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## The Role of Faith and Science in the Development of Civilisations

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The philosopher Herbert Spencer argued that science is organised knowledge.<sup>1</sup> Science is a system where beliefs are based on objective methodology and logical reasons designed to analyse the experience of reality. Faith means complete trust or confidence in someone or something based on spiritual apprehension rather than proof. Science with faith creates a vision and both these aspects of human thinking and experience can be necessary for human life while neither is adequate on its own. Einstein said that "Religion without science is blind; while science without religion is lame." Here, we are saying that science with faith is a vision. Language incorporates concepts which interpret human experiences; however some languages maps better onto the experience of reality than others. Human observation entails interpretation and a choice of perspective while there can be different perspectives on a single reality. As an example, three famous scientists observed a falling stone in different historical periods: the ancient Greek philosopher Aristotle believed that no force was needed for moving a stone as it was moving naturally. Newton saw motion caused by the force of gravity by the earth and Albert Einstein saw a warp in space-time introduced by the presence of a large mass- the earth. The concepts of physics and the word for inertia had not been invented at the time of the Ancient Greek philosopher but appeared in Newton's physics. Although reason makes sense of our experiences and relates them to our world-view, assumptions underlay that world-view and have an influence beyond pure experience and reason, requiring faith to accept something that is not strictly provable. Nevertheless, reason using wrong assumptions will result in wrong answers.

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1 UNESCO, 2002, *International Bureau of Education*, 24: 3/4, (1994), 533-54.

The first chapter, or the first verse revealed to Prophet Muhammad in the Qur'an interestingly says: "Read in the Name of the Lord and Cherisher {قُلْ اٰخِذْ يَدِيْذَلَّا كَبَّرْ مَّشَارِ اَرْقَا} and then it goes on to say; "He who had taught the use of the pen, taught men that which was unknown to him."<sup>2</sup> In this part of Quran, both scientific methodology and a religious belief were integrated together by using "taught by the pen" and "the Lord created the man" respectively to lead to the result that it "taught a man that which he knew not". There is also another verse of the Qur'an, the most conscious of Allah are the knowledgeable, the scientists (نُمِّهَ لَّا شَيْ خِي اَمِّ) (عَمَّا لَعَلَّ وِدَابِع).<sup>3</sup> That is a fundamental starting point about knowledge. Do we create knowledge or do we discover knowledge? How does all this relate to religion? The human being has a mind to imagine, enquire, study and understand the Creator or the Initiator of the universe with a mind and heart that is rational, where human reasons can be used to understand it. It is reasonable to look for a link between the faith and science and convert this link to something useful. This is because knowledge is only discovered and faith helps finding new knowledge. Is there a link between faith and science in general?

In this paper the relation between science and faith is introduced in the next section. Then the role of an integrated faith and science on the development of civilisation is presented in section 3 and finally examples of faith inspired inventions and discoveries in human life are given in section 4.

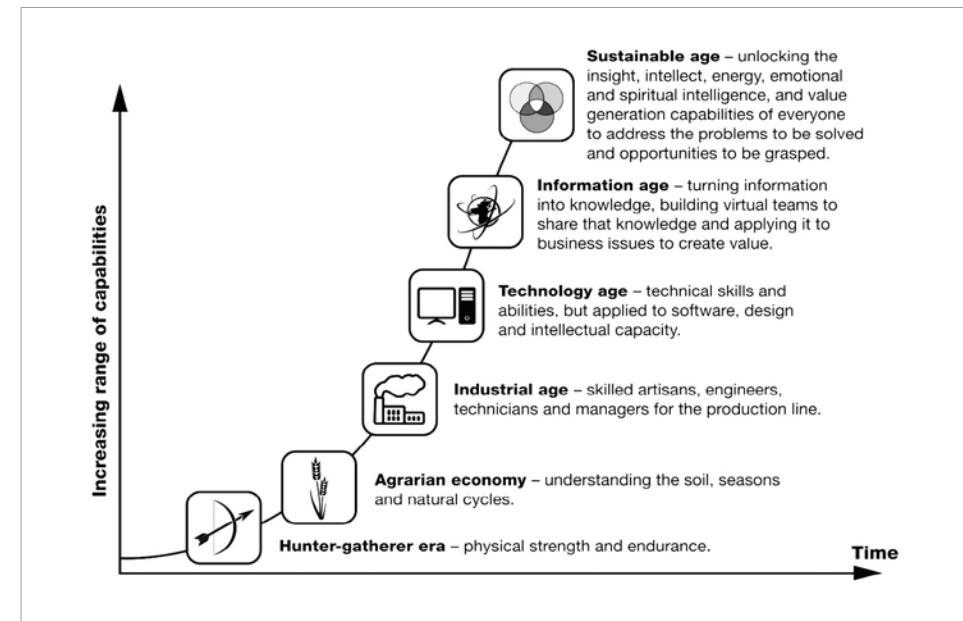
### I. The Relation Between Science and Belief

Human development has been marked by many ages. It has progressed from the hunter-gather age to the information age in maybe less than ten thousand years. However the time scale with the period of each age is getting shorter (Fig. 1).

