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THE RISE OF MODERN SCIENCE: ISLAM AND THE WEST

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Introduction

The rise of modern science has evoked responses from both Muslim and Western thinkers. Since science is a central feature of modernity, their responses to science can also be read as their responses to modernity. These intellectual responses can best be gauged through discourses in the history and philosophy of science since the 1970s.

Although the history and philosophy of science are commonly understood as academic disciplines that study science in its historical and philosophical aspects, discourse in the history and philosophy of science can nevertheless be seen as part of the wider discourse on modernity (Ravetz 1990; Rouse 1991). Scholars have attempted to define the meaning and content of modernity and what makes it different from pre- and postmodernity. Its essential features, among others, are: rationality, objectivity, empiricism, scientific method, the concept of progress, and secularism. As the modernists have associated these characteristics of modernity with science itself, the issues concerning modernity are therefore discussed in the academic discipline of the history and philosophy of science, in terms formulated by those who advocate and oppose modernism as ways of life and thought, respectively. To a certain extent, discourses on the history and philosophy of science sometimes reveal the contestation of ideas between modernists and anti- or non-modernists, and it is on this issue that the present essay shall dwell, albeit from a comparative perspective involving Islamic and Western thought.

Apart from the introduction and the conclusion, the main body of this article will be divided into three sections. The first section offers an exposition of Western philosophy of science in its two main forms, (1) positivist/modernist and (2) postpositivist/postmodernist. Postpositivist or postmodernist philosophy of science can be regarded as a reaction to positivistic and modernist philosophy of science. Such an exposition is necessary since discourse in Islamic philosophy of science cannot be understood independently of the Western background, given that Muslim thinkers such as Nasr, Sardar, and al-Faruqi are themselves in dialogue with

Western philosophy of science in articulating their own Islamic responses to science (Zaidi 2006). Also, it facilitates a comparison between Islamic and Western responses to science, and consequently toward modernity.

The second section deals with the responses of Muslim thinkers toward science, especially attempts at “Islamizing” science by Nasr, al-Attas, al-Faruqi, and Sardar, and criticisms toward such an enterprise. The discussion on the Islamization of science will be brought up to date by looking at its continuation by the “new generation” of discussants on the subject after the 1990s (Bigliardi 2014, pp. 173–176).

The third section is devoted to examining the responses made by Muslim thinkers toward science in comparison with their Western counterparts. Similarities and differences in their responses will be identified, highlighted, and commented on. Such a cross-cultural comparison helps to elucidate the (nuanced) nature of two different civilizational responses not only toward science but also toward modernity, given the central position of science in contemporary culture and society.

The Modernist Philosophy of Science

If we turn to philosophy of science, we can see that up to the 1960s it was dominated and influenced by those modernists who sought to portray a positivistic image of science. In this conception, science is regarded as objective, rational, progressive, and true. The most influential proponents of this conception are the Logical Positivists and Karl Popper. Despite the fact that Popper regards himself as a vehement opponent of logical positivism, he shares the same aim with the positivists in upholding the supremacy of science. Thus, the projected image of science is closely tied to modernism. In fact it can be said that modernism itself reflects the positivistic image of science. And this is a common picture throughout the modern intellectual tradition of the West. If we turn to the Enlightenment, we can see the exalted status of rationality, logical argument, and empirical evidence. All these characteristics are associated with science, and science in turn is considered the manifestation of them. Religious knowledge and authority has been put aside as it gives way to the newly found humanism.

The modernist perspectives on philosophy of science, albeit their internal differences, have the same aim: to support the Enlightenment ideal of the superiority of science. Among the prominent figures in this school are the logical positivists, Karl Popper, and Imre Lakatos. The positivists are the first to attempt to develop a philosophy and image of science compatible with the twentieth-century conception of science. Like all other attempts, this particular one has its own weaknesses, which Popper tries to solve with his falsificationist philosophy of science. This new philosophy by Popper in turn has its own weaknesses, triggering a new theory proposed by Lakatos in order to solve the problem.

Logical Positivism

The logical positivists, led by figures such as Moritz Schlick, Otto Neurath, and Rudolf Carnap, entered the scene around the 1920s, and are well known as the

Vienna Circle (Ayer 1984, pp. 121–130). Their aim was to develop a philosophical conception of science that would establish the epistemological superiority of modern science over other forms of knowledge. In their conception, epistemologically, science is based on two foundations: logic and empiricism. To them, science obviously meets the criteria of valid knowledge, while other approaches do not. For instance, religion and myth refer to the supernatural world, which cannot be verified empirically. It is obvious that the eighteenth-century Enlightenment ideals are still preserved and continued through logical positivism in its privileging of science and reason and its rejection of dogma and tradition. As science is built on a firm empirical and a strong logical foundation, its epistemological status is therefore unchallenged.

