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ISLAM AND SCIENCE: HISTORICAL CONTEXT AND MODERN CHALLENGES

BY

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Introductory Remarks

This inaugural lecture is the fourth from the Department of Religions and the second from the Islamic Studies Unit. My area of specialization is Islamic theology and Qur'anic exegesis. Theology relates to the doctrines of Islam as embodied in the fundamental articles of faith (*'iman*); it is the intellectual and integrative approach to the study of all the different and valid branches of knowledge with the concept of *al tawhid* - the existence and unity of Allah - the Creator and Sustainer of the universe. Samples of such integrative approach in my academic research include: "*Natural Environment*" (2003), "*Ahl al-kitab and religious minorities in the Islamic* *state"* (2000), *Imam Fakhr al- Din al-Razi's Philosophical theology in Al-Tafsir Al-Kabir* (1994), *Reason and Revelation*(1991), *Manpower Development (1988).*

The topic of this inaugural lecture is "Islam and Science: Historical context and Modern Challenges". This age of revolution is marked by a proliferation of intellectual, spiritual and ethical questions as novel and revolutionary in character as the science and technology that inspire them. These revolutionary questions exceed the conceptual limitation of any single discipline or perspective. Their significance and complexity command the attention and intellectual resources of scholars from diverse backgrounds. For example, there is the heightened concern for ethics in science, felt strongly in the areas of genetic research, biotechnology and ecology. The import and implications of such concern and similar considerations can be more effectively anticipated and thoughtfully approached when science and religion engage one another. Hence in this inaugural lecture, we are going to look at the historical and theological relationship between Islam and science and the resultant modern challenges. The lecture into four parts,namely; (i) Conceptual Framework (ii) Islam and Science: Historical Context,

(iii) Modern Challenges and (iv) Conclusion

1. **Conceptual Framework**

A. Islam

Tawhid as the Foundation of Knowledge

Tawhid or the doctrine of absolute unity, transcendence and ultimacy of God is the basis of Islamic theology. It implies the unity of God - the Creator, unity of creation and unity of truth and knowledge.

Unity of God

Reality is of two generic kinds, God and non-God, Creator and creature. The first order has but one member, Allah, the Absolute and Almighty. He alone is God, Eternal, Creator, Transcendent. Nothing is like unto Him, He remains forever absolutely unique and devoid of partners or associates. The second is the order of space-time, of experience, of creation. It includes all creatures, the world of things, plants and animals, humans, jinn and angels, heaven and earth, paradise and hell and all their becoming since they came into being. The two orders of Creator and creation are utterly and absolutely disparate as far as their being, or ontology and existence and careers are concerned. (al-Faruqi, 1986:94).

Unity of Creation

The world has not been created in vain, or in sport (Qur'an 3:191; 23:116). It is not the work of chance, a happenstance but created by Allah. It was created in perfect condition. Everything that exists does so in a measure proper to it and fulfils a certain universal purpose (Qur'an 7;15; 10:5;13:9;15:29;25:2). The world is indeed a "cosmos", an orderly creation, not a "chaos". In it, the will of the Creator is always realized. His patterns are fulfilled with the necessity of natural law, for they are innate in the very nature of things. No creature other than man acts or exists in a way other than what the Creator has ordained for it (Qur'an,17;77; 33:62; 35:43; 48:23; 65:3). Man is the only creature in whom the will of God is actualized, not necessarily, but with man's own personal consent. Hence, he is responsible and accountable.

Unity of Knowledge and Truth

The Arabic expression *'ilm*, which in the singular, stands for knowledge of all sorts, it also stands in the plural (*'ulum*) for science. The characteristics of knowledge (science) in Islam as outlined by Wan Daud (1989:62-91) are as follows:

i. There is the inseparability of knowledge from Allah. It means that since Allah is All-knowing and Omniscient, He is the root of all knowledge.

ii. Whatever form of knowledge is possessed or acquired by humanity, it is definitely vouchsafed to it by Allah. It should never be seen as purely a product of human independent effort and endeavour. Hence, no aspect of knowledge should be separated from Him.

iii. Knowledge and truth are interwoven; the essence of knowledge is to lead to truth, and nothing but the truth. Since Allah is the Absolute and Ultimate Truth, knowledge should lead humanity to Allah. Any knowledge which does not lead to the truth is not in the real sense a sound knowledge but a mere misconception.

There is a relationship between knowledge, action, spirituality and morality. In Islam the essence of knowledge is good deeds and righteousness. In a number of verses in the noble Qur'an and *Hadith*, the emphasis has been on combining knowledge with good deeds and piety (Imam Nawawi, 1974:232-233).

According to Islam, the main sources of human knowledge are the two 'revelations', namely; the scriptures and the natural phenomena. Hence, the early Muslims had an integrated worldview, thatis, no dichotomy between the spiritual and the physical (phenomena), if properly understood and interpreted. Indeed the phenomenal world is to be studied with a view to understanding its ingrained nature, purpose and use, on the one hand, and for better appreciation of the Creator - God - and His worship, on the other.

Methods of Knowledge

The Qur'an recognizes three levels of perception. These are the spiritual, intellectual and sensory levels. According to Muhammad (1995) they constitute the major methodological components of Islamic epistemology. The organs on which the three levels are represented are the sensory organs.

i. The spiritual level deals with revelation (e.g., inspiration, intuition and telepathy). Revelation par excellence is otherwise known as *haqq a*l-*yaqin* (absolute and experienced certainty). (Qur'an,56:95).

ii. The intellectual level deals with cognitive processes like thinking, reflection, meditation, contemplation and understanding or discernment. This is otherwise known as *'ilm al-yaqi* (cognitive certainty) (Qur'an 102:5).

iii. The sensory level deals with things like observation, empirical studies and experimentation. This is otherwise known as *'ayn al –yaqin* (certainty of sight) (Qur'an 102:7).

It is, however, important to note that at the spiritual level of perception both the intellect and the heart are involved, and at the sensory level the intellect is still involved. Another aspect of the method of knowledge in Islam is the method followed by *hadith* scholars and scientists collecting, authenticating, recording and reporting all information about the Prophet Muhammad and his Companions. The foundations of these scholarly endeavours (criticality in research) are in the Qur'an. In many places the Qur'an enjoins Muslims to authenticate information (knowledge) before passing it over, and to avoid acting on hearsay and conjectures. In fact, the Qur'an puts conjecture as the direct antithesis of knowledge in many verses (2:170, 247; 53:27-28; 39:18; 93:7; 29:49 etc)

B. Science

The word science is from the Latin word '*scientia*' meaning 'knowledge' or to know. George Sarton defines science as a positive knowledge (*Encyclopedia Americana*,1988). The *Encyclopedia Britannica* (2003: 553, vol.10) calls it any intellectual activity concerned with the physical world and entailing unbiased observations and systematic experimentation. It is also defined as "an organized body of knowledge and opinions which is systematically supported by formal proofs or by observational evidence" (*Encyclopedia of Science*,1977).

Science, whether natural (biology, physics, chemistry, astronomy) or social (economics, psychology) is the area of knowledge based on the observation and testing of facts. It includes the working into an ordered system and also acting as a base for new knowledge and a guide to ways of getting it. The whole idea of science can be summarized as the casting of knowledge into empirical data and mathematical exactitude. The word scientist is relatively recent - first coined by William Whewell in the 19th century. Previously, people investigating nature called themselves natural philosophers.

Methodology

Scientific methods are considered to be so fundamental to modern science that some, especially philosophers of science and practising scientists, consider earlier enquiries into nature to be pre-scientific. Traditionally, historians of science have defined science broadly to include those inquiries. The four components of science according to Osmar Bakar (2003; 35) are as follows:

i. Main or knowledge content of a science: It is a well defined subject-matter or object of study pertaining to which is established an accumulative body of knowledge in the form of concepts, facts (data), theories and laws, and the logical relationships that exist among them.

ii. Epistemological foundation: it is comprised of the basic premises and assumptions. The premises are primarily about the nature and reality of the object of study and its ontological status. Philosophers of science maintain that, unlike the knowledge content of the first component which can be proved and verified within that science itself, the premises and assumptions cannot. Their truths have to be assumed in that science, but may be established in another science which is more fundamental and comprehensive.

iii. Methods of study vary with the nature of the objects being studied. There is no one single method that is common to all the sciences except perhaps the use of logic. But for any science, its core method would be the one concerned with how to gather data for analysis and theory formation and how to test and verify truth claims such as are formulated in hypotheses, theories and laws. A science may employ more than one core method.

iv. Goals: the fourth component concerns the goals sought to be achieved by that science. The main goal of science is to discover that aspect of reality pertaining to its objects of study. It is to arrive at a complete knowledge of that domain of reality with scientific certainty (*'ilm al-yaqin*).