<sup>2</sup> The Qur'an, 96/al-'Alaq, 1-4.

<sup>3</sup> Surat al-Fātir, 35: 28.

Figure 1: Human Mission Diagram



The right hand side of the y-axis in figure 1 shows that increasing our capabilities, tools and critical mass help to make those sorts of leaps and progress. Today, we may not be more brilliant or clever than previous generations but we certainly have more tools than them. The information age gives us access to all knowledge, previous and current, which has made the world almost like a village. Furthermore, as there are many people now looking at the same problem, a solution will be found sooner. But in this information age which is where we are now, where will it take us? We all have the inspiration and the hope that make all theories and most ideologies looked towards what we call a Sustainable Age. Whether it is from the non-believer's point of view or the believer's point of view, they name this age for example "Sustainable Age", "The Kingdom of God on Earth" or "the State of God on Earth" respectively. The Sustainable Age means that humanity reaches the stage where it achieves social justice, fairness, prosperity, an environmentally friendly society and a sustainable society. We are all inspired by the desire to contribute to that stage, and the time when this can be achieved also depends on us.

How does this process and organised knowledge come about - do we discover new knowledge or do we acquire it? Scientific laws have been

made by human beings involving concepts, models, rules, exemplars, and language to perceive phenomena and explain the experience. However these paradigms can ever be absolute and sometimes change in a major way such as the change from Newtonian to the modern physics of relativity and uncertainty and some changes in paradigms may occur in the future. Although events at a certain level are unchanged by the way they are perceived for instant the cavemen knew that if they released a rock it fell. This fact remained known and unchanged throughout Galileo and Newton formulated a mathematical law for gravitational phenomena to explain that particular behavior under law and prediction. However they established the existence of gravity long before anyone was able to give a descriptive account of gravitation.<sup>4</sup> Intellectual curiosity is discovering the unknown and acquiring new knowledge. Invention is looking to what everyone is looking at but seeing what no one else is seeing. A new device, method, or process developed from study and experimentation is an incremental development of known knowledge.

Furthermore, all this tells us that this knowledge must come from one source that is intelligent, comprehensive, limitless, powerful and not confined by time and space. Because knowledge is consistent, elegant, profound and factual; otherwise if knowledge comes from different sources then we have contradictions and inconsistency. For example, the fluid flow laws that are applied in the lab, the same laws can be applied in the ocean, and that true for all laws. So this consistency of knowledge shows that it must come from one source, and this source is called God or the Creator by the believers; while non-believers may use different ways to describe it.

### A. Knowledge And Religions

What is the meaning of knowledge from the religious point of view? In Christianity, Catholicism or Evangelism knowledge is one of seven gifts of the Holy Spirit. But there is no elaboration to specify the gift and its importance. Hindu Scriptures present two kinds of knowledge, secondhand knowledge obtained from books, hearsay, etc. and knowledge borne from direct experience, i.e., knowledge that one discovers for oneself. In Islam, knowledge (Arabic: علم, 'ilm) is given a great significance. "The

<sup>4</sup> J. P. Moreland. *Christianity and the Nature of Science: A Philosophical Investigation* (Grand Rapids, MI: Baker Books, 1989).

All-Knowing" (al-'Alim) is one of the Beautiful Names of God in Islam. The Qur'an declares that knowledge comes from God.<sup>5</sup> Islamic scholars, theologians and jurists as well as scientists are often given the title 'alim, meaning "knowledgeable". So science refers to that sort of broader context of organised knowledge, structure and discipline.

We know that belief is a subjective personal basis for an individual behaviour, while the truth is an objective state independent of an individual. Interestingly philosophy traditionally defined knowledge as justified true belief<sup>6</sup> because the whole concept of philosophy is based on the truth and searching the truth. So the relationship between belief and knowledge is that a belief is knowledge, if it is true and factual or if the belief is consistent with the truth it is also knowledge. Therefore, a false belief is not considered to be knowledge even if it is sincere. Since we said earlier that science is organised knowledge, then a true belief is knowledge and therefore it is science. Science is the system where beliefs are derived from objective methodologies, observations, experimentations, and proof. But also we have to accept that all methods of proof whether it is experimentation, observation, hearing, seeing can be quantified; however feeling cannot be quantified scientifically. There has not been a scientific methodology to quantify feeling yet. This also put us into the context of a definite foundations of the personality, physical, intellectual, moral and spiritual which the scientific methodologies alone cannot capture all those elements of the personality.<sup>7</sup> Religion is the system of beliefs based on faith and if the belief is true it is therefore knowledge. Hence science and true beliefs are consistent. Because true belief is knowledge, it excludes the interpretations, as sometimes people are interpreting Holy Scriptures such as the Qur'an, by telling their own interpretation and it is not necessarily reflecting the true meaning of the text. The ultimate truth is remained to be discovered, so that the truth is not missing.

Both scientific research and religious beliefs and, indeed, the combination of the two schema involve a mixture of subjective and creative thinking and objective realities. Both work from the seen to the unseen in

<sup>5</sup> Surat al-Baqarah 2: 239.