The logical positivist attempt at privileging science involves the rejection of metaphysics from science. Metaphysical statements, being neither analytic nor synthetic, cannot be accepted as knowledge. Metaphysics is rejected not because it is false, but because it is considered meaningless based on the logical positivist criteria of meaning. Therefore all non-scientific knowledge—including religion—is considered devoid of cognitive content.

One of the tasks of the logical positivists was to free science from metaphysics, and this was done by interpreting theoretical statements in terms of observation statements. The most prominent example is the use of Ramsey sentences and Craig's theorem, where theoretical terms are given empirical expressions so that they will not refer to anything beyond our senses.

The positivists' program is not limited to the natural sciences alone, but, through the idea of "the unity of science," it has attempted to "scientize" other forms of knowledge—such as psychology, sociology, and economics—that are regarded as having a "unity" with the natural sciences in terms of their methodology and logical structure (Sorrell 1991, pp. 12–15).

In short, their program is aimed at extending and integrating eighteenth-century Enlightenment ideals, nineteenth-century Comtean positivism, and the twentieth-century logicism of philosophers of mathematics such as Russell and Hilbert. The philosophical program of the logical positivists has wider cultural implications as well. It attempts to provide a philosophical basis for a modernist culture based on science, which supposedly epitomizes rationality and universality.

Karl Popper's Philosophy of Science

Critical of logical positivism, especially its failure to censure the "pseudo-sciences" and prevent them from claiming scientific status, Karl Popper developed a new philosophy of science based on the concept of falsification, according to which a theory can only be regarded as scientific if and only if it is falsifiable. Any statement or hypothesis that can only be proven true, but not false, is considered unscientific. This falsification criterion is intended to distinguish or demarcate between science and pseudo-science. If the positivists were obsessed with establishing a criterion for meaningful discourse, Popper's obsession now lies in preventing pseudo-sciences such as Psychoanalysis and Marxist Social Theory from claiming scientific status. For

Popper, linguistic analysis of science as practiced by the positivists has failed to prevent such knowledge as psychoanalysis and astrology from claiming scientific status since they are also able to meet the criterion of empirical verification through the support given by empirical data.

However, despite Popper's efforts at differentiating his own philosophy of science from logical positivism, their differences lie mainly in matters of emphasis rather than orientation. They both share Enlightenment ideals with regard to science, and work toward the philosophical privileging of science. They differ in terms of means rather than ends. Popper claimed that the inductive methodology adopted by the logical positivists failed to provide epistemic justification for science, or prevent pseudo-sciences from claiming scientific status. Instead, by using deductive logic and certain empiricist principles, he hoped to reclaim that epistemic justification back to science. Another novel approach adopted by Popper in his philosophy of science was his attention to the problem of theory change in science, which is neglected by the positivists, as they are much more interested in studying the structure of science and not its dynamics. Popper tried to show that theory change in science in fact shows the rationality of science itself, and should not be taken as a sign of its instability. Popper's philosophy was influential during the 1960s and 1970s, and temporarily secured the modernist image of science. Critics of science argued that science cannot provide us with certainty since scientific knowledge may change, as the history of science has shown. Popper, however, turned the tables and argued that scientific change is a sign of its strength rather than weakness. Scientific change shows the rationality of science, and that change implies progression toward the truth. Again, we can see the way in which the modernist image of science and its status are defended. The modernist character of Popper's philosophy of science is obvious in his effort to defend the concept of science as rational and true.

Postpositivist Critiques of the Modernist Image of Science: Kuhn and Feyerabend

If the Logical Positivists and Karl Popper can be cast into the "positivist" or "modernist" mould, critics of science such as Kuhn and Feyerabend can be classified as distinctively "postpositivistic." Their philosophies of science are critical of both logical positivism and Karl Popper, and present an image of science that radically differs from the positivistic or the modernist.