These four components define the theoretical structure of science. All issues raised in the course of discussing the components are epistemological in nature. But the knowledge content of a science has uses and applications which may be beneficial or harmful. There are its theoretical application in other sciences and its practical applications in the production of tangible things.

The ethical issues raised relate to three things, viz: (i) theoretical application which may lead to harmful knowledge; (ii) harmful knowledge which may lead to the production of harmful and destructive objects

(iii) actual use of those harmful and destructive objects for whatever purpose. It is the value-system of a culture that determines how much science and scientists can be blamed and held responsible.

Philosophy of Science

It is the study of the assumptions, foundations, and implications of science. The field is defined by an interest in one of a set of "traditional" problems or an interest in central or foundational concerns in science. In addition to these central problems for science as a whole, many philosophers of science consider these problems as they apply to particular sciences (e.g. philosophy of biology or philosophy of physics). Some philosophers of science also use contemporary results in science to draw philosophical morals. Although most practitioners are philosophers, several prominent scientists have contributed to the field and still do.

Issues of ethics such as bioethics and scientific misconduct are not generally considered part of the philosophy of science. These issues may be studied in ethics or science studies.

Next, is the discussion of historical relationship between Islam and science.

2. **Islam and Science: Historical Context**

History of Science in Early Cultures

In prehistoric times, advice and knowledge was passed from generation to generation in an oral tradition. The availability of clay tablet in Mesopotamia by 492 B.C allowed writing and recording of classical information. The development of writing enabled knowledge to be stored and communicated across generations with much greater fidelity. Combined with the development of agriculture, which allowed for a surplus of food, it became possible for early civilizations to develop, because more time could be devoted to tasks other than survival.

Many ancient civilizations collected astronomical information in a systematic manner through simple observation. Though they had no knowledge of the real physical structure of the planets and stars, many theoretical explanations were proposed. Basic facts about human physiology were known in some places, and alchemy was practised in several civilizations. Considerable observation of macrobiotic flora and fauna was also performed.

Science in the Fertile Crescent

From their beginning in Sumer (now Iraq) around 3500 B.C. the Mesopotamian peoples began to attempt to record some observations of the world with extremely thorough qualitative and numerical data. But their observations and measurements were seemingly taken for purposes other than for scientific laws. A concrete instance of Pythagoras's law was recorded, as early as the 18th century B.C: the Mesopotamian cuneiform tablet Plimpton 322 records a number of Pythagorean triplets (3,4,5) (5,12,13)…dates 1900 BC, possibly millennia before Pythagoras, but an abstract formulation of the Pythagorean theorem was not.

In Ancient Egypt significant advances were made in astronomy, mathematics and medicine. Their geometry was a necessary outgrowth of surveying to preserve the layout and ownership of farmland, which was flooded annually by the Nile River. The 3, 4, 5 right triangle and other rules of thumb served to represent rectilinear structures, and the post and lintel architecture of Egypt. Egypt was also a centre of alchemy research for much of the Mediterranean. (*Encyclopedia Britannica*, 1911).

History of Science in Classical Antiquity: Science in the Greco-Roman World

Plato and Aristotle: The School of Athens

In Classical Antiquity, the inquiry into the workings of the universe took place both in investigations aimed at such practical ends as establishing a reliable calendar, or determining how to cure a variety of illnesses, and in those abstract investigations known as natural philosophy. The ancient peoples who are considered the first scientists may have thought of themselves as natural philosophers, as practitioners of a skilled profession (for example, physicians), or as followers of a religious tradition (for example, temple healers).

The earliest Greek philosophers, known as the pre-Socratics, provided competing answers to the question found in the myths of their neighbours: "How did the ordered cosmos in which we live come to be?" The pre-Socratic philosopher, Thales, dubbed the "father of science", was the first to postulate non- supernatural explanations for natural phenomena such as lightning and earthquakes. Pythagoras of Samos founded the Pythagorean School, which investigated mathematics for its own sake, and was the first to postulate that the Earth is spherical in shape. Subsequently, Plato and Aristotle produced the first systematic discussions of natural philosophy, which did much to shape later investigations of nature. Their development of deductive reasoning was of particular importance and usefulness to later scientific inquiry (Lloyd, 1973:177).

The important legacy of this period included substantial advances in factual knowledge, especially in anatomy, zoology, botany, mineralogy, geography, mathematics and astronomy;

an awareness of the importance of certain scientific problems, especially those related to the problem of change and its causes; and recognition of the methodological importance of applying mathematics to natural phenomena and of undertaking empirical research. In the Hellenistic age, scholars frequently employed the principles developed in earlier scientific investigations. Thus, clear unbroken lines of influence lead from ancient Greek and Hellenistic philosophers to medieval Muslim philosophers and scientists, to the European Renaissance and Enlightenment, to the secular sciences of the modern day. Neither reason for inquiry began with the Ancient Greeks, but the Socratic method did, along with the idea of forms, great advances in geometry, logic, and the natural sciences. Benjamin Farrington, former Professor of Classics at Swansea University, wrote:

> *Men were weighing for thousands of years before Archimedes worked out the laws of equilibrium; they must have had practical and intuitional knowledge of the principles involved. What Archimedes did was to sort out the theoretical implications of this practical knowledge and present the resulting body of knowledge as a logically coherent system (Lloyd ,1970; 144-6; 1973: 177).*

And again:

> *With astonishment we find ourselves on the threshold of modern science. Nor should it be supposed that by some trick of translation the extracts have been given an air of modernity. Far from it, the vocabulary of these writings and their styles are the sources from which our own vocabulary and style have been derived. (Lloyd, 1963, pt 2, ch.4).*

The level of achievement in Hellenistic astronomy and engineering is impressively shown by the Antikythera mechanism (150-100BC). The astronomer Aristarchus of Samos was the first known person to propose a heliocentric model of the solar system, while the geographer Eraosthenes accurately calculated the circumference of the Earth.

Hipparachus (ca. 190-ca. 120 BC) produced the first systematic star catalogue. In medicine, Herophilos (335-280 BC) was the first to base his conclusions on dissection of the human body and to describe the nervous system. Hippocrates (ca.460 B.C.-ca.370 B.C.) and his followers were first to describe many diseases and medical conditions. Galen (129-ca. 200 AD) performed many audacious operations - including brain and eye surgeries - that were not tried again for almost two millennia.

The mathematician, Euclid, laid down the foundations of mathematical rigour and introduced the concepts of definition, axiom, theorem and proof still in use today in his *Elements*, considered the most influential textbook ever written. (Boyer,1991:119). Archimedes, considered one of the greatest mathematicians of all time, is credited with using the method of exhaustion to calculate the area under the arc of a parabola with the summation of an infinite series, and gave a remarkably accurate approximation of *Pi*. He is also known in physics for laying the foundations of hydrostatics and the explanation of the principle of the lever.

Theophrastus wrote some of the earliest descriptions of plants and animals, establishing the first taxonomy and looking at minerals in terms of their properties such as hardness. Pliny the elder produced what is one of the largest encyclopedia of the natural world in 77 AD, and must be regarded as the rightful successor to Theophrastus. For example, he accurately describes the octahedral shape of the diamond and proceeds to mention that diamond dust is used by engravers to cut and polish other gems owing to its great hardness. His recognition of the importance of crystal shape is a precursor to modern crystallography, while mention of numerous other minerals presages mineralogy. He also recognizes that other minerals have characteristic crystal shapes, but in one example, confuses the crystal habit with the work of lapidaries. He had seen samples with trapped insects within them.

Science and Technology in Ancient India

Indian philosophers in ancient India developed atomic theories, which included formulating ideas about the atom in a systematic manner and propounding ideas about the atomic constitution of the material world. The principle of relativity was also available in an early embryonic form in the Indian philosophical concept of "*sapekshavad*". The literal translation of this Sanskrit word is "theory of relativity" (not to be confused with Einstein's theory of relativity). The wootz, crucible and stainless steels were invented in India, and were widely exported, resulting in "Damascus steel" by the year 1000.