<sup>6</sup> Alvin Plantinga & Nicholas Wolterstorff. *Faith and Rationality: Reason and Belief in God* (Notre Dame, IN: University of Notre Dame Press, 1983).

<sup>7</sup> Karl Popper. *The Logic of Scientific Discovery* (New York: Basic Books, Inc., 1956).

human experience and involve the confession that our knowledge is partial.

There are three levels of new knowledge that could be defined. This is depending on how a new knowledge is discovered or observed. The highest level of knowledge is 'miracles' which is defined according to the Oxford Dictionary as an event manifesting divine intervention in human affairs and extremely outstanding or unusual event thing or accomplishment. A miracle could also be defined as an external event that follows natural laws and principles which have not been discovered yet. In the Qur'an, Allah says that "Everything happens with a reason" and a scientist believes that everything must have a reason. There are some critical questions being in search of that reasons which we have not found answers to those yet, such as why we are here; what is the purpose of creation? But it does not mean that those questions will never have an answer. Again Allah said in the Qur'an "we will (continue to) show them our evidence in the world and within themselves".<sup>8</sup> It means it is a continuous learning process because there is a limit to how much we know and can comprehend. However those principles once they will be known.

For example, speaking of a mobile phone a hundred year ago would be a miracle, but the iPhone is not due to the fact that the principles of mobile communications are now known to us. There are so many examples of miracles which we have not yet found an explanation for; whether it is the virgin birth of Mary, or the crossing of the sea by Moses, or some of the extraordinary events which we heard about or sometimes even experiencing in our own life. Science looks for explanations in terms of natural processes and a miracle is a gap in scientific explanation.<sup>9</sup>

There is another level of knowledge which is a new knowledge that can be explained or observed such as the discovery of gravity, electricity and penicillin among other discoveries. Finding new knowledge is driven by intellectual curiosity to discover the unknown. However, there is a perception that discoveries happen by pure chance and chance favours the prepared minds. Although, if chance favours the prepared minds that it must have a choice and that is inconsistent with chance! If chance makes a choice then it must be intelligent and that again is inconsistent with defi-

<sup>8</sup> (سُرِّيهِمْ آيَاتِنَا فِي الْأَفَاقِ وَ فِي أَنْفُسِهِمْ) Surat Fussilat 41: 53.

<sup>9</sup> Surat Maryam 19: 20-21. See C. S. Lewis, *The Problem of Pain* (New York: Macmillan, 1976), Ch. 7.

nition of chance! What is missing that new knowledge comes from God by inspiration and God favours the prepared minds for obvious reasons! (وَمَنْ يَتَّقِ اللَّهَ يَجْعَلْ لَهُ مَخْرَجًا وَيَرْزُقْهُ مِنْ حَيْثُ لَا يَحْتَسِبُ)<sup>10</sup> "The one who is the believer and most aware of Allah (God), Allah will make a way for him out and will provide for him from where he does not expect". One of the most important characteristic of the believer is believing in the unseen. In the Qur'an this point was described several times such as "This is the Book (The Qur'an); in it is a guidance and gifts, and ensure, without doubt, to those are most conscious of Allah; who believe in the Unseen" (بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ (الم (١) ذَلِكَ الْكِتَابُ لَا رَيْبَ فِيهِ هُدًى لِّلْمُتَّقِينَ (٢) الَّذِينَ يُؤْمِنُونَ بِالْغَيْبِ)<sup>11</sup> As mentioned before the intellectual curiosity is to discover the unknown. For the believer who believes in the unseen, he/she believes that there is a solution out there for the problem that is not solved yet or the phenomena that has not been discovered yet. The new knowledge is out there created by God. However, this knowledge is also time dependent. This means that we have to reach a stage in our understanding to be ready 'prepared' to get a new knowledge. Faith provides the base and the trust in accessing this knowledge and this goes back what was mentioned earlier that science with faith is a vision. For solving a given problem, a believer believes that there is a solution out there, and would be more confident to find it; with God's help. This might prompts the question about the fairness of God for giving one but does not give someone else. The idea of the faith is believing in the unknown to acquire a new knowledge. It is to do with our own understanding of things around us and the choices we make. Helping a hard working student advances his or her knowledge does not constitute unfairness for other students, who might not put the same time and effort. This would be more consistent with the concept of favouring the prepared minds, which was described in the Qur'an as "my Lord grant me more knowledge (وَقُلْ رَبِّ زِدْنِي عِلْمًا)<sup>12</sup> A new knowledge is a kind of inspiration and no one can be in control of inspiration, because no one could tell us how to be inspired. It is our own way of interacting with the world around us and using our knowledge and our faith.

<sup>10</sup> Surat al-Talaq 65: 6.

<sup>11</sup> Surat al-Baqarah 2: 1-2.

<sup>12</sup> Surat Taha 20: 114.

The third lower level of a new knowledge is invention. An invention could be a new device, method, or process developed from study and experimentation. It is an incremental development of known knowledge such as car, telephone, computer, chair, scientific community and publication and so on. These all are inventions not discoveries. Invention is the making of known knowledge and principles.