Kuhn (1970) adopts a historical approach in his philosophy of science, and maintains the importance of historical perspective in understanding the real nature of science. To him, what has been said by the philosophers of science is nothing more than an idealization that cannot be supported by evidence from the history of science. If we look into the history of science, it would be apparent that the image of science projected by the logical positivist or Karl Popper has strayed away from real science. This new historical factor introduced by Kuhn has more or less challenged the previously ahistorical philosophical analysis of science. In his *The Structure of Scientific Revolutions* ([1962] 1970), Kuhn shows, by using history of science, that the process of paradigm shifts in science does not occur based on rational factors, but

rather on non-rational factors such as psychology and sociology. He also argues that the concept of scientific change as a progression is indefensible, due to the fact that scientific paradigms are incommensurable and therefore cannot be evaluated. Furthermore, such changes, as with the evolution of species in Darwin's theory, have no objective aim and thereby do not move toward any specific direction such as "true theory," as pointed out by Popper. This view, which rejected the modernist image of science as rational, objective, true, and progressive, is the precursor of a more critical approach toward science, as initiated by the postmodernists later on.

Another vehement critic of the modernist image of science is Paul Feyerabend. He criticizes the view that there are certain "methodological rules" that are responsible for scientific success (Feyerabend 1978, p. 14). He also criticizes the view that the supremacy of science lies in its rules, that is, the scientific method. According to Feyerabend, there is no such thing as a scientific method; it is nothing more than a myth made up by the rationalists. He tries to dispel such myths by showing that science progresses in spite of the so-called scientific method. Using the history of sixteenth- and seventeenth-century astronomy in support of his claim, he tries to show how progress in astronomy was achieved by "violating" the so-called methodological rules of the scientific method.

Feyerabend's criticism of the theory of scientific method has a broader aim: to deny the privileged status of science in contemporary Western culture. In his view, science has become dogmatic and ideological, and leaves no room for other traditions or life-forms to co-exist in modern society (Feyerabend 1982). In order to break science's stranglehold on modern society, it is imperative to criticize the assumption that there is a special method used by scientists. Feyerabend's antidote to the totalitarian dominance of science over other traditions is to adopt pluralism in its widest sense, that is, theoretical and methodological as well as epistemological pluralism. Thus, it is appropriate to suggest that Feyerabend's polemics on the nature of the scientific method and the advocacy of pluralism is a strategy aimed at de-privileging science.

Pertinent questions can be raised at this juncture. What are the implications for such critiques of science for the Muslim thinker who is bent on privileging the Islamic approach toward science? Are such critiques to be welcomed, or should similar skepticism be heaped on them? The responses are admittedly varied; thinkers such as Sardar are sympathetic and even take advantage of such critiques, while mystically inclined philosophers such as Nasr and al-Attas would have no truck with the relativism and humanism of such Western critics of science.

Postmodernist Critique against Science and Modernity

The postmodernists are indeed a motley crowd consisting of existentialists, phenomenologists, deconstructionists, and social constructivists. What qualifies and unites them as "postmodernists" is their rejection of modernism and the values associated with it. The postmodernist range of influence is rather comprehensive, and it includes such fields as literature, art, philosophy, the social sciences, politics, architecture,

and culture (Best and Kellner 1997). However, our interest here is confined to its influence on the history and philosophy of science. Historically, it has influenced the growth of philosophy of science since the 1970s, beginning with critiques of science by Kuhn, Feyerabend, and the Edinburgh School. For them and subsequent critics, science no longer has any special epistemic status over other forms of knowledge. The postmodernists even question the validity of science itself as it symbolizes hegemony and logocentrism, which they oppose.

In the field of history and philosophy of science, postmodernist writings take many forms. Some of them have been influenced by Continental phenomenology, while others are influenced by Richard Rorty, Wittgenstein's philosophy of language, Social Constructivism, and Deconstruction. They generally refuse to accept the modernist image of science as objective, rational, and true. The essential features of postmodernism, among others, are as follows (see Hart 2004; Best and Kellner 1997, Gellner 1992):

1. It accepts relativism, while rejecting absolute truth.
2. It opposes grand narratives and promotes local knowledge, by which it rejects universal and foundational theories of science as promoted by logical positivism.
3. It rejects the view that language has a fixed, unique, and objective reference, a rejection expounded by Wittgenstein in the 1950s that has since influenced the postmodernist view on the relationship between language and reality.
4. It refuses the binary opposition or dichotomy that draws a strict distinction between two concepts such as East and West, man and nature, objective and subjective, theory and observation, and so forth.
5. It rejects essentialism, that is, the view that there is a set of independent characteristics or properties all of which any entity must possess. In contrast, it proposes anti-essentialism or constructivism, which regards entities as conceptual constructivism, which has no referents with essential or universal qualities.