The Hindus excel in the manufacture of iron, and in the preparations of those ingredients along with which it is fused to obtain that kind of the soft iron which is usually styled Indian steel (Hindiah). They also have workshops wherein are forged the most famous sabres in the world. Ancient India was an early leader in metallurgy, as evidenced by the wrought iron pillar of Delhi.

Indian astronomer and mathematician Aryabhata (476-550), in his *Aryabhatiya* (499) and *Aryabhata Siddhanta,* worked out an accurate heliocentric model of gravitation, including elliptical orbits, the circumference of the earth, and the longitudes of planets around the Sun. He also introduced a number of trigonometric functions (including sine, versine, cosine and inverse sine), trigonometric tables, and techniques and algorithms of algebra. In the 7th century, Brahmagupta recognized gravity as a force of attraction. He also lucidly explained the use of zero as both a placeholder and a decimal digit, along with the Hindu Arabic numeral system now used universally throughout the world. Arabic translations of the two astronomer's texts were soon available in the Islamic world, introducing what would become Arabic numerals to the Islamic world by the 9th century. (O'Connor & Robertson, 2000).

The first 12 chapters of the *Sidhanta Shiromani*, written by Bhaskara in the 12th century, covers topics such as: mean longitudes of the planets; the three problems of diurnal rotation; syzygies; lunar eclipses; solar eclipse; latitudes of the planets; risings and settings; the moon's crescent; conjunctions of the planets with each other; conjunctions of the planets with the fixed stars; and the patas of the sun and moon. The 13 chapters of the second part cover the nature of the sphere, as well as significant astronomical and trigometric calculations based on it.

During the 14th-16th centuries, the Karalla school of astronomy and mathematics made significant advances in astronomy and especially mathematics, including fields such as trigonometry and calculus. In particular, Madhava of Sangamagarama is considered the "founder of mathematical analysis".

History of Science and Technology in China

China has a long and rich history of technological contributions. The four great inventions of ancient China are the compass, gunpowder, papermaking and printing. These four discoveries had an enormous impact on the development of Chinese civilization and far ranging global impact. According to the English philosopher, Francis Bacon:

> *Printing, gunpowder and the compass: These three have changed the whole face and state of things throughout the world; the first in literature, the second in warfare, the third in navigation; whence have followed innumerable changes, in so much that no empire, no sect, no star seems to have exerted greater power and influence in human affairs than these mechanical discoveries. (Novum Organum)*

There are many notable contributors to the field of Chinese science throughout the ages. One of the best examples would be Shen Kuo (1031-1095), a polymath scientist and statesman who was the first to describe the magnetic needle compass used for navigation, discovered the concept of true north, improved the design of the astronomical gnomon, armillary sphere, sight tube, and clepsydra and described the use of dry docks to repair boats. After observing the natural process of the inundation of silt and the find of marine fossils in the Taihang Mountains (hundreds of miles from the Pacific Ocean), Shen Kuo devised a theory of land formation, or geomorphology. He also adopted a theory of gradual climate change in regions over time, after observing petrified bamboo found underground at Yan'an, Shaanix province. If not for Shen Kuo's writing, the architectural works of Yu Hao would be little known, along with the inventor of movable type printing, Bi Sheng (990-1051).

Shen's contemporary Su Song (1020-1101) was also a brilliant polymath, an astronomer who created a celestial atlas of star maps, wrote a pharmaceutical treatise with related subjects of botany, zoology, mineralogy, and metallurgy and had erected a large astronomical clock tower in Kaifeng city in 1088. To operate the crowning armillary sphere, his clock tower featured an escapement mechanism and the world's oldest known use of an endless power transmitting chain drive.

One of the star maps from Su Song's *Xin Yi Xiang Fa Yao,* published in 1092, featuring a cylindrical projection similar to mercator projection and the corrected position of the pole star, thanks to Shen Kuo's astronomical observations. Su Sang's celestial atlas of 5 star maps is actually the oldest in printed form.

The Jesuit China missions of the 6th and 7th centuries "learned to appreciate the scientific achievements of this ancient culture and made them known in Europe. Through their correspondence, European scientists first learned about the Chinese science and culture". Western academic thought on the history of Chinese technology and science was galvanized by the work of Joseph Needham and the Needham Research Institute. Among the technological accomplishments of China were, according to the British scholar Needham, early seismological detectors (Zhang Heng in the 2nd century), the water powered celestial globe (Zhang Heng), matches, the independent invention of the decimal system, dry docks, sliding calipers, the double-action piston pump, cast iron, the blast furnace, the iron plough, the multi-tube seed drill, the wheelbarrow, the suspension bridge, the winnowing machine, the rotary fan, the parachute, natural gas as fuel, the raised-relief map, the propeller, the crossbow, and a solid fuel rocket, the multistage rocket, the horse collar, along with contributions in logic, astronomy, medicine, and other fields.

However, cultural factors prevented these Chinese achievements from developing into what could be called "Science". According to Needham (1986:208), it was the religious and philosophical framework of the Chinese intellectuals, which made them unable to believe in the ideas of laws of nature:

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

aforetime. The Taoists, indeed, would have scorned such an idea as being too naïve for the subtlety and complexity of the universe as they intuited it.

History of Science in the Middle Ages

Alexander the great succeeded his father Philip, who was king of Macedonia from 359 to 336 B.C. Two years later (334 B.C), Alexander started upon his career of world conquest. His ideal, a world-state dominated by Greek ideas was excellent, and he did much to promote it. He built cities on the lines of his marches, which were to be radiating points of Hellenism, and it was through him that the influence of Greek art penetrated to the far East - to India, China, and Japan. He was the patron of learning and scientific enterprise - he sent expeditions to solve the problem of the rise and fall of the Nile and to explore the Caspian Sea; and his campaign proved advantageous to the development of natural science, for he sent numerous specimens to his old master, Aristotle, in Athens (Davis 1964:147).

With the division of the Empire, the Western Roman Empire lost contact with much of its past. The library of Alexander, which has suffered since it fell under Roman rule, had been destroyed by 642, shortly after the Arab conquest of Egypt. While the Byzantine Empire still held learning centres such as Constantinople, Western Europe's knowledge was concentrated in Monasteries until the development of Medieval Universities in the 12th and 13th centuries. The curriculum of monastic schools included the study of the few available ancient texts and new works on practical subjects like medicine and timekeeping.

Science in the Muslim World

Meanwhile, in the Middle East, Greek philosophy was able to find some support under the newly created Arab Empire. With the spread of Islam in the 7th and 8th centuries, a period of Muslim scholarship, known as the Islamic Golden Age, lasted until the 14th century. There was intellectual awakening in Baghdad during the reigns of Caliph Harun al-Rashid and his son and successor, Caliph al-Ma'mun (d 833 C.E) who, in 830 C.E., established a Baytul-Hikmah (House of Wisdom) in Baghdad. The establishment is reputed for being a library which also served as an academy and translation bureau, which in many respects proved the most important educational institution since the foundation of the Alexandrian museum in the first half of the third century B.C. (Hitti, 1970:310). Translation into Arabic of works on medicine, astronomy, philosophy, mathematics etc were undertaken from Persian, Sanskirt, Syraic and Greek sources.

In three-quarters of a century after the establishment of Baghdad, the Arabic-speaking world was in possession of the chief philosophical works of Aristotle, of the leading Neo-Platonic commentators, of most of the medical writings of Galen, as well as Persian and Indian scientific works. In only a few decades, Arab scholars assimilated what had taken the Greeks centuries to develop. (Ibid: 306-307) . The copious translation of earlier works was studied rigorously by the Muslim scientists who demonstrated their own abilities for creativity and originality. This scholarship was aided by several factors. The use of a single language, Arabic, allowed communication without need of a translator. Access to Greek and Latin texts from the Byzantine Empire along with Indian sources of learning provided Muslim scholars a knowledge base to build upon. In addition, there was the *Hajj*, which facilitated scholarly collaboration by bringing together people and new ideas from all over the Muslim world.