Today, there is a conflict view taken by many scientists that there is non-compatibility and the relationship has not been very sweet between science and faith or science and religion for obvious reasons. There is also the view of independence that treating each as quite separate realms of enquiry. Moreover there are people who leading that campaign and dialogue to make integration between faith and science, aiming to unify both fields into a single discourse.

### **B. Technology, Science and Faith**

Technology is the application of scientific knowledge for practical purposes, especially in industry. It is a set of tools and technical means and their interrelation with life, society, and environment. Technology has largely affected society in many positive ways, enhancing health, quality of life, advancing economies, etc. However many technological processes have also produced many unwanted by-products known as pollution that to do with the unsustainable use of technology.

Science and technology are consistent with faith, as they are both true beliefs.<sup>13</sup> The consistency of science and faith can be seen in Prophet Muhammad (PUH) sayings. He said “الدين طاعة الخالق وخدمة المخلوق”. Faith is a submission to God and it is a service to his creations.<sup>14</sup> Science provides the knowledge to reflect on and understands the existence of God, while technology provides the tools to serve the society. Science provides the means to understand the physical reality and questioning its origin, its initiation and the link to faith.

Science inspires intellectual curiosity and keeping the ongoing big question about the purpose of our existence. Science makes us closer to understand the existence of the Creator because the concept of Creator is consistent with the scientific methodologies and the natural laws and

<sup>13</sup> Bas. C. van Fraassen. *The Scientific Image* (Oxford: Clarendon Press, 1980).

<sup>14</sup> Alvin Plantinga. *Warrant and Proper Function* (Oxford: University Press, 1993).

principles of the universe, such as mass and energy conservation among others. It is also consistent with the scientific principle of cause and effect; and action and reaction. Because the subject of ‘matter’ in science brings the question of time and space which both have a marked beginning, i.e. matter has an age, which means there was initiator. The initiator is the Creator but what is the nature of the Creator is not the subject of this paper, though the Creator is not a matter, i.e. is not confined by time and space.

## **II. Islamic Civilisation: Bayt Al-Hikmah Centre For Study and Research**

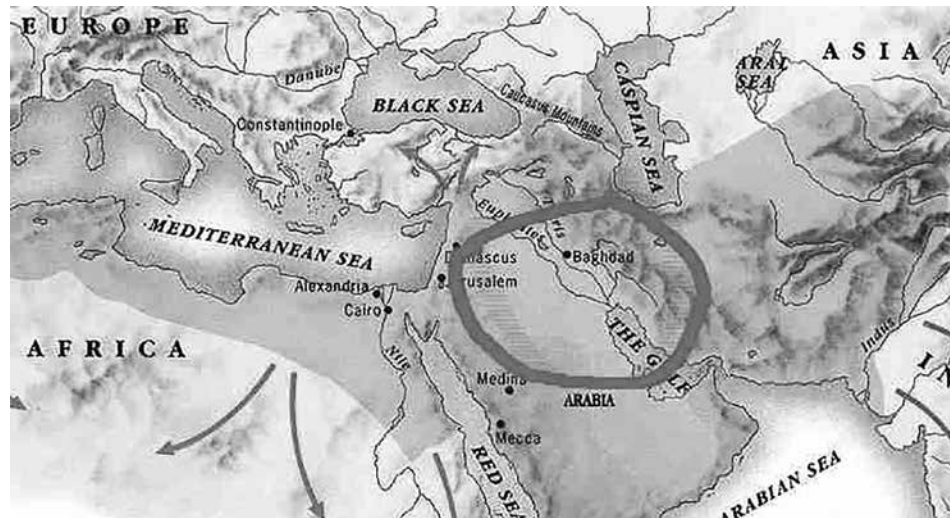
The contribution of Islamic Civilisation to science is an instant for a linkage between faith and civilisation. Islamic Civilisation is not a specific race such as an Arab or a Persian or a Turkish, but it is the contribution of all Muslims or non-Muslims who even lived in the Ur of the Chaldees (South of modern Iraq where Abraham lived) because the centre of activity throughout history moved from one place to the other. According to the Qur’an, it was Abraham who first called the believers in one Creator ‘Muslims’, though Muslims have been associated with the followers of Prophet Mohammad.<sup>15</sup>

During the Islamic Golden Age (7th century to the mid-13th century), Muslim rulers established the “House of Wisdom (Bayt al-Hikmah)” in Baghdad (Figure 2) and the Muslim world became a major intellectual centre for science, philosophy, medicine and education. There were Christians, Jews, Muslims, Arabs and non-Arabs who contributed to that civilisation. Artists, engineers, scholars, poets, philosophers, geographers and traders contributed to agriculture, the arts, economics, industry, law, literature, navigation, philosophy, sciences, sociology, and technology by using their own inventions and innovations at that time. Not all scientists during this period were Muslim or Arab, as there were a number of notable non-Arab scientists as well as some non-Muslim scientists, who contributed to scientific studies in the Muslim world. The majority of texts during this period were written in Arabic, and many classic works of antiquity that might otherwise have been lost were translated into Arabic and

<sup>15</sup> Surat al-Baqarah 2: 132-133.

