is different. The Muslim view is not that everything is the way is because it could be no other way, but that everything is the way that it is because *Allah willed it to be that way.* The question, then, is what are the implications of this assumption? One of the main implications is the *reason is not a sufficient source of knowledge.* There are no self-evident first principles from which you can derive a complete knowledge of reality. Consider, as al-Ghazali did,[7] the shape of the universe. The philosophers who followed the Greek teaching first believed that the universe was shaped like an onion. The Earth at the center, the moon in sphere around it and the other spheres around it and so on and the sphere of the stars and outer most reaches and so on. Now the important thing about al-Ghazali's critique is not that he said this is false; he did not. He said it might be true, but that if it is true, it is true because Allah willed it to be that way and not because he had no other choice. There are an infinite number of ways Allah could have constructed the universe and if he instructed it this way, it is because he choose to construct it this way. That is the heart of Islamic critique of what you might think is the natural law theory. It is not a denial of the existence of natural laws, for such laws are easily demonstrable. Rather, it is a criticism of the monistic epistemology that says reason is a sufficient source of knowledge.

Now if reason is not a sufficient source of knowledge, what else do we need? Well everyone knows besides reason, which has a role in science under the rubric of "theory," there is also experimentation and observation. This is precisely what the Qur'an addresses when it commands us to look for Allah's signs in the heavens and on earth. However, beyond these two sources of knowledge, there is a third, which is Authority. This surprises people who are used to thinking science is opposed to authority, but let me assure you as someone who was a working scientist for 20 years that science, any scientist gets most of his knowledge not from his own experiments or his own theories but from *reading the professional literature*. The literature is the authority and the literature is known to be trustworthy because it has been peer-reviewed and because scientists are open to question it and challenge it at any time. These three sources of knowledge, reason, experience and transmission from reliable sources are in fact the sources of all forms of knowledge.

Immediately some Muslims jump up and say, "No, no, no, you have forgotten about *wahî*." I haven't forgotten *wahî*. What is *wahî* except transmission from particularly reliable sources? If Allah, the angels and the prophets are not reliable, who is? But even these have to be subject to the same sort of questioning. We are all born in different religions. We cannot simply believe whatever has been handed to us as a holy book, whatever some professed prophet has been reported to have said, whatever some priest teaches us, whatever our mother tells us is all true beyond question. All of these three sources of knowledge have to check one another. When our reason and our experience and the reliable sources all agree, then we can say that you have knowledge with as much certainly as human beings are capable. Only Allah knows anything with absolute certainty. To the limits of human certainty, we can say that this is our key to knowledge; this is what we know.

Now let me take a look at some of these particular elements that drove this development from the ancient Greek rationalistic method to the modern method of science that I have just described. The first is "*iqra!,*" the respect for knowledge. The Qur'an has commanded us to read, meaning to acquire knowledge from exogenous sources. There may be other creatures that are intelligent. I once heard Jacque Cousteau claim in a radio interview that the killer whale is more intelligent than human beings, but the whale can't go to the library or look things up on the Internet. Therefore the whale knowledge is forever limited to what he carries around with him in his brain, whereas our knowledge is always open. I don't have to memorize hadith to be able to read them and the evaluations of their chains of transmission and soundness of their texts.

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[7] Al-Ghazali, *The Incoherence of the Philosophers*, Michael E. Marmura, *trans.* (Provo, UT: BYU, 2000), pp. 8-9.

A second element is induction. This process is the heart of the scientific method, requiring the rigorous testing of theory by experiment and empirical observation. The role of observations is clearly something that is encouraged in the Qur'an when it says look for God's signs in the heavens and the earth.

A third element is universality. The Qur'an teaches, and we believe, that all truths come from Allah. Therefore, because Allah sent messengers to every people, every people have access to the truth. Therefore, we are not limited to the knowledge of our own history. When the Muslims came across Greek knowledge they didn't say the Greek are pagans; we don't have to read these books. They translated them all, not for uncritical acceptance, but for critical consideration, to decide what is true and what is false. We'll accept the truth and reject the false and we will be better off for having gone through the process.

A fourth element, that is very important, is the abolition of the priesthood. There were many scientific civilizations in the past before the Islamic one. The ancient Babylonians, for example, had a fine astronomical science, but it was known to the elites. It was not available to the masses. The idea that the masses should be trusted with this kind of knowledge was anathema to them. In Islam, we have the teaching of the prophet, peace be upon him, that is it the duty of every Muslim, male or female to seek knowledge from the cradle to the grave.[8] Therefore, knowledge is not to be the province of the elites. Indeed, we find that Muslim scholars who made advances in arithmetic, for example, would not just write papers for other scholars, but wrote books on arithmetic for secretaries and scribes.[9] So that people who were providing clerical services to others would be able to do their arithmetic properly.