Muslim scientists placed far greater emphasis on experiment than had the Greeks. This led to an early scientific method being developed in the Muslim world, where significant progress in methodology was made, beginning with the experiments of Ibn al-Haytham (Latinised, Alhazen) on optics from circa 1000, in his *Book of Optics*. The most important development of the scientific method was the use of experiments to distinguish between competing scientific theories set within a generally empirical orientation, which began among Muslim scientists. Ibn al-Haytham is also regarded as the father of optics, especially for his empirical proof of the intromission theory of light. Some have also described Ibn-al-Haytham as the "first scientist" for his development of the modern scientific method. Rosanna Gorini (2003) writes:

> *According to the majority of the historians al-Haytham was the pioneer of the modern scientific method. With his book he changed the meaning of the term optics and established experiments as the norm of proof in the field. His investigations are based not on abstract theories, but on experimental evidences and his experiments were systematic and repeatable.*

Due to the development of the modern scientific method, Robert Briffault (1928: 190-202) observes:

> *What we call science arose as a result of new methods of experiment, observation, and measurement, which were introduced into Europe by the Arabs. Science is the most momentous contribution of Arab civilization to the modern world, but its fruits were slow in ripening. The debt of our science to that of the Arabs does not consist in startling discoveries or revolutionary theories; science owes a great deal more to Arab culture, it owes its existence… the ancient world was, as we saw, pre-scientific. The Greeks systematized, generalized and theorized, but the patient ways of investigations, the accumulations of positive knowledge, the minute methods of science, detailed and prolonged observation and experimental inquiry were altogether alien to the Greek temperament.*

In mathematics, the Persian mathematician Muhammad Ibn Musa - al-Khwarizmi (d.ca 850) gave his name to the concept of the algorithm, while the term algebra is derived from *al-jabr*, the beginning of the title of one of his publications. What is now known as Arabic numerals originally came from India, but Muslim mathematicians did make several refinements to the number system, such as the introduction of decimal point notation. The Sabian mathematician, Al-Battani (850-929), contributed to astronomy and mathematics, while the Persian scholar, al-Razi, contributed to chemistry and medicine. In the field of mathematics the name of Al-Khwarizmi was paramount during the Golden Age of Islam. He is widely considered today as one of the greatest scientific minds of Islam. He composed the oldest works on arithmetic and algebra. His work on algebra "was used until the sixteenth century as the principal mathematical text book of European universities and served to introduce into Europe the science of algebra" (Hitti, 1970:379)

In astronomy, Al-Battani improved the measurements of Hipparchus, preserved in the translation of Ptolemy's *He Megale Syntaxis* (The great treatise) translated as *Almagest*. Al-Battani also improved the precision of the measurement of the precession of the earth's axis. The corrections made to the geocentric model by al-Battani, Ibn - al-Haytham, Averroes and the Maragha astronomers such as Nasir al-Din al-Tusi, Mo'ayyeduddin Urdi and Ibn al-Shatir were later incorporated into the Copernican heliocentric model. Heliocentric theories may have also been discussed by several other Muslim astronomers such as Ja'far ibn Muhammad Abu Ma'shar al-Balkhi, Abu-Rayhan al-Biruni, Abu Said al-Silzi, Qutb al-Din al-Shirazi, and 'Umar al-Katibi al-Qazwin.

Muslim chemists and alchemists played an important role in the foundation of modern chemistry. Scholars such as Will Durant and Fielding H. Garrison considered Muslim chemists to be the founders of chemistry. In particular, Jabir b. Hayyan (Latinized Geber) is "considered by many to be the father of chemistry". The works of Arabic scientists influenced Roger Bacon (who introduced the empirical method to Europe, strongly influenced by his reading of Arabic writers), and later Isaac Newton.

Some of the other famous scientists from the Muslim world include al-Farabi (a polymath), Abu al-Qasim (a pioneer of surgery), Abu Rayhan al-Biruni (pioneer of indology, geodesy and anthropology), Avicenna (a pioneer of momentum and medicine), Nasir al-Din al-Tusi (a polymath), Abu 'Uthman 'Amr b. Bahr al-Jahiz (zoology and anthropological sciences), Ahmad Fadilan b. Hammad (geography) and Ibn Khaldun (forerunner of social sciences such as demography, cultural history, historiography, philosophy of history and sociology, among many others).

Science in Medieval Europe

Muslim Spain: Transmission of Science to Latin Europe

‘Abd al Rahman III of Cordova (d. 961) and his son al-Hakam II (d. 976) played similar roles in Spain to those of Harun al-Rashid and Ma’mun in Baghdad by patronizing learning and culture. Higher education was based on Qur’anic exegesis and theology, philosophy, Arabic grammar, poetry and lexicography, history and geography. Several of the principal towns possessed what might be called universities, chief among which were those of Cordova, Seville, Malaga and Granada. The University of Cordova included among its departments astronomy, mathematics and medicine, in addition to theology and law.

Side by side with universities, libraries flourished. The royal library of Cordova, started by Muhammad I (852-86 C.E) and enlarged by Abd al-Rahman III, became the largest and best, when al-Hakam II added his own collection (Hitti, 1970:563).

Works of Spanish Muslim scientists on astronomy, mathematics, medicine and philosophy were translated into Latin. For example, the planetary tables (zij) which comprised geographical information derived from Ptolemy and al-Khwarizmi were rendered into Latin in the twelfth century by Gerard of Cremona (*ibid,* 571)

Many Christians who studied in the University of Cordova carried learning and culture into the countries from which they came, and the influence of the Spanish Universities upon the Universities of Paris, Oxford, and those that were established in Northern Italy must have been considerable. Gerbert and afterwards Pope Sylvester II were students of the University of Cordova; the latter did much to introduce the science of mathematics to Europe. (Davies, 1964:284).

An intellectual revitalization of Europe started with the birth of medieval universities in the 12th century. The contact with the Islamic world in Spain and Sicily, and during the Reconquista and the crusades, allowed Europeans access to scientific Greek and Arabic texts, including the works of Aristotle, Ptolemy, Geber, al-Khwarizmi, Alhazen, Avicenna, and Averroes. European scholars like Michael Scotus would learn Arabic in order to study these texts. The European universities aided materially in the translation and propagation of these texts and started a new infrastructure which was needed for scientific communities. As well as this, Europeans began to venture further and further east (most notably, perhaps, Marco Polo) as a result of the Pax Mongolica. This led to the increased influence of Indian and even Chinese science on the European tradition. Technological advances were also made, such as the early flight of Eilmer of Malmesbury (who had studied mathematics in 11th century England) and the metallurgical achievements of the Cistercian blast furnace at Laskill.

At the beginning of the 13th century, there were reasonably accurate Latin translations of the main works of almost all the intellectually crucial ancient authors, allowing a sound transfer of scientific ideas via both the universities and the monasteries. By then, the natural philosophy contained in these texts began to be extended by notable scholastics such as Robert Gosseteste, Roger Bacon, Albertus Magnus and Duns Scotus. Precursors of the modern scientific method, influenced by earlier contributions of the Islamic world, can be seen already in Grosseteste's emphasis on mathematics as a way to understand nature, and in the empirical approach admired by Bacon, particularly in his *Opus Majus*. According to Pierre Duhem, the condemnation of 1277 led to the birth of modern science, because it forced thinkers to break from relying so much on Aristotle, and to think about the world in new ways.

The first half of the 14th century saw much important scientific work being done, largely within the framework of scholastic commentaries on Aristotle's scientific writings. Williams of Ockham introduced the principle of parsimony: natural philosophers should not postulate unnecessary entities, so that motion is not a distinct thing but is only the moving object, and an intermediary "sensible species" is not needed to transmit an image of an object to the eye. Scholars such as Jean Buridan and Nicole Oresme started to reinterpret elements of Aristotle's mechanics. In particular, Buridan developed the theory that impetus was the cause of the motion of projectiles, which was a first step towards the modern concept of inertia. The Oxford calculators began to mathematically analyze the kinematics of motion, making this analysis without considering the causes of motion.

In 1348, the Black Death and other disasters sealed a sudden end of the previous period of massive philosophic and scientific development. Yet, the rediscovery of ancient texts was improved after the fall of Constantinople in 1453, when many Byzantine scholars had to seek refuge in the West. Meanwhile, the introduction of printing was to have great effect on European society. The facilitated dissemination of the printed word democratized learning and allowed a faster propagation of new ideas. New ideas also helped to influence the development of European science at this point: not least the introduction of algebra. These developments paved the way for the Scientific Revolution, which may also be understood as a resumption of the process of scientific change, halted at the start of the Black Death.