Persian and later in turn translated into Turkish, Hebrew, and Latin. The Islamic empire was the first “truly universal civilization,” which brought together for the first time people as diverse as the Chinese, the Indians, the people of the Middle East and North Africa, black Africans, and white Europeans<sup>16</sup>

**Figure 2:** Baghdad (Gift of God) was at cultural crossroads in the early ninth century.



Christianity is a monotheistic Abrahamic religion based on the life and teachings of Jesus of Nazareth as presented in the New Testament. In the west and on 27 February 380, Emperor Theodosius-I enacted a law establishing Christianity as the official religion of the Roman Empire. From at least the 4th century, Christianity has played a prominent role in the shaping of western civilization and inspired, philosophy, art and science in the West.

With the decline of Islamic Civilizations in the late Middle Ages and the rise of Europe, the Islamic scientific tradition shifted into a new period. Institutions that had existed for centuries in the Muslim world looked to the new scientific institutions of European powers. This changed the practice of science in the Muslim world, as Islamic scientists had to confront the Western approach to scientific learning, which was based on a different philosophy of nature. However, most have maintained the view that the acquisition of knowledge and scientific pursuit in general is not in

<sup>16</sup> George Saliba. *A History of Arabic Astronomy: Planetary Theories during the Golden Age of Islam* (New York and London: New York University Press, 1994), 245, 250, 256–7.

discord with Islamic thought and religious belief. There are many religious scholars were curious to put knowledge into practice by their effective discoveries and inventions. A summary of their biography and works are summarised in the next part.<sup>17</sup>

### A. Faith Inspired Discoveries and Inventions

According to most historians, the modern scientific method was first developed by Islamic scientists, pioneered by Ibn Al-Haytham, known to the west as “Alhazen”. Ibn al Haytham (965- 1040) was the First Scientist to test hypotheses with verifiable experiments, developing the scientific method. In his massive study of light and vision, *Kitâb al-Manâzir* (Book of Optics), he devised the world’s first camera obscura (المراه), which means like a mirror in Arabic, to discover the truth about nature. Ibn al-Haytham reasoned, one had to eliminate human opinion and allow the universe to speak for itself through physical experiments.<sup>18</sup>

Al-Khwarizmi (780-850) the Islamic mathematician adopted Arab-Hindu numerals and zero and the word Algorithm derives from his name. Islamic heritage being described generally in the Quran was a complex process for people at that time. Al-Khwarizmi who was a religious scholar as well as a mathematician found a solution to calculate the amount of heritage for each person and make heritage rule easy for people by his famous and important inventions of Algebra and Algebraic equations. He also described the constant need to find the direction of Ka’ba in Mecca, like geometry a tool worth developing.<sup>19</sup>

Jabir ibn Hayyan, (721-815) was a chemist, astronomer, engineer, geologist, philosopher, physicist, pharmacist and physician. He is considered by many to be the “Father of Chemistry” (science of quantities), Distillation, and nitric acids, and crystallisation – that have become the foundation of today’s Chemistry and Chemical Engineering. In response to Imam Jafar al-Sadiq’s (grandson of Prophet Mohammad) wishes, Jabir

<sup>17</sup> Jim Al-Khalili. *The House of Wisdom: How Arabic Science Saved Ancient Knowledge and Gave Us the Renaissance* (New York: Penguin Books, 2011).

<sup>18</sup> Charles M. Falco. “Ibn al-Haytham and the Origins of Computerized Image Analysis”, International Conference on Computer Engineering & Systems (ICCES), 2007.

<sup>19</sup> Jim Al-Khalili. *Pathfinders: The Golden Age of Islamic Science* (New York: Penguin Books, 2012).

invented a kind of paper that resisted fire, and an ink that could be read at night. He invented an additive which, when applied to an iron surface, inhibited rust and when applied to a textile, would make it water repellent.

Ibn Sina (980 – 1037) is the father of modern medicine. The Canon (Law) of medicine, which was a standard medical text at many medieval universities, was used as a text-book in the universities of Montpellier and Leuven as late as 1650. Canon of medicine provides a complete system of medicine according to the principles of Galen and Hippocrates. He is regarded as the most famous and influential polymath of the Islamic Golden Age.

Muhammad ibn Zakariyā al-Rāzī (865– 925): He is known to have perfected methods of distillation and extraction, which have led to his discovery of sulfuric acid, by dry distillation of vitriol (al-zajāt), and alcohol (ethanol). As a pioneer of alchemy, al-Razi was the first to distill/refine petroleum and produce kerosene (later used as lamp oil and jet fuel).