Another element is the fact that Islam does not despise material success or advocate asceticism. A materially successful society is one that will do research in the hard sciences. If you're poor, you're only concern is subsisting; you are concerned about developing that low technology that is going to keep you from starving to death. When you have a materially successful society, then you have people who will dedicate their wealth to setting up *awqâf* that will provide not only hospitals, but institutions of learning and scientific research. The Muslim society in its heyday had a wealth that was unprecedented and gave birth to the modern university and college.

Another element is academic freedom, this is absolutely necessary for science to move forward. The necessity of academic freedom for scientific progress is self-evident. The point here is that, for Muslims, academic freedom is the corollary of our individual responsibility and duty to Allah. Every Muslim is directly responsible to Allah and this means that no one has the right to censor the academic work of another person. What you do when confronted by falsehood is not to censor it, but to expose its fallacy: "Nay We hurl the Truth against falsehood and it knocks out its brain, and behold falsehood doth perish!"[10] This, of course, is the way science is done.

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[8] Narrated from Anas by al-Bayhaqi in Shu`ab al-Iman and al-Madkhal, Ibn `Abd al-Barr in Jami` Bayan al-`Ilm, and al-Khatib through three chains at the opening of his al-Rihla fi Talab al-Hadith (p. 71-76 #1-3) "Seek knowledge from the cradle to the grave." "Seeking knowledge is a duty upon every Muslim (male and female)." Quoted by Khalid El-Darymli, "Values, Technology and Society Islam and Science," (2005) http://www.slideshare.net/kkkseld/microsoft-word-the-project-islam-and-science/ (accessed 11/18/08), citing M. Husain Sadar 'Science and Islam: Is There a Conflict? in Z. Sardar, *The Touch of Midas: Islam, Values, and Environment in Islam and the West* (Manchester Univ. Press, 1984), p. 15.

[9] Abu'l-Wafa al-Buzjani, *Book on the Stations on What Scribes and Secretaries Need in the Science of Calculation*. See "Abu'l Wafa Mohammad b. Mohammad Buzjani" in *Encyclopedia Iranica*. (2008). http://www.iranica.com/newsite/index.isc?Article=http://www.iranica.com/newsite/articles/unicode/v1f4/v1f4a083.html. Accessed 11/17/08.

[10] Qur'an 21:18.

The kind of interference that the Church has on scientific affairs exemplified by the Galileo affair was the exception, not the rule, in Islam. It is so much of an exception that those who have tried to paint Islamic civilization as medieval in the sense of Christian civilizations only embarrassed themselves. One very good scholar contradicted himself when he tried to represent the burning of Ibn Rushd's books as an example of intolerance of science by the orthodoxy of twelfth century Spain, yet acknowledges that "some strictly scientific ones" were exempted.[11] He has missed the point that Ibn Rushd was persecuted for his philosophical views not for his scientific views. Of course, I am not defending the persecution of philosophers. Abu Yusuf should not have burned any of Ibn Rushd's books. I am only saying that to accuse Islam, or even Muslims, of having a problem with science is erroneous because to the degree that Ibn Rushd's work was purely scientific, it was not censored.

One element driving Islamic science that does not come directly from the Qur'an is the issue of proper citation. Islam had a major role in the development of citation in Hadith science. I said that authority plays a role in science, but in modern science authority may be questioned. Therefore it is very important that if I'm going to cite authority, I identify it clearly. If I write a scientific paper and cite Einstein as an authority, I have to state where and when he said whatever I attribute to him. I have to give you the book or journal in which he published it, the page number and so on. If I claim the transmission was personal rather than public, I still have to cite its origin. Did I talk to Einstein? Did his wife tell me? Did his son, or one of his colleagues claim to have spoken to Einstein on this matter? Anyone familiar with Hadith science recognizes the *isnâd* that is involved in that kind of personal communication. So the Hadith science made a model that was followed by the other sciences. This kind of care in citation was not part of Greek scholarship, so we should credit Islamic civilization for the contribution of this important part of the scientific method.