The renewal of learning in Europe, that began with 12th century scholasticism, came to an end about the time of the Black Death, and the initial period of the subsequent Italian Renaissance is sometimes seen as a lull in scientific activity. The Northern Renaissance, on the other hand, showed a decisive shift in focus from Aristotelian natural philosophy to chemistry and the biological sciences (botany, anatomy, and medicine). Thus modern science in Europe was resumed in a period of great upheaval: the Protestant Reformation and Catholic Counter-Reformation; the discovery of the Americas by Christopher Columbus; the fall of Constantinople; but also the re-discovery of Aristotle during the scholastic period presaged large social and political changes. Thus, a suitable environment was created in which it became possible to question scientific doctrine, in much the same way that Martin Luther and John Calvin questioned religious doctrine. The works of Ptolemy (astronomy) and Galen (medicine) were found not always to match everyday observations. Works by Vesalius on human cadavers found problems with the Galenic view of anatomy.

Persecution of Scientists

The word renaissance signifies the rebirth of the freedom-loving, adventurous thought of man, which, during the Middle Ages, had been fettered and imprisoned by religious authority. The influence of the Church was paramount both in the schools and in the universities which had been founded at such places as Paris, Oxford, Cambridge, Naples, Prague, Cologne, Heidelberg, and Vienna, and no encouragement was given to the spirit of inquiry.(Davis,1964:384). Abelard, who taught in the University of Paris between 1110 and 1140, declared that a doctrine was not to be believed because God has said it, but because we are convinced by reason that it is so. This was pure rationalism and it so alarmed the Church that Abelard was tried for heterodoxy, and forced to recant his opinions. Roger Bacon (1214-94) suffered from disadvantage of holding beliefs which were at least two centuries ahead of his time; he accordingly spent some years of his life in the prison of the Church. His career has been well described as an intellectual tragedy. The blind and unreasoning acceptation of the techniques of Aristotle simply because of the fame of their author seemed wrong to him; and he made a bold and vigorous appeal for a freer use of the powers of the human mind. (Ibid, 384 - 86).

Later came the astronomer Nicolaus Copernicus (1473 - 1543), a Pole who showed that the earth moved round the sun. The work of Galileo (1564 –1642) was considerably hampered by the attention of the Church which still exercised much authority over the opinions which men might express. Galileo reasserted the theory of Copernicus that the sun is in the centre of the solar system and that the earth moves round it. The Church decided that this was a dangerous doctrine, implying that since the earth was made inferior to the sun, that Christianity and man were of little account, and considerably lessening the importance of the Pope. Galileo was accordingly made to recant his opinions, and pretend that he believed that the earth was the immoveable centre of the universe.

The willingness to question previously held truths and search for new answers resulted in a period of major scientific advancements, now known as the scientific revolution. The scientific revolution is traditionally held by most historians to have begun in 1543, when *De Revolutionibs* by Copernicus was first printed. The thesis of this book was that the Earth moved around the sun. The period culminated with the publication of the *Philosophie Naturalis Principia Mathematica* in 1687 by Isaac Newton. Other significant scientific advances were made during this time by Galileo Galilei, Edmond Halley, Robert Hooke, Christiana Huygens, Tycho Brahe, Johannes Kepler, Gottfried Leibniz, and Blaise Pascal. In philosophy, major contributions were made by Francis Bacon, Sir Thomas Browne, Rene Descartes, and Thomas Hobbes. The scientific method which was also better developed as the modern way of thinking emphasized experimentation and reason over traditional considerations.

Decline of Scientific Knowledge in the Muslim World While science was developing in Europe after its transmission from Muslim Spain, the process of decline had set in in the Muslim world. After the fall of Baghdad in 1258 CE, the dismembered Muslim empires (Turkey, Persia, India and Indonesia) only thrived for a brief spell when symptoms of decline set in. The contributory factors are as follows:

i. Incompetent leadership and ignorant following.
ii. Loss of political power by the Muslim empires and colonization by the Europeans.
iii. Obsession with controversies of a theological and trans-empirical nature, thereby promoting sectarianism and disunity.
iv. Passionate clinging to the past (i.e. blind imitation) is an indication of mental morbidity. For example, the closure of the door of *Ijtihad* in *Shari'ah* (Islamic law) for six centuries.
v. Mysticism lost its glory. Gnostic illumination (k*ashf*) was substituted for knowledge. The Muslim world abandoned its commitment to and pursuit of rational, scientific knowledge for the vision of mystical experience.
vi. Emphases on other-worldliness and apathy to urgent matters of the present world.

As a result of these reactionary tendencies, reason became the target of attack and even an object of ridicule. It was contended that reason was foreign to religious truths and led only to their distortion and misrepresentation. Consequently, all domains of knowledge were given scant attention and their findings were not properly appreciated. Science was discredited on the plea that it led to materialism, and philosophy was opposed as intellect was debarred from entering the portals of divine knowledge. The result can be well imagined. Not only was there a dearth of scientific thinking in this period but also an absence of genuine philosophical activity. (Qadir, 1963:1417ff).

With the exception of Indonesia where decadence started earlier, all the Muslim countries witnessed a terrible decline not only in their political status but also in their intellectual and cultural life soon after the awakening of Europe from a long slumber, an awakening which was the result of her intellectual, scientific and philosophical movements. While the Ottomans lost their glory after Sulaiman the Magnificent, the Safawids after Shah ʻAbbas the Great, and the Mughuls in India after Aurangzib, the European nations went from strength to strength, acquiring more and more territories and trade centres from the Muslim rulers, defeating them on land and sea, and finally pronouncing the Muslim empires to be suffering from incurable diseases.

Vice Chancellor, Sir, when in the Middle Ages the Church considered theology more important than science, Western scientists adopted secularism as an ideology and worldview. During the dark era of Islamic history, when the Muslim world abandoned philosophy and discredited science, the Mosque also in this regard preferred theology to science. The resultant effect of this, is the secularization of knowledge, including science by the West in the beginning of the present era, and denunciation of religion including Islam as irrational and unscientific. Thus, secularism as a product of modern science is defined as "the deliverance of man from religious and metaphysical control over his reason and language" (Ashraf, 1985:8-9). Western secular education spread throughout the world through colonialism. Now that education had been divorced from the influence of divine guidance and morality, secularistic tendencies have completely taken over the intellectual as well as physical domains of man's experience and directed them towards unhealthy and evil ways.

Science in the Age of Enlightenment

The 17th century "Age of Reason" opened the avenues to the decisive steps towards modern science, which took place during the 18th century *"Age of Enlightenment"*. Directly based on the works of Newton, Descartes, Pascal and Leibniz, the way was now clear to the development of modern mathematics, physics and technology by the generation of Benjamin Franklin (1706-1790), Leonhard Euler (1707-1783), Georges-Louis Leclerc (1707-1788) and Jean Le Rond d' Alembert (1717-1783), epitomized in the appearance of Denis Diderot's *Encyclopedi*a between 1751 and 1772. The impact of this process was not limited to science and technology, but affected philosophy (Immanuel Kant, David Hume); religion (notably with the appearance of positive atheism, and the increasingly significant impact of science upon religion); and society and politics in general (Adam Smith, Voltaire), the French Revolution of 1789 setting a bloody interlude,indicating the beginning of political modernity. For example, David Hume and his disciples held that only the data of the senses (what could be perceived in the test tubes and telescopes) were acceptable and all else (goodness, God and the rest) was meaningless. Immanuel Kant reduced God to a subjective sentiment. Fredrick Nietzsche declared Him dead. Charles Darwin found chance a better explanation for the cosmos than a creator. Karl Marx revealed that religion God was the opium of the masses invented by the ruling classes. Sigmund Freud insisted that He was merely a neurosis (projection of man's imagination). In the *Humanist Manifesto* I of 1933 *and Humanist Manifesto* II of 1973, the atheistic signers saw themselves as setting the intellectual agenda for subsequent years. They "regard the universe as self-existing and not created" and declared:

> *We find insufficient evidence for the belief in the existence of a supernatural;it is either meaningless or irrelevant to the question of survival and fulfillment of the human role. As non-theists, we begin with human not God, nature not deity. Nature may indeed be broader and deeper than we now know, and new discoveries, however will but enlarge our knowledge of the natural .But we can discover no divine purpose or providence for human species. While there is much that we do not know, humans are responsible for what we are or will become. No deity will save us, we must save ourselves.(Kurtz 1977; cited in Varghese 1984; xxix) .*

Thus, within late modern culture, the material world in which we live is no longer understood as God's creation with moral significance and purpose. Instead, it is viewed as "nature" able to be manipulated in remarkable ways because of the deep scientific understanding and sophisticated technologies of control and exploitation. In secular views of nature, the absence of any framework of moral purpose means that it is in principle open to any manipulation that we humans may choose, to an open–ended process of commodification. (Ian Barns, 2005:188). Knowledge and science are reduced only to the empirical. indeedit is certainly possible to offer philosophical, religious, and other extra–scientific explanations of some observed phenomena, which are non-reductive. However, the scientific establishment is not likely to accept these in its framework. In fact, this reductionist ideology and tendency constitutes what in the modern West is called *Scientism,* something that is fundamentally opposed to Islam and its world view.