There are sometimes difficulties in identifying religious convictions of scientists; however it is obvious that the general public greatly underestimates the religion of scientists. Justin Marston, founder-chair of Christian Students in Science did a 1997 survey of 850 British students at ten universities to find out their views of whether some great scientists were religious or nonreligious. The students were asked to identify their opinion on religious views of the scientists in three categories including more religious, about the same or less religious than their contemporaries. The answers were illustrated in percentage of the total participants. Table 1 shows the results of students' views on the religion of some major scientists. Moreover, table 1 introduces the scientists across their main area of science.

**Table 1:** Student's views on religion of scientists<sup>20</sup>

Name	Main Area(s)	More religious	About the same	Less religious
Planck	Quantum Physics	5.0	64.1	30.9
Einstein	Relativity	15.5	48.2	36.3
Galileo	Dynamics	16.2	54.1	29.7
Newton	Physics	20.1	60.8	19.1
Kepler	Solar System	10.9	63.1	26.0
Faraday	Electricity/Physics	10.4	74.5	15.1

<sup>20</sup> Roger Forster. Paul Marston. *Reason, Science and Faith* (Oxford: Monarch Books, 1999).

The results showed that two third of the participants suggested that Kepler, Newton and Faraday were not more religious than their contemporaries; while they were all markedly devout to their faith. Newton (1643-1727) wrote more on religion than he did on natural science. He demonstrated that “Gravity explains the motions of the planets, but it cannot explain who set the planets in motion. God governs all things and knows all that exists and can be done”.<sup>21</sup> He saw evidence of design in the system of the world: “Such a wonderful uniformity in the planetary system must be allowed the effect of choice.”<sup>22</sup>

The one third of students suggested that Galileo was less religious than his generation whereas he was a Catholic among his contemporaries in which they were protestant and there was a major conflict between two religious ideas at that time. The half of students attended on this survey suggested that Einstein was religious about the same of his contemporaries though he was not a Christian. He is associated with major revolutions in our thinking about time, gravity, and the conversion of matter to energy. The way he expressed his belief in God reveals that he perceived the universe to be harmonious. He said that “I want to know how God created this world. I am not interested in this or that phenomenon, in the spectrum of this or that elements. I want to know His thoughts, the rest are details.”<sup>23</sup>

In general, the great scientists have had religious convictions however their biographies may fail to mention their deep beliefs expecting a rational universe from a rational creator-God. The next section shows how a scientific approach has been achieved with the faith.

## B. Sustainable Age and Modern Civilization

Energy, water and food play a key role in the sustainable environment, extreme poverty reduction and child morality which those have been considered in international development goals “Millennium Goals” to achieve by 2015. Interestingly these three fundamental elements, food-

<sup>21</sup> John Hudson Tiner. *Issac Newton: Inventor, Scientist and Teacher* (Milford, Mich.: Mott Media, 1975).

<sup>22</sup> Franklin L.V. Baumer. *Main Currents of Western Thought* (New York: Alfred A. Knopf, Inc., 1970), 324.

<sup>23</sup> Iain Paul. *Science and Theology in Einstein's Perspective* (Edinburgh, Scottish Academic Press, 1986).

water-energy, are highly interdependent together; for instant food production needs clean water, and energy is consumed for producing clean water whereas energy generation requires water. Therefore a sustainable solution for water shortage would set a sustainable development for both food and energy accordingly. In other word, a Sustainable Age would not be reached without having access to clean water, sufficient energy and food; regardless of how many people lives on earth and where.

The Quran mentioned an exciting energy source which could be exploited technologically to produce clean power. This is described in the Qur'an as follows: *مَرَجَ الْبَحْرَيْنِ يَلْتَقِيَانِ بَيْنَهُمَا بَرْزَخٌ لَا يَبْغِيَانِ* "When two seas meet there is a barrier between them."<sup>24</sup> If we look to the meaning of the Arabic text, it is much deeper and wider than just the conventional sea water and the fresh water. When it says *مَرَجَ* (maraj) means 'a dense' solution or generally every two solutions of different densities, there is a barrier exists between them. In scientific term when there is a barrier between a dense solution and a less dense solution, it means there is a potential energy in the barrier, whether it is a physical or a chemical barrier. In case of miscible waters with different densities, the barrier is chemical due to the different chemical potentials between the two solutions. This chemical potential energy difference could be converted into a mechanical form of energy which could be used to produce power in a process termed Osmotic Power, which is based on the natural osmosis process.<sup>25</sup> This phenomenon is coming almost like a battery which is the platform for many inventions and processes in the area of desalination and power generation.<sup>26</sup> Power can be produced from any two immiscible solutions of different densities. The power could be used for producing electricity and water, which are the