Social constructivists, for example, do not regard science as reflecting the truth about the natural world, but as a form of knowledge that is socially constructed. For example, Shapin and Schaffer in their *Leviathan and the Air-Pump* (1985) tried to show how politics influenced the use of experimental methods in the study of gas phenomena in seventeenth-century England. It should be noted that such historical studies have an epistemological goal, namely to show, through historical narratives, how external factors influence the formation of science. In this way they try to demonstrate that science is not an objective reflection of nature, but rather a human invention in which human interests are incorporated.

For the purposes of this essay, our interest in postmodernism lies in its critique of science, which for the former epitomizes modernity. It is interesting to see the nature and basis of the postmodernist critique, and later on to compare it with Islamic critiques of science.

The Discourse on Islamic Philosophy of Science

It should be noted at the outset that the themes discussed in the discourse on Islamic philosophy of science are by and large the same as in its Western counterpart. However, the main issue and approach as well as the tentative solutions are somewhat different. This difference is due to the underlying Islamic perspectives, which act as guiding principles in dealing with modern science. In fact, the notion of Islamic science is a response to the encounter between modern science and Islam, which has brought about the present crisis in the Islamic world. This crisis is due to the contradiction between modern science and traditional knowledge, otherwise known as *al-'ilm* or *scientia sacra* (Nasr 1994). Modern science is widely regarded as the best form of knowledge of the natural world independent of any metaphysical or spiritual element. As a response to this prevailing secular conception of science, some Muslim intellectuals have attempted to provide a concept of science that is consistent with the ideals and values of Islam, and to which the term "Islamic science" refers. However, there is consensus neither on what constitutes Islamization nor on what is meant by the term "Islamic science" (Abbott and Gregorios-Pipas 2010, p. 136).

Generally, there are two different views of the meaning of Islamic science: (1) Islamic science in terms of its history, and (2) Islamic science as a program of the Islamization of science itself. The first puts an emphasis on science as it was developed during the heyday of Islamic civilization. Western scholars have equated this kind of science with the science that flourished, for example, in the civilizations of Greece, China, and India. The second emphasizes the Islamic perspective on science itself. This perspective on science is widely expounded by Muslim intellectuals such as Seyyed Hossein Nasr and Syed Naquib al-Attas, and it is on this latter notion of Islamic science that we shall dwell in this section. Islamic science is seen as a form of science that is in harmony with the religious principles of Islam. The aim of the discourse on Islamization of knowledge/science is to recast contemporary knowledge/science so as to be consistent with Islamic principles and in harmony with the different cultures within the Islamic world.

Seyyed Hossein Nasr on Islamic Science

The first scholar we shall discuss is the Iranian American scholar Seyyed Hossein Nasr, who was one of the earliest to promote the concept of Islamic science. Among the Muslim commentators on science, Nasr is one of the few who has an extensive knowledge and mastery of modern science. Throughout his works Nasr takes a resolute stance and insists on questioning the received meaning of modern science, its historical formation, its philosophical premises and claims, and the environmental crises brought about by the unquestioned acceptance of modern science and technology. The root problem in the environmental crisis is the spiritual crisis in man (Nasr 1990), and therefore the only solution to the environmental crisis is to return to the traditional *scientia sacra*.

The most important aspect of Nasr's critique of modern science lies in the fact that it has declared its independence from metaphysics, by which it refuses to accept the authority that would establish the boundary of its legitimate activity (Nasr 1989, p. 179). From this attitude it has developed a complete and totalitarian philosophy that rejects the hierarchies of being and knowledge and reduced all reality to a single psychophysical domain and denies the existence of non-scientific worldviews (Nasr 1990). Metaphysical truths have been rejected in favor of scientific knowledge. It is also through this attitude that modern science has divorced itself from the sacred, which is regarded as meaningless in the secular worldview of science. Thus, Nasr's highly critical stance toward modern science can best be understood in the light of his notion of sacred science, which he describes as "the application of the supreme knowledge of the One and the Absolute to the plane of relative existence" (Nasr 2001a, p. 465). In other words, it is the Supreme Science or metaphysics that deals with the Divine Principle and its manifestations in the light of that Principle (Nasr 1993, p. 1). On the other hand, Nasr insists that science has been "desacralized" and "compartmentalized" (Bigliardi 2014, p. 169).