Now let me turn to the second point, the limitations of the literalist perspective. Some people try to use the Qur'an as a scientific text. This results in what I have called "Muslim pseudo-science." One writer has gone so far as to claim that the miraculous nature of the Qur'an is shown by the fact it has the speed of light to four decimal places.[12] The refutation of this claim is available on the Internet[13] and I have elsewhere made my own critique.[14] Here, I only wish to note that he Qur'an makes these allusions, and I have no doubt when I read the Qur'an that the Author of the Qur'an knows more science than anybody ever has. But I also have no doubt that He's not trying to teach science there. There is no way you can arrive at scientific knowledge by studying the Qur'an. What you do is study nature, acquire scientific knowledge and look at the Qur'an and say, "This book is consistent with what I have learned."

The third point is the complicated one, as it deals with the emerging post-modernist paradigm. The West went through a period of a couple of hundred years of materialism. When I say materialism, I don't mean everyone in the West was a materialist; I mean materialism was the dominant philosophy. If it wasn't accepted everywhere, it challenged everything that people believed and it was constantly in contention. Its rise was ironic, because the scientists who developed the scientific paradigm on which the materialist philosophy was later based were by-and-large believers. Isaac Newton was the most important of them and in the *General Scholium* appended to Newton's magnum opus, the Principia *Mathematica*, he testifies to his belief in God

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[11] Pervez Hoodbhoy, *Islam and Science: Religious Orthodoxy and the Battle for Rationality* London: Zed,1991),pp 114-5.

[12] Mansour Hassab-Elnaby, "A New Astronomical Qur'anic Method for the Determination of the Greatest Speed C," (5/1/01) http://www.55a.net/firas/english/?page=show_det&id=297 (accessed 11/22/2008).

[13] Attributed to Arnold Neumaier, "Review of A New Astronomical Quranic Method for The Determination Of The Greatest Speed C by Dr. Mansour Hassab-Elnaby," http://www.mat.univie.ac.at/~neum/sciandf/eng/c_in_quran.txt. Accessed 11/23/08.

[14] Ahmad, ch. 8.

in a way that is reminiscent of the Muslim belief.[15] We know from his religious writings that he rejected the trinity. We also know from his writings that he believed in God not just as the spirit of the world and not just as a Creator of the world who went away (an absent clockmaker as some have described it). Newton believed God is the Creator *and S*ustainer of the world *and* the Lord of the world, whom men worship as Lord, making him a theist not a deist.[16]

Now that was Newton's belief, but others looked at Newton's theories and said concluded that Newton and Galileo and these others developed a system for understanding the motion of the planets, and of the mechanics of the universe, all of physics, in a way that didn't require God's active intervention. Therefore, they argued, either God created the world and He went away, or maybe the world is always like this and we don't need to assume God's existence at all. As Laplace put it, "I have no need of this hypothesis."

This was the dominant paradigm, the dominant way of thinking, for centuries, until three major discoveries of the twentieth century undermined that paradigm. Taken together, relativity theory, chaos theory and quantum mechanics have destroyed the view of the universe as a three-dimensional billiard table. The last section of this paper attempts to sort out the legitimate and illegitimate associations between internal religion and new emerging science.

When I say it is emerging, I mean that while these things have been pretty well established in the scientific world, they have not yet totally seeped into the consciousness of the masses. Just as the idea that the earth goes around the sun was well established for scientists pretty quickly, common people didn't take it as common sense for a couple of hundred years. One of the things that I always enjoy with my students when I teach the course on this is when I say that the people believed the sun went around the earth, they laugh. I ask, "Why are you laughing? Is it self-evident to you that the earth goes around the sun? No, you were just raised in that belief so it seems self-evident, but it is not based on your personal experience." Then when I start explaining to them what we learn from quantum mechanics and relativity they are so shocked, so disbelieving, that I ask, "Do you feel like those people when it was first discovered the earth went around the sun?" Some day these things will become common sense, but not yet.

We are going to be looking at what the Qur'an calls the *ghaib* and the *shahâdah*, the hidden and the manifest, or the unseen and the seen. As previously noted, the problem with the classical mechanics of Newton was that it seemed to make the entire universe a billiards table, little billiards balls bouncing around. If you know their positions, their motions, and the laws of physics that govern them, then you can tell what they are going to do next. So, everything seems to be determined. If we are made up of matter, as we seem to be, then doesn't that say our actions are also determined? It seems as though everything has been determined. Even if Allah determined these rules when He set up the universe, as Newton believed, they allow no room for further divine intervention, which implies there can be no miracles. The billiard balls can only go a certain way. Allah, even if He wrote the rule on Himself, would seem to have written a rule that prevents miracles.