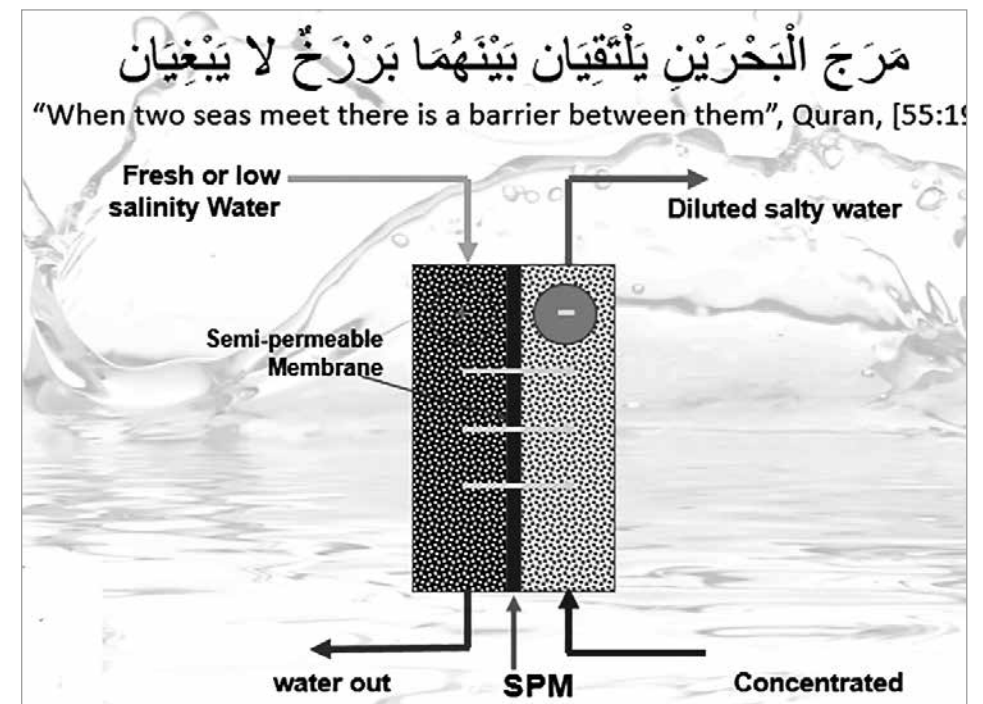
<sup>24</sup> Surat al-Rahman 55: 19-20.

<sup>25</sup> Adel O. Sharif and Maryam Aryafar. "A Thermal Regeneration Forward Osmosis Process", UK patent application number GB1321711.2. See also A. K. Al-Mayahi and A. O. Sharif, "Salinity Gradient Method for Power Generation", Japan Patent No. JP 4,546,473, (2010).

<sup>26</sup> Adel O. Sharif, "Separation Method, European", Patent No. EP2089142. Also see Adel O. Sharif, "Separation Method", European Patent No. EP2089142; A.O. Sharif, "Solvent Separation", UK, Patent application, December 2008; A.O. Sharif, "Zero Liquid Discharge Desalination", UK Patent GB0822359.6, (2008); A.O. Sharif and A.M. Al-Tae, "Membrane Pre-treatment", UK Patent GB0817248.8, (2008); A. O. Sharif, "Secondary Oil Recovery", U.S. Patent No. US 7,942,205 B2, Date of Patent: May, 17, 2011; European Patent No. EP1,877,163.

biases for food production. Figure 3 illustrates the osmotic cell concept, where water moves naturally, through a membrane which retains the solutes, from the fresh water or low concentration solution side to the more concentrated side. The low solute concentration side of the chamber acts as the 'positive electrode' in the cell, while the high solute concentration side acts as the 'negative electrode' in the osmotic cell. The flux of water induces pressure on the concentrated side which can be converted into power using a turbine and a generator.

**Figure 3:** Power generation by using direct osmosis process

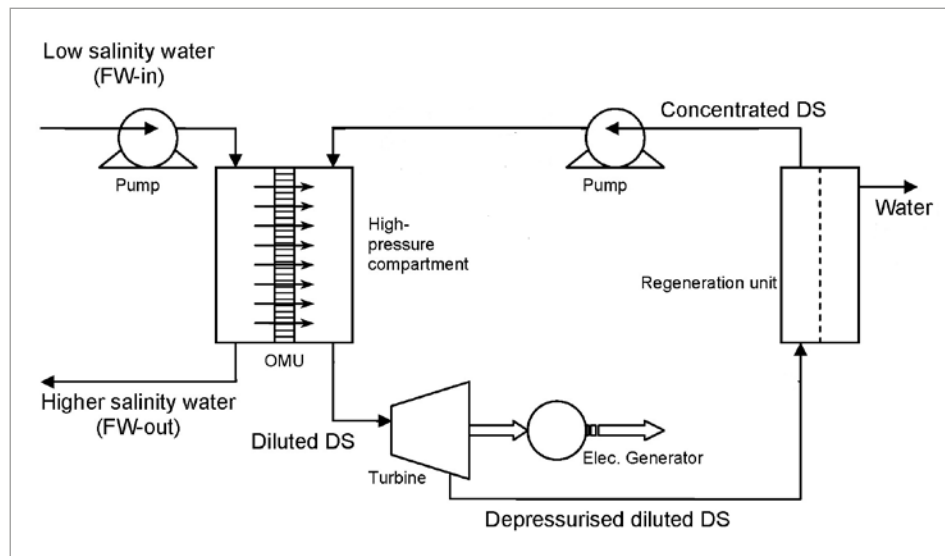


Osmotic Power has been introduced as a source of renewable and sustainable energy, and it shows a great potential for clean power production. Osmotic power is produced in a process, as illustrated in Figure 4, of mixing a low solute concentration solution (FW), which has a relatively low osmotic pressure (FW-in), and a high concentration solution (DS), which normally has a higher osmotic pressure, through a semi-permeable membrane in an Osmotic Membrane Unit (OMU). The membrane retains the solute movement between the two solutions and only allows pure wa-