In his notion of Islamic science, Nasr construes that the natural sciences as developed by Muslim scientists are based on a meticulous and analytic study of nature within the matrix of Islamic revelation. The kernel of this revelation is *Tawhid*, the principle of unity that underlies the unity and interrelatedness of the world of nature (Bigliardi 2014, p. 169). For Nasr, the primary goal of Islamic science is to unveil this underlying unity and to show "the unity and interrelatedness of all that exists" (Nasr 2001b, p. 22). Seen from this standpoint, reality presents itself to us as a well-knit whole in which the individual objects that form the subject matter of science are located (ibid., p. 25). It is also from this specific vantage point that Nasr regards modern science as an anomaly since it has considered nature as a completely independent and autonomous order. Instead, according to Nasr, the natural sciences in Islamic and other Oriental civilizations are always cultivated within an order that is dominated by hierarchy and integration, and subsumed within some form of divinity (Nasr 2001a, p. 464).

From the foregoing brief analysis of Nasr's metaphysical and traditional religious views of science, it is therefore appropriate to suggest that his critique of modern science is marked off from the other prevailing criticisms by his appeal to divinity and metaphysics. We shall now turn to Syed Muhammad Naquib al-Attas.

Syed Muhammad Naquib al-Attas on Islamic Science

The second scholar is the Malaysian Syed Muhammad Naquib al-Attas, who is also one of the most prominent proponents of Islamic philosophy of science. Unlike Nasr, however, he launches his critique of modern science through a critique of secularism. According to al-Attas, secularism is the product of a long history of philosophical and metaphysical conflict in the worldview of Western man (al-Attas 1993, p. 20).

Al-Attas traces the genealogy of secularism in the West back to the misapplication of Greek philosophy in Western theology and metaphysics, which logically led to the Renaissance in the fifteenth and sixteenth centuries. Then, in the seventeenth century, it led to the scientific revolution, and subsequently, in the eighteenth and nineteenth centuries and in our own time, to atheism and agnosticism, to utilitarianism, dialectical materialism, evolutionism, and historicism. According to al-Attas, the intrinsic element in secularization is the disenchantment of nature. This concept is borrowed from the German sociologist Max Weber:

[It is] the freeing of nature from its religious overtones; and this involves the dispelling of animistic spirits and gods and magic from the natural world, separating it from God and distinguishing man from it, so that man may no longer regard nature as a divine entity, which thus allows him to act freely upon nature, to make use of it according to his needs and plans, and hence create historical change and "development." (al-Attas 1993, p. 18)

It should be noted that al-Attas maintains that religion is not opposed to the desacralization of nature if it means the elimination from our understanding of a magical or mythical conception of nature. It is only opposed to desacralization if it means the obliteration of all spiritual meaning in our understanding of nature as advocated by secular philosophies and science (al-Attas 2001, p. 113). As modern science is one of the products of the process of secularization, al-Attas suggests that we should critically examine

the methods of modern science; its concepts, presuppositions, and symbols; its empirical and rational aspects, and those impinging upon values and ethics; its interpretation of origins; its theory of knowledge; its presuppositions on the existence of an external world, of the uniformity of nature, and of the rationality of natural processes; its theory of the universe; its classification of the sciences; its limitations and inter-relations with one [or] another of the sciences, and its social relations. (al-Attas 2001, p. 114)

From his critical examination, and based on the standpoint of the Islamic philosophical and scientific tradition as integrated into a coherent metaphysical system, al-Attas maintains that there are several important similarities found between the Islamic standpoint and modern philosophy and science with regard to their external aspects, for example in terms of the sources of knowledge; the unity of the rational and empirical ways of knowing; the combination of realism, idealism, and pragmatism as the cognitive foundation of a philosophy of science; and the philosophy and science of process (al-Attas 2001, pp. 117–118).

There are, however, some fundamental and irreconcilable differences between Islamic and Western concepts of philosophy of science. The most profound difference is that Islamic philosophy of science regards Revelation as the source of knowledge of ultimate reality and truth, the source that provides the foundation for a metaphysical framework in which we can expound our philosophy of science as an integrated system descriptive of that reality and truth in a way that is not open to the methods of the secular philosophic rationalism and philosophic empiricism of

modern philosophy and science (al-Attas 2001, p. 118). Other points of difference between both concepts of science lie in the problems of the sources and methods of knowledge. In contrast to the Western view on science, al-Attas maintains that according to the Islamic perspective on science “knowledge comes from God and is acquired through the channels of the sound senses, true report based on authority, sound reason, and intuition” (al-Attas 2001, p. 118).