Renaissance of Scientific Knowledge in the Muslim World (1266AH/1850-20th Century C.E).

Reformers and Reforming Movements

Reformers and reforming movements among others were the Sanusiyyah movement of North Africa, Jamal al–Din al-Afghani, Muhammad 'Abduhu and his school in Egypt, Zia Gokalp and his school in Turkey, Sayyid Ahmad Khan in Indo-Pakistan. Efforts for revival amongst the Muslims are a subject of profound interest. During the very early years of the period of decadence two leaders of thought rose to combat the forces of ignorance and tried their best to bring back the Muslims to the fountain head of Islam. The first of these was Muhammad bin 'Abd al-Wahhab of Arabia whose spiritual influence spread far and wide in the Islamic world, particularly in Arab countries: Yemen, Iraq, Syria, and Lebanon. And the second was Shah Wali Allah of Indo-Pakistan. Sequel to their reformative efforts the following achievements were made:

i. The doors of *Ijtihad* in *Shari'ah* were opened and the educated people began to feel that no finality and definiteness could be legitimately attributed to any interpretation or conclusion regarding any problem not justified by the *nass* (text) of either of the two primary sources the Qur'an and *Hadith*. There was change in the attitudes of Muslim scholars towards social philosophers such as Al-Farabi and Ibn Khaldun..

ii. Literary revival of the past cultural and intellectual heritage by the collection, presentation, translation and publication of classics of Muslim ancestors (Nicholson, 1977: 468). For example, the Presbyterian College in Beirut (established in 1283/1866) which became the American University was the first modern educational centre in the Near East where young Arabs could gain a scholarly knowledge of their great cultural and national past (Landau, 1958: 256).
iii. Muslim scholars began to drink deep at the fountain of Western learning by receiving higher education and have research degrees in the fields of arts, sciences and humanities (in the Universities of Europe, America, and the Soviet Union).
iv. Establishment of language academies. For example, the Arab Academy of Damascus in Syria founded by Muhammad Kurd 'Ali and endowed by King Faisal.
v. Establishment of local, national, international institutes and universities in Muslim countries pursuing science and technology, arts, humanities and education.
vi. Establishment of the Philosophical Society of Egypt, the Pakistan Philosophical Congress, the Philosophical School of Farangi Mahal in Lucknow (India), and the Khayrabadi School in Iran (Nasr, 2003:16).

Modern Science

The scientific revolution established science as the preeminent source for the growth of knowledge. The early modern period is seen as flowing from the Renaissance, in what is often known as the scientific revolution viewed as the foundation of modern science. During the 19th century, the practice of science became professionalized and institutionalized in ways which continued through the 20th century. As the role of scientific knowledge grew in society, it became incorporated with many aspects of the functioning of nation-states.

The history of science is marked by a chain of advances in technology and knowledge that have always complemented each other. Technological innovations bring about new discoveries and are bred by other discoveries which inspire new possibilities and approaches to longstanding science issues. Investing in science and technology is critical to ensuring prosperity and a high quality of life. Scientists are at the forefront of the development of scientific and technological innovations. The primary objectives of these professionals are to create and develop novel research that can be used to solve problems for both the states' populations and individual entities like companies or other private organizations.

However, the fundamental disconnect between contemporary science, technologies and the transcendental reality – God has robbed the scientific community of all values and stripped it of essential humanness. Ataur-ur-Rahman (1981:172) explains that there is a growing number of areas in science where the truth of this in clearly visible. The field of genetical engineering is one: the ability to manipulate the human species so as to be able to breed geniuses, labourers or soldiers has horrific possibilities. The power of the tom for destructive purposes has already been demonstrated in Hiroshima and Nagasaki. Research in the fields of nerve gas and lethal germs have already resulted in the development of horrifying destroyers of humanity, many of which were freely used in Vietnam. A field of emotional chemistry that is evolving may, eventually, make it possible to control human "will" through chemical agents. In all these developments scientists play a crucial role.

3. **Modern Challenges**

Islam

According to Al-Attas (1993:39-40), the leading modern Western intellectuals admitted that secularization as an ideology or a philosophical programme consists of three interrelated and integral components: the disenchantment of nature, the desacralisation of politics, and the deconsecration of values. In his analysis, the disenchantment of nature is the most fundamental component in the dimensions of secularization as a philosophical programme and most certainly opposed to the Islamic view of nature. The disenchantment of nature understood and propagated as such, aims at, as well as, ends up divesting nature of any cosmic significance and severing its symbolic connection with God; depriving man's respect for nature to the extent that he treats nature which he once held in awe with a ruthless kindof vindictiveness; destroying the harmony between man and his environment.

Moreover, the disenchantment of nature has led both secularists and humanists to the cultivation of a scientific attitude which, according to them, means the rejection of dogma, questioning of absolutes and, instead of faith, sole reliance on reason. Reason must be given complete freedom and not to be guided by revelation. Any human spirit receiving revelation is rejected because such revelations cannot be proved according to Western scientific methodology.

To tackle the challenge posed by secularization of knowledge by the West, a World Conference on Muslim Education was held in Saudi Arabia in 1977 to ward off the moral turpitude of a scientific attitude (or method) which rejects faith in God and promotes reason which is independent of scriptural revelations. Similar world conferences on Muslim Education were held in Islamabad, Pakistan 1980, Dhaka, Bangladesh, 1981, Jakarta, Indonesia, 1987 and Cape Town, South Africa, 1996. (Adebayo, 2006:176-177).

The conferences have opened up the eyes of the entire Muslim *Ummah* to realize the marginalization of their education, colonization of their traditions, distortion of their culture and erosion of their worldview. The main task of the conferences was to design curricula for different ladders of education with the view of bridging the gap between secular and *madrasah* systems of education. The International Institute of Islamic Thought (IIIT) was established in 1981 in Herdon, Virginia, United States and the World Centre for Islamic Education (WCIE) in Makkah, 1981, to spearhead conceptual research and implementation of the blueprints and the recommendation of the Organization of Islamic Conference (OIC).

The Islamization of Knowledge Programme under the auspices of IIIT has been adopted as a methodological and epistemological rearrangement of the sciences and their principles. In the working paper for the successful implementation of the Islamization of Knowledge Programme, al-Faruqi (1981) proposed a twelve-step work-plan which to him aimed at mastering the modern disciplines, mastering the Islamic legacy, establishing the specific relevance of Islam to each area of modern knowledge, seeking ways for creative synthesis between the legacy and modern knowledge and launching Islamic thought on the trajectory which leads it to the fulfilment of the divine patterns of Allah.

A critical appraisal of the work-plan of the Islamization of Knowledge Programme and its challenges have been identified as follows: lack of model institutions on the programme, problem of personnel (staff teaching and students pursuing the programme), influence of secular education, government policy on the curriculum, adequate funding, and dearth of relevant textbooks in the various intellectual disciplines being developed for the Programme. (Adebayo, 2006:178, 2008:231).

More to the point, Vice Chancellor Sir, in order to meet the challenges of modern science and cast its mould in the crucible of Islam, Muslim philosophers of science have taken a critical look at the four structural components of science (Osman Bakar, 2003:34ff).

❖ First component consists of concepts, facts (data) theories, laws and the logical relationships that exist among them. It is the knowledge content of the science in question, and this can be proved.

❖ Second component: consists of basic premises and assumptions (epistemological foundations which cannot be proved, (i.e. the nature and reality of the object of study and its ontological status). These cannot be proved, but their truths may be established in another science or metascience.