ter to pass through it. This can be achieved by using fresh water, brackish water or waste water effluent as the lower osmotic potential side (FW) and a saltier water such as seawater or brine as the high osmotic potential side (DS) to create the required osmotic pressure difference to run the process (Figure 4). In this process, the clean water passes across the membrane from FW side to DS side and the volume of water on the DS side is increased accordingly. The resultant high-pressure DS is then used to drive a turbine, and generate power. It means that the osmotic energy due to the chemical potential difference can be converted into mechanical energy and to hydropower. The diluted saltier water (DS) is then goes to a Regeneration Unit (RU) such as evaporation, crystallization, membrane separation, or other solutes concentration techniques in order to separate and recycle DS for reusing in the process and the clean water is extracted as the product.<sup>27</sup>

**Figure 4:** Schematic diagram of the Osmotic power generation and clean water production process



27 Adel O. Sharif and Maryam Aryafar. "A Thermal Regeneration Forward Osmosis Process", UK patent application number GB1321711.2. Again A.K. Al-Mayahi and A. O. Sharif, "Salinity Gradient Method for Power Generation", Japan Patent No. JP 4,546,473, (2010).

The reference to the difference between salty and fresh water in the Qur'an is in chapter Furqân verse 53: "And God it is Who has made two seas to flow freely, the one sweet that subdues thirst by its sweetness, and the other salt that burns by its saltiness; and between the two, God made a barrier and inviolable obstruction."<sup>28</sup> This is another example of faith inspired scientific activities where we can put scientific knowledge into useful applications. In this case, the source of knowledge is the holy Qur'an, but scientific tools allowed the understanding and the conversion of knowledge.

The aforementioned examples of faith inspired science enforce the point that there is no conflict between faith and science. The integration of both science and faith could facilitate the advancement of science and enhancing the understanding of faith. Such integration could benefit humanity in reaching a Sustainable Age.

#### Conclusion

If knowledge is the fundamental basis for both science and faith, and knowledge cannot be created but discovered, the source for this knowledge must therefore be intelligent. This source for the believers is God or the Creator, while it remains undetermined for the non-believers. Our current understanding of both science and religion is incomplete, as the ultimate truth of both has not been discovered. For example, human emotions and feelings cannot be modeled by mathematical equations. This learning curve should go on and the interaction between science and faith can facilitate this process. History has shown us time and time again, that faith has inspired inventions and discoveries. When faith is subjected to logic and rational; and where imagination and inspiration are considered as scientific tools there should be no conflict between faith and science.

Science when inspired by faith allows us to enhance our understanding of both faith and science. Thus, our advances towards achieving the Sustainable Age is greater. Human knowledge and skills alone cannot lead humanity to a happy and dignified life. Humanity has every reason to place the proclaimers of high moral standards and values above the discoverers of objective truth.<sup>29</sup>

28 Surat al-Furqân 25: 53.

29 See above Tiner, Issac Newton: Inventor, Scientist and Teacher.

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## Thinking of the Philosophy of Environment and Technology

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Taşköprülüzade (d. 1561), one of the most prominent scholars and thinkers of the Period of Sulayman the Magnificent, says: "Learning is the worship of the mind." Four centuries after him, Martin Heidegger (1889-1976), the leading German philosopher who questioned technology in terms of moral values said "searching is the religion of thinking." Even though what he meant by religion was the kind of belief Ancient Greeks had, I understand from the way Taşköprülüzade used the word that this meeting is worth to be considered as "the worship of the mind."

Technology is an important element when the relationship between humans and environment is considered. The people with environmental-oriented consciousness hold technology responsible for the most significant problems of 21<sup>st</sup> century. That is why, when the reasons of environmental issues are discussed, we need to question modern science and the result of it which is the technology itself. Talking about the philosophy of environment and technology, the first thinker that comes to mind is Heidegger. For, he considered this issue before the negative results of human-environment relationship (*fasâd fi'l-âra*), which is also defined as environmental problems, became widespread and he became one of the first thinkers, who "questioned" environment and technology thoroughly. Heidegger pointed out eagerly: "Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like to do homage, makes us utterly blind to the essence of technology."<sup>1</sup>

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1 Heidegger's "Questioning Technology" article was written after his sequential conferences that took place in Bremen in 1949. Heidegger studied on rough copies and published a book called *Die Technik und die Kehre* in 1961. The book was translated into Turkish as *Tekniğe İlişkin Soruşturma* by Doğan Özlem (Istanbul: Paradigma Yayınları, 1998). English translation by William Lovitt as *The Question Concerning Technology and Other Essays* (New York: Harper Troch Book, 1977), 4. The references are to the English translation.