Furthermore, and very important for religious belief, where is the room for free will? How am I going to be held responsible for my actions when they have been pre-determined at the time of Creation? Whether I commit adultery or murder or any kind of sin is just the result of a lot of material particles moving in a certain way. Where is the justice in holding me responsible for the choices that seem to be impossible? In other words, where is the room for human will and for God's will? They seem to be absent in this mechanical universe.

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[15] See Ahmad, *Signs*, p. 122.

[16] Ibid.

The answer to this question of course is that physics and mechanics are not all there is to reality, but in this paradigm, people couldn't see where the room was for a non-physical action. Physics seemed to be taking up all the room for all the possible explanations for anything. However, we have the discovery of quantum mechanics and chaos theory and everything changed. As a complete discussion of chaos theory is beyond the scope of this paper,[17] I shall briefly discuss a single element of chaos theory, the Butterfly Effect.

The Butterfly Effect points to the fact that in general physical systems are extremely sensitive to small changes in the initial conditions. Even if it were true—which its not—that a given system's future is entirely determined by its present positions and motions, it turns out that the tiniest conceivable change in that present motion totally changes the future and makes it utterly unrecognizable, no matter how tiny that changes is. In other words, a butterfly's decision whether or not to flap its wings somewhere in Kansas right now could change the course of a storm in China six months from now. Miniscule changes like that can have such profound effects.

When combined with quantum mechanics, this hypersensitivity of physical systems to small changes relates to the discussion of religious issues such as human free will and divine intervention. Quantum mechanics seems to say that the premise that everything is determined from its initial state is false. On the quantum level, on the level of the tiniest subatomic particles, things are not determined. Picture an illustrative experiment: First, imagine that we have set up a machine gun randomly firing bullets in the general direction of a wall with two holes in it and behind that wall there is another wall. Obviously, the bullets tend to collect directly behind the holes in the near wall.

Now, imagine that you are watching a sea and there are some breakers, some kind of barriers. The outer barrier has two of holes in it, and as the waves comes in they are stopped by the barrier except for those two holes and the passing waves, as they come out of those two holes on the other side, interfere with one another. You will see the waves form an "interference pattern," so that as the waves crash against the inner, you would see that the highest waves are not the ones directly behind the two holes but in the middle between them, where the waves constructively interfere with one another. And then they get smaller and smaller as they go out. If there had only been one hole, then the wave would have been highest after that hole and the other one would be highest after the other one.

The question arises, what happens when you shine a light in the two holes. You do the same experiment, you have a thin barrier with two slits in it and you have a piece of film like the wall on the other side, and you record the light coming through both holes. It turns out that if both holes are open, the light pattern on the film will be like the wave pattern on the wall, an interference pattern; a lot of peaks and troughs in it, as if the light is made of waves interacting with one another. However, we understand light to come in the form of little particles called photons. If you close one of the slits, of course the light is brightest behind the slit. What happens if you take a piece of film and you close one slit at one time and the other slit at the other time and you let the light accumulate. What if you leave both slits open but shine one photon at a time over a long period of time so the total number of photons is very large. You do it one time randomly closing one or another of the slits and another time with both slits open. In the first instance you see the light collected behind the slits but in the second case you see an interference pattern. How does the light going through a slit "know" if the other side is open or closed? Why is it going to have one pattern if they are both open and a different pattern if one of them is closed? This is especially troubling in the light of relativity theory that says that you cannot have instant communication between distant things. How is this information transmitted? This is a serious question and the dominant interpretation of quantum mechanics that has been derived from this is, is that **you cannot know both the position and the momentum of a partial at the same**

[17] For lucid and accessible summary of chaos theory see James Gleick, *Chaos*: *Making a New Science* (New York: Viking Penguin, 1987).

time. It turns out you do the same experiment with electrons instead of photons, which you would normally think of as a particles rather than waves, and you get the same result. In other words, everything in the universe seems to be interacting with everything else in some kind of way, but in what way? Quantum mechanics has said that the wave involved here is a wave of probability of the particle's position and momentum, and that the position of a particle or the momentum of a particle do not actually exist until they are observed. There is only a probability that the particles are in a particular place or a probability the particle has a particular momentum. The only way you can ever hope to know the position and momentum of a particle is to observe it, but by doing so you affect the thing observed; and you change it. Thus, the answer to the question the question "What is it if I don't observe it?" is, "You can't know." Is the moon there when nobody is looking? We don't know. This is very shocking, very hard to believe, and it raises all kinds of questions.