Ismail al-Faruqi on Islam, Science, and Modernity

The third scholar, Ismail al-Faruqi, an Arab American, emphasizes the concept of monotheism and the essence of Islam; principles that he believes are capable of being translated in the formulation of knowledge. Thus, al-Faruqi strongly advocates that Muslims must master all disciplines of modern knowledge, and then integrate them with the Islamic worldview (al-Faruqi 1982). Besides that, with a “strong pragmatic penchant” and political concern (Bigliardi 2014, p. 170), he sees the importance of re-discovering Islamic principles and recasting science according to the Islamic worldview. He also believes that in the relationship between science and modernization, there is an epistemological gap that needs to be filled by Islamic thought, to enable science to be practiced in human life in an Islamic way. Islam provides a strong foundation based on rationality and a critical approach that is proven by the success of Islamic science in the history of Islamic civilization. Islam also provides a strong basis for a constructive dialogue that allows human consciousness to create a new world based on the importance of obedience to God.

Al-Faruqi is devoted to bringing Muslims back to a true understanding of Islam, the divine unity and its implications for community life. The essence of Islam is monotheism, which represents the whole essence and foundation of Islam. In his *Al-Tawhid: Its Implications for Thought and Life* (al-Faruqi 1992), he tries to explain the fundamental doctrines of Islam from various interrelated perspectives such as history, comparative religion, anthropology, philosophy, ethics, epistemology, and archaeology.

Al-Faruqi rejects the reductionistic notion of a reality based on the view that science is only grounded on empirical data, and that the axiology behind it is irrelevant. This is not true, because there is no separation between the empirical and the axiological in real life. Furthermore, with the rise of utilitarian science after the Second World War, science did not have as its main objective the search for truth about nature, but only a scientific investigation using specific technologies to meet human needs. This change in the attitude of scientists has also had an impact on the environment, causing the current environmental crisis to worsen. Al-Faruqi also asserts that there are major differences in the nature of Islamic science as compared to Western science that have to do with the concept of divinity and the consequences for nature of human activity (Miriam Abdul Halim 2007, p. 35). Thus, in the Islamic worldview science is not autonomous but has a strong relationship with the Muslim faith and should be practiced in accordance with the moral and ethical guidelines given by God.

The fourth scholar is the British Pakistani Ziauddin Sardar. He views science as a tool for solving the problems of civilization; without science a civilization cannot maintain political and social structures and cannot meet its basic needs (Stenberg 1996, p. 69). Sardar puts an emphasis on science as a cultural phenomenon. Every culture has a different view of the nature of science, and exerts its own influence on science and society in order to address specific problems. Thus, science has been subjected to cultural influences; different cultures have produced different forms of science (Sardar 1977, p. 28). This also applies to Western science, which inherits those characteristics of Western civilization that emphasize the attribute of rationality. In short, Sardar views science as socially constructed and instrumental in the solution of practical problems (Bigliardi 2014, p. 169).

Sardar also characterizes science as a type of human activity aimed at acquiring knowledge by using specific methodologies. As such, it can be considered a cultural activity that is directly shaped by the worldview of the agents who are actively carrying out the activity, namely the scientists. Moreover, Sardar also argues that science is not value-free and that the activities carried out by the scientists themselves are highly dependent on, and guided by, a set of values framed in the context of a particular view of nature. Therefore, the framework required by Islamic scientists is one that should be able to guide scientific research activities in a manner that is ethical and avoids causing a crisis. When looking at science as a cultural activity, Sardar realizes that Muslims should develop an Islamic science based on the values of Islamic culture and applicable to Islamic society. This is very different from Western science, which exalts rationality and freedom while it ignores the question of ethics in the application of science. Science is also oblivious to moral issues involving questions of right and wrong conduct; such questions cannot be answered by modern science because of its neutrality. In this case, the determination of how to use scientific knowledge is to a great extent dependent on and driven by its users; ethical aspects play an important role in helping the user to determine what is good and bad in the use of scientific knowledge.

Sardar further claims that modern science is a product of Western culture and Western values and represents a cultural phenomenon that is very different from the values and culture of Islam. Islamic science advocates a holistic concept of science and a close unity between man, knowledge, and values that cannot be denied. Sardar also describes the epistemology of science from an Islamic perspective, drawing on the work of the influential medieval thinker al-Ghazali (Sardar 1977, p. 30). Sardar uses history to understand the development of ideas regarding the concept of epistemology in Islam while at the same time studying the philosophy of Western science.