❖ Third component relates to methods of study which vary according to the nature of study: perhaps logic is common to all the sciences. The core method of any science consists of the following: gathering of data for analysis, theory formation, test and verification of truth claims in hypotheses, theories and laws. Diversification of sources of data is allowed in Islam to even include divinely revealed sources. A science may employ more than one method. For example, Ibn al-Haytham (d.430/1039) used a combination of mathematical and physical methods in his *The Book of Optics*, the best Muslim work on optics.

❖ Fourth component: concerns the goals sought to be achieved by that science. The main goal of a science is to discover that aspect of reality pertaining to its object of reality. It is to arrive at a complete knowledge of that domain of reality with scientific certainty (*'ilm al-yaqin*).

Given the fact that the structural division of science pertains generally to epistemological issues, it is most appropriate to relate these divisions to the dimension of the religion of Islam dealing with knowledge. This means we are here interested in exploring Islam's inner resources that would enable us to shape them into a universal vision of "Islam as a way of knowledge". *'Iman* as summarized in the six fundamental articles of faith and as understood and interpreted at the level of *Ihsan* (virtuous conduct) is precisely the domain that serves as the epistemological foundation of universal sciences like metaphysics, theology, cosmology, psychology and eschatology. The Islamic worldview in which science is to be cultivated and pursued "is one that is fully informed by these universal sciences". If we would like to see the four structural components of science to be in harmony with Islam, then we have to make sure that they have been shaped by the relevant ideas embodied in those sciences (i.e. metaphysics, theology, cosmology, psychology and eschatology).

It is also quite clear why the Islamic intellectual tradition is important for our inspiration, consultation and guidance when it comes to the formulation of the relationships between science and Islam. The experience of our predecessors in using Islam's inner resources and developing theology, metaphysics, cosmology, psychology and eschatology in conformity with religion is inevitable to us. Needless to say, there is always room for improvements in intellectual matters like these.

As for the second structural component of science which consists of the basic premises or the foundational principles, it is important to bring Islam's epistemological resources to bear on it. This is because we do know that, on the basis of their nature and epistemic status, the premises of a science may not belong to the category of real knowledge or their truths may be doubtful. As maintained by Muslim philosophers of science, all premises may be reduced ultimately to the following four categories:

- ❖ the category of received opinions or beliefs
- ❖ the category of generally accepted opinions and beliefs
- ❖ the category of sensory knowledge or empirical data based on sense perceptions, and
- ❖ the category of intuitively accepted intellectual principles.

In their view, premises in the fourth category are necessarily true and certain and therefore completely acceptable. Also acceptable are new premises derived from them in accordance with the rules of logic. In other words, the truths of rational propositions based on intuition and logic are affirmed and their suitability as premises of a science unquestionable. Where the premises may be questionable is in the other three categories. It is in the nature of beliefs that they may be true or false. It is therefore, necessary to scrutinize premises belonging to the first two categories to ensure that these do not contradict Islamic doctrines. The beliefs and opinions taken as premises, whether these originate from religious sources other than Islam, or happen to be generally accepted in a certain culture, should be replaced, wherever possible, with explicit Islamic doctrines even if they are not contrary to Islam. The implication here is that Islamic doctrines may provide a much richer source of basic premises for the sciences even when we can accept those beliefs coming from other religious traditions.

As for the reliability of sensory knowledge or data based on sense perceptions to be used as premises, the issues involved need to be well understood. We may say that for the particular purpose at hand, by itself, such kind of knowledge is legitimate and reliable only in a limited context. The extent of its legitimacy and reliability varies with the nature of the subject matter of the science in which it is sought to be used. Clearly, empirically derived premises are more relevant to empirical sciences like physics and chemistry. But in the case of those sciences in which our approach to the subject matter would involve elements of belief, conjecture and other more subjective considerations to a great extent, the use of empirical data alone would be inadequate. The required premises need to be formulated on the combined basis of empirical and rational knowledge.

Furthermore, there are sciences in which we have to depend solely on rational or intellectual principles for our premises. It is clear to us that traditional Islamic disciplines such as epistemology, metaphysics, theology, cosmology, and psychology have a very important role to play in any intellectual project to formulate conceptual relationships between science and Islam. Their main role would be to furnish us with rational doctrines that are scientifically justifiable to be used as premises of the various sciences. The cosmological doctrines are perhaps the most needed in the task of laying the foundations of the physical and biological sciences. Premises of the life sciences need to be based on the traditional conceptions of such central ideas as soul and life pertaining to all living things. In the cognitive sciences, among other things, we have to enlist the help of traditional cognitive psychology in clarifying for us the multi-layered meaning of intelligence and its whole range of activities. The consideration of these traditional doctrines for their roles as premises of the sciences in no way nullifies the roles of empirical investigations. By all means, let us resort to the empirical investigations as well, wherever possible and pertinent.

Issues of methodology, the third structural component of science, are no less important in their need to be treated in the Islamic perspective. At the methodological level, the relationship between science and Islam would involve a general discussion of how the religion views the different sources of knowledge accessible to humankind. The most fundamental question that needs to be asked and answered in this matter is how can we humans gain knowledge of reality either in its partial or total aspects? . This question has been answered in the past in different ways by Muslim scholars. On the basis of their answers, we come to the conclusion that we have to develop an Islamic cognitive psychology which is at once traditional and contemporary. In this psychology, we would synthesize the traditional exposition of the hierarchy of human faculties of knowing, corresponding to the hierarchy of the cosmos, with modern discoveries in the subject. We then need to apply this newly formulated Islamic cognitive psychology to the specific sciences to determine the methods of study that are most appropriate for each of them.

As for the last structural component, the aim of science to know an aspect of reality need to be related to the more general Islamic perspective on the purpose of human existence, which is to gain knowledge of reality. It is through the cultivation of the reality of the sciences that human beings find themselves in the best position to know reality.

The *Shari'ah* is the main source of Islam's value-system. Thus, the applications of science of Muslim society and culture should be guided by the *Shari'ah's* hierarchy of values of human acts and objects. In this value-system, every human act must fall into one of the following five categories:

- Obligatory (*wajib*);
- Meritorious or recommended (*mandub*)
- Forbidden (*haram*)
- Reprehensible (*makruh*)
- Indifferent (*mubah*).

Clearly, in the domain of applications of science and technology, there is an urgent need to categorize them in the light of the above hierarchy. Given the present situation in Muslim societies, the task of categorizing contemporary scientific and technological applications has to be jointly undertaken by scholars of Islamic law and Muslim scientists. To be given top priority are legal-ethical evaluations of applications in fields like genetic engineering, technologies used to produce weapons of mass destruction, and food and medical technology.

Science

A few decades ago, Naquib Al Attas (1976:127) pinpointed the contemporary arch-problem in the concept of knowledge. He observed:

> *Many challenges have arisen in the midst of man's confusion throughout the ages, but none perhaps more serious and destructive to man than today's*

challenge posed by western civilization. I venture to maintain that the greatest challenge that has surreptitiously arisen in our age is the challenge of knowledge indeed, not as against ignorance; but knowledge as conceived and disseminated throughout the world by western civilization; Knowledge whose nature has become problematic because it has lost its true purpose due to being unjustly conceived and has thus brought about chaos in man's life instead of, and rather than, peace and justice.

Another contemporary philosopher Fritjof Capra (1988: 144-115) of Lawrence Berkeley Laboratory, California, has acknowledged the same fact in his own way in the following words:

> *The major problems of our time - the growing threat of nuclear war, the devastation of our natural environment, our inability to deal with poverty and starvation around the world, to name just the most urgent ones - are all different facets of one single crisis, which is essentially a crisis of perception.*

Another scholar, Steve Fuller, the author of *Philosophy of Science and its Discontents* (1989) has asserted that the present science *per se* is suffering from a crisis of identity. His discontent and dissatisfaction with contemporary science and disciplines is so intense that it seems unbelievable for him to accept a crisis in science and philosophy of science. He asked: Why is the philosophy of science suffering an identity crisis? Can a discipline suffer an identity crisis?

Here it is also important to note a profound observation of Radcliff-Brown, (1958:152) who claimed that the real problem lies in the conception of science. According to him, the science (method) is not properly developed. Commenting on Saint-Simon and Comte, he argued that neither of them really developed the science (method). "*Saint-Simon was one of the founders of socialism,and endeavored to establish a new religion; his disciple, Comte, was a philosopher who also founded a new religion of positivism*".