Einstein was of the opinion that even if the position or momentum of a particle does not precisely exist at a particular moment, there must be some hidden variable that will determine what they are at a future moment, and that some day our physics will advance enough to determine what those variables are. Experiments have been done that prove conclusively that Einstein was at least partially wrong. There may be hidden variables but they are not what Einstein would call "local variables." They are not local to the particle. They may be global variables or transcendent variables, but they are beyond the locality of the time and space that you're talking about. And that has caused a crisis in the materialistic paradigm.

One physicist who tried to resolve this problem was David Bohm.[18] Bohm's very interesting approach boils down to this: Let us accept what is called "the Copenhagen interpretation" of quantum mechanics, that observables don't exist until we observe them. If this is true we must then assume that reality is divided into two parts, which he calls the "explicate" and the "implicate." The explicate is that which we can observe. The explicate is determined by the implicate which consists of that which we cannot observe, a whole realm of reality that is forever cut off from our senses. We can't know it in any way; we only see its effects as it affects the phenomenological world. What calls explicate and the implicate, we can call the *shahâdah* and *ghaib*.

One of the implications of this is that not everything is physics. The *shahâdah* is the consequence of the *ghaib*. The *ghaib* may not be physical. Of course, a materialist might say, of course it is material; it's only physics that is hidden from you. Maybe, or maybe not. Consider the following. Somebody walks into the room and I see its my friend Jamal and I reach out to embrace him. If it were some Islamophobe propagandist, my reaction would be different. What determines whether I stretch out my arms or not? In the classical mechanical school it was a bunch of atoms in my brain that move in certain patterns or not. Introspectively, it's my will; it's my decision. I'm happy to see my brother and I want to make a gesture towards him. Where, in physics, is the room for this will? In the emerging paradigm, whether a synapse in my head fires or not is at the quantum level and therefore it is not determined by physics, it would be determined by will. I can choose whether the synapse fires or not.

In chaos theory, a quantum difference such as whether a synapse fires or does not fire can lead to different chains of events in the macroscopic world, like whether I embrace someone I see or whether I turn away from him. These are questions of human will. There are implications for the divine will when we speak about the entire universe. A butterfly flapping its wings may determine whether or not a storm goes one way or another in China, but butterflies don't think, and therefore they don't make a decision in any meaningful sense. However, Allah makes such decisions. Therefore, the question how can one believe in the laws of physics and pray for divine intervention at the same time is not problematical. If Allah wants to answer your prayers, He can answer your prayers without contradicting the physical laws He Himself has decreed because quantum mechanics only tells you how things are going to behave in the collective, in other words

[18] See David Bohm, *Wholeness and the Implicate Order* (London: Routledge, 1981).

it gives you probabilities. It says certain things are improbable to a certain degree. Something only has a fifty-fifty chance of happening; something else has maybe a one in a quintillion chance of happening or one in a googol chance. The odds of all the air in this room will rise to the top half and we will suffocate to death is not zero, but it is so infinitesimally small that we can ignore it—unless Allah wills it to happen, in which case, we cannot ignore it. So now miraculous things like all the air in the room going to one side is not a violation of the laws of physics, it's just something very unusual. Or as the classical era Muslim scientist might have said, it's not the sunnah of Allah. Allah has a sunnah; he has a usual way of doing things. That's what quantum mechanics tells you, how Allah usually does things, but then in any given instance, Allah might do something else and it's not a violation of the laws of physics. It is totally consistent with the laws of physics.

My conclusion is that the revelatory and the scientific epistimes are not mutually exclusive alternatives but they are complimentary. The revelatory epistime gives us access to the hidden or implicate order, which cannot be known directly by our senses, but which Allah can choose to make known by the methods of revelation described by brother Mahmoud Ayoub.[19] Such revelations may even come in dreams, since the firing of a synapse in sleep is an obvious interface point between the explicit and implicate. Perhaps we need to be cautious about revelations in dreams, but there may be an infinite variety of means by which Allah may give us knowledge of the hidden so while we don't see the angels helping us as we fight our battles, Allah can tell us that they are there.

The latter approach, the scientific epistime provides us with an understanding of the manifest of the *shahâdah* that Allah does reveal to us through the cognitive process. In the Tawhidi worldview, both are sacred. I emphasize that very strongly because I take offense when people say "well the religious is sacred and the scientific is profane." The work of understanding the manifest, the explicate, the *shahâdah*, is as sacred as the work of as sacred as understanding the word and meaning of the holy text. The book of nature is a holy text as well, and understanding it is also an act of worship.

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[19] Mahmoud Ayoub, "Qur'an As Revelation," IIIT Summer Institute Proceedings, accepted for publication, 2009.