The epistemology of Islamic science is like a tree with many branches, where the branches represent a wide range of scientific disciplines. From this perspective, knowledge is divided into three main categories: (1) revealed and non-revealed; (2) the levels of obligation, such as *fardhu ain* (obligatory on every individual like

prayers, fasting) and *fardhu kifayah* (collective obligation—knowledge that Muslims should obtain for their society for their survival in this world, such as knowledge on science and technology); and (3) social function, that is, whether knowledge is used for good or bad. Sardar thinks that al-Ghazali's epistemological framework did not separate science from humanity; the practice of science is a combination of knowledge obtained from human activities in various scientific disciplines and ethical principles based on revelation. Thus, science should be connected with society, and science must be able to achieve higher goals for a virtuous life. The problem of the relationship between science and Islam is not due to weakness in religion, because religion has always encouraged the quest for knowledge; rather the problem arises from the actual practice of science itself. The reconstruction of Islamic science is based on the Qur'an and Sunnah, and "Muslims need to evolve their own paradigms and innovate appropriate disciplines within the conceptual and value framework of Islam" (Ahsan et al. 2013, p. 33).

An appropriate value system in relation to science is an important element in solving problems within the framework of Islam in order to avoid negative consequences from science. Sardar and his group, referred to as Ijmali, identified ten key concepts that can be translated into a value system that can be practiced in scientific research, namely *tawhid*, *khilafa* (vicegerency), *ibadah* (worship), *'ilm* (knowledge), *halal* (lawful), *haram* (forbidden), *'adl* (social justice), *istislah* (public interest), *zalim* (avoidance of tyranny), and *diya* (avoidance of wastefulness). This approach helps to build a value system that connects scientific activities and takes into account the social responsibilities of scientists. These values will directly shape the activities of science and technology (Sardar 1991, p. 9).

Reconciling Science and Islam: New Generations

The contemporary debate about science, Islam, and modernity as discussed by Nasr, Naquib, al-Faruqi, and Sardar is a critical issue whose resolution is important in determining the attitude of Muslims toward science. Nevertheless, this discourse has undergone a significant change compared with the discourse carried out by those just mentioned, who are classified by Bigliardi (2014) as the "old generation." This discourse is now continued by a new group of scholars such as the Iranian physicist Golshani, the Iraqi physicist Altaie, the French astrophysicist Guiderdoni, and the Algerian astrophysicist Guessoum. They share the same goal of protecting and advancing science and technology in the Muslim world, but while adopting different paradigms. In labeling these new figures the "new generation," Bigliardi outlines three major differences in their discourse compared to the old generation.

First, the younger generation try to harmonize science and Islam, but according to the rules and dynamics of existing science, and they do not have the goal of reshaping the methodology or science itself.

Second, the older generation are more inclined to use a syncretic approach that takes elements from various traditions that are then "incorporated and assigned new positions within a basically Islamic conceptual framework" (Bigliardi 2014, p. 175),

such as found in the works of Nasr. However, there are also scholars among the old generation who take an exclusive approach, for instance Bucaille, who tries to highlight the superiority of Islam and the Qur'an with respect to science, over and above other religious traditions. These approaches differ from the approach taken by the new generation, who attempt to avoid taking either extremes in discussing the relationship between science and Islam.

Third, the basis for discussion presented by the old generation in discussing scientific issues derives from philosophy of science, and refers to philosophers such as Kuhn and Popper. On the other hand, the new generation mainly draw on their scientific expertise rather than philosophy in discussing science and religion.

Thus, it can be seen in general that there is a "conceptual and methodological shift at work" in discussing science and Islam (Bigliardi 2014, p. 176). The new generation tend "to take full account of the scientific discoveries and methods" to benefit Islam and the Muslim community or ummah (Guessoum 2011, p. 354). For instance, some Muslim scientists take an accommodating approach in accepting the theory of evolution as a scientific theory in order to understand natural selection as a specific mechanism to explain the diversity of organisms (ibid.). But Muslim scientists should understand that the challenges posed by the contemporary scientific culture and modernity have no similarity or precedent in pre-modern societies, and certain contemporary scientific issues were not addressed during the Golden Age of Islamic civilization (Dallal 2010; Iqbal 2009):

When confronted with the realities of modernity, including not just highly complex technologies but also developed and complex ethical debates about science and technology, Muslims cannot formulate their views on science in isolation from the world around them, nor is it desirable for them to do so. (Dallal 2010, p. 176)

Views of Critics of the Islamization of Science

The efforts of Muslim scholars to meet the challenge posed by modern science by introducing the concept of the Islamization of science have met with criticism. The Nobel Laureate Abdus Salam and his protégé Pervez Hoodbhoy believe that science is universal and objective (Salam 1986; Hoodbhoy 1992) and not bound to culture or religion. Furthermore, what scientists discover about the truth of physical reality would be universally true (Paya 2013, p. 162). These critics adopt the modernist approach to science, technology, and Islam, and try to adapt modern science to meet the contemporary needs of the ummah. Furthermore, the science practiced in Islamic countries should not differ from Western science. In his book *Islam and Science: Religious Orthodoxy and the Battle for Rationality* (1992, pp. 77–84), Hoodbhoy argues that efforts to form a new Islamic scientific epistemology have failed, and there is not much new scientific content discussed in the discourse. However, Salam and Hoodbhoy do not deny the importance of both science and religion, but assign different functions to them so as to allow science and religion to develop in different directions (Guessoum 2011). They seem to be pragmatic, insisting that sci-

ence is science and religion is religion, and both are preserved separately (Inayatullah 1996, p. 338).

The discourse on Islamic science does not help the move toward practical consequences (Hoodbhoy 1992; Paya 2013) such as developing technology or the manufacturing of medicines. Instead, the issues highlighted by the scholars of Islamic science are more directed to issues that are outside the realm of scientific practice such as the construction of an Islamic metaphysical framework involving different interpretations of metaphysical principles by different thinkers (Paya 2013). Hoodbhoy also criticizes the approach presented by Sardar and Nasr because they are not practicing scientists. Although some aspects of their work in the history of science are relevant for scientific practice, they are not aware about how contemporary scientific activities work (Lotfalian 1999, p. 142). Even if science is produced locally and is influenced by its local context, it can still be applied universally. For example, although the discovery of the anthrax vaccine was based on the pioneering work of Louis Pasteur in France, and that of polio by Jonas Salk in the United States, the basic science is nevertheless applicable worldwide. Similarly, Ptolemy's model not only laid the foundations of astronomy in ancient Greece, but also influenced Arab-Islamic science. Therefore, science is not a localized phenomenon, but rather transcultural and transnational (Huff 1996).

Concluding Remarks

Philosophical discourses on science have been conducted by both Western and Muslim intellectuals over the last several decades. Here, we have looked at the discourses separately as they have occurred in the Western and Islamic worlds, focusing on the issues that are dealt with by each group in their own separate domains of discourse. From there we moved to establishing connections between the two domains of discourse by comparing them and finding out the similarities and differences. Such an exercise is useful in that it helps us understand how science is viewed in the two worlds, and consequently in attitudes toward modernity, given the central role of science in modernity. In attempting to make such intercultural comparisons and connections, we are equally aware of the intracultural differences existing within both the Western and Islamic worlds in their conception of science.

In the West, the contest is between the "modernists" and the "postmodernists" as exhibited through the so-called "science wars." In the Islamic world, it is between supporters of "Islamic science" and those who are against this idea. Both postmodernists and supporters of "Islamic science" share a common ground by virtue of their critique of modern science. However, the epistemological foundations upon which such critiques are launched differ markedly. The postmodernists celebrate relativism and reject essentialism or the existence of an absolute truth. Muslim thinkers, on the other hand, reject relativism but embrace essentialism, on the grounds that Islam provides absolute Truth. "Islamic exceptionalism" is what disables the Muslim mind from accepting relativism/postmodernism, as well as a privileged epistemological position for science. This religious character of the Muslim critique of science

might appear “medievalist” to the Western mind, since the latter has moved beyond medievalism in their cultural and intellectual history. To the Muslim, however, the historian’s chronological classification of human history into ancient, medieval, and modern is itself an indication of (Western) modernity’s victory over its past, to which the Muslim need not be a party. On the other hand, Western critiques of science—especially postmodernist and postpositivist critiques—are based not on religion but instead on secular humanistic philosophies that have evolved from the Western intellectual tradition. The battle between the modernist and the postmodernist, for instance, seems to be a replay of the battle between Enlightenment and counter-Enlightenment thought in eighteenth- and nineteenth-century Europe.

Thus an examination of the philosophical discourses on science as they have occurred in both the Western and Islamic worlds helps us understand the attitudes and responses toward modernity in both cultures. In the West, given the decline of religion, a critique of science and modernity can only mean a return to humanism and the celebration of humanistic values over what is perceived as a scientific culture. In Islam, a critique of science and modernity signifies a return to the Muslim’s religious roots. Despite the apparent difference, they can both be viewed in a similar light, that is, as forms of re-enchantment in a disenchanted modern world.

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