All these and several other observations echo the same problematic of science! This realization eventually has opened new avenues for refection on the redefinition and reconceptualization of the terms 'knowledge' and 'science'. But the rethinking on the redefinitions of the terms are geared in different ways like the shifting of the paradigm, change of perspectives or in the re-establishment of the relationship between physics and metaphysics and their problems and implications. Even a cursoryglance at the literature on the 'paradigm shift' and the various proposals on the change of perspectives can elucidate the point. Here are some observation for quick reference and clarification. On the nature and problem of the relationship between physics and metaphysics, Ivor Leclerc (1988: 25) observed that "a*n examination of the relationship between physics and metaphysics will be superficial if it does not recognize that the very conception of physics and metaphysics respectively are themselves involved in a process of change*"

For a shift in the paradigmatic framework, Thomas H. Kuhn (1968:62) maintains:

> *The transition from a paradigm in crisis to a new one from which a new tradition of normal science can emerge is far from a cumulative process, one achieved by an articulation or extension of the old paradigm. Rather, it is reconstruction of the field from new fundamentals, a re-construction that changes some of the field's most elementary theoretical generalizations as well as many of its paradigm methods and applications.*

On the necessity of the reconceptualization of the term 'science', Jafar Shaikh Idris (1975:9) suggests that "*natural as well as social scientists to be true to their convictions must consciously and intelligently put forward a new and radical conception of science…* " . Mumtaz 'Ali (1994:8) explored and examined the shortcomings of the existing scientific method and observed that science is generally understood as a new spirit of systematic enquiry, of new methods of investigations, of the method of experiment, observation, measurement, collection of data, of analysis and examination and explanation of data. This method is based on some unprovable cosmological and ontological assumptions. Chava-David Nachmias (1990:6) categorically accepts this fact. He writes:

> *The scientific approach is grounded on a set of fundamental assumptions that are unproved and unprovable. They are necessary pre-requisites for the conduct of scientific discourse and represent*

> *those issues in the area of the philosophy of science that is termed epistemology - the study of the foundations of knowledge.*

Let us turn to the analytical exposition of the concept of method, identifying the shortcomings thereof. In the Western positivist tradition, science is defined as method. Whenever a branch or piece of supposed factual knowledge is rejected by science it is always on the basis of its method. The ultimate purpose of the application of the method is to know the true nature of the things, which is only possible if we base our investigation on a correct method. In other words, to know the truth we need true method. *"The term 'method' is referred <u>to the specification of steps</u> which must be taken in given order to achieve a given end"* (Caws, 1967: 339). It is also argued that the knowledge thus derived ultimately depends on <u>the concrete facts of observation and experiment to find out the truth</u>. (Coser, 1987: 38). If we examine these two claims of the specification of steps and the concrete facts we will come to this conclusion that as a first step in the process of investigation, we have to determine the existence or non-existence of the Absolute Truth on the basis of absolute certainty. Can we argue that man is self-created? Can we prove this as true? If we are able to prove it, is it on the basis of our speculation and conjecture or on the basis of absolute certainty? The true nature of everything is ultimately related with Absolute Truth of this world.

In the scientific method, man is assumed to have evolved, but there is no conclusive empirical evidence for this. In other words, in our method of scientific knowledge, we start on the basis of an assumption rather than on the basis of absolute certainty about the Absolute Truth. To be a true, scientific method we have to determine our each specific step on the basis of Absolute Certainty. Here in the scientific method our step is based on assumption.

Now we will look into the claim of the scientific method which upholds that it completely depends on concrete facts. When we are observing or examining a natural or social phenomenon are we sure that we have gathered all the concrete facts about it? Can we argue with certainty that we know the origin of man and nature? Can we prove this on the basis of scientific method without involving any element of speculation or rational explanation? So far there is no science or any scientist who can claim that all his explanations are based only on experiment and observation. Now, even natural scientists accept that when the present science gives us the latest news about the nature of the reality it, at the same time provides us with metaphysics (Kitcheners, 1998:4).

Again here in the scientific method we have developed our argument on the basis of our assumption about the origin of man and nature. The question is, even while not identifying the true nature of the relationship of man and nature on the basis of Absolute Certainty, how can we determine the true nature of the things? Here again, the relationship is determined on the basis of our assumptions. The quest of the modern philosophy of science for the conquest of nature to bring real progress to mankind proves that this assumption is based on man's speculation. All these emphatically demonstrate that at several stages the scientific method has assumed things, which are unprovable. Is it appropriate to take any single step on the basis of unprovable assumptions?

On the basis of these assumptions, even we have formulated our worldview. The present debate among world scientists and philosophers for a change of paradigm in science and social sciences is a witness to this fact. The new paradigm has now been formulated on the basis of the same philosophy of life upon which the scientific method was developed. A few questions would throw light on this fact. Does this new paradigm regard 'man' and his power of 'reason' and sense observation' as the only methods of knowledge? Does it determine as a first step the existence or the non-existence of Absolute Truth on the basis of an absolute certainty? Or still does this new paradigm depend only on 'man' for valid knowledge?

A close analysis of the arguments for a new paradigm as well as the old positivist-empiricist tradition reveals this important fact that they mainly depend on 'man' as the only source of knowledge. It is immaterial here whether they differ from each other on their emphasis on different capabilities of man. Furthermore, the very purpose of acquiring knowledge of nature for them is to control nature to such an extent that man should be liberated from God and nature and should become autonomous and sovereign. Consequently, all the studies of 'nature' and society are categorized as science and scientific knowledge and this science is also extended to the philosophical enquires of what is Truth and what is Reality? Consequently, the character of truth and reality is also radically changed and becomes relative.

After this analysis, will now we look into the main tool of scientific method, i.e., sense perception, which is held to be the primary source of all valid empirical knowledge. Again here we depend on some assumptions. This claim itself is based on an assumption (Theodorson, 1969:375). We argue that reason and the senses are too limited to look into the realm of both noumena and phenomena. We can only penetrate into phenomena. Here we admit the limitation of reason and observation, but at the same time we assume two things: that reason and observation cannot penetrate into noumena, and that noumena is not reality. How can we argue that something is not 'reality' if we are unable to observe it? Does it not mean that we have assumed it only because we cannot empirically prove it. The question is, if we mean by science the method of observation and experiment, then how can a method look only into some aspects, i.e., phenomena, and overlook other aspects, i.e.,noumena?

To be a complete method we have to observe both the outward phenomena and inward noumena. If we observe only the outward physical phenomena and deny the existence of any inward noumena it means we have ourselves limited our own observation only to the outward physical phenomena. This limited observation, therefore, cannot be taken as a valid method. Because if we observe only the outward phenomena without any transcendental signs underlying it, this would be our animalistic observation, for it is an animal which is least concerned about the transcendental signs of the green grass and only enjoys eating it with no reflection.

However, an animal cannot be blamed for an animalistic observation for it is not blessed with the intellectual faculty. But what about man's animalistic, one-sided observation since he possesses the intellectual and sensory faculties? If these powers of observation and reflection do not penetrate into both the inward noumena and outward phenomena and fail to perceive the 'complete understanding' of a particular thing, then the method loses all its meaning and ceases to be the method. If method implies an orderly procedure, how can it still remain a method if all through its techniques, both the outward appearance and inward reality are neither observed nor recognized? In other words, the observational faculty of man requires the knowledge of the noumena to be the complete observation. We can conclude our discussion with this submission that since the scientific method of observation includes phenomena and excludes noumena it is incomplete and unreliable.

However, before we take up the venture for the reconceptualization of science and scientific method, it seems pertinent to discuss briefly the factors that led to the separation of the phenomenon and noumenon, one as the domain of science and the other as the arena of metaphysics, and how a re-union of both is a heated discussion of contemporary times. Earlier, the study of nature was categorized under the philosophy of nature, *philosophianaturalis*. Philosophy was derived from the study of nature during the eighteenth century and 'reason' and 'experience' were held as the only true ways to acquire knowledge; later experience was alone emphasized as the only positive means of knowledge.

According to Whiteman, the term 'natural-science' was first used by Thomas Hobbes in *Leviathan* and the word 'scientist' was not in use before 1839. Under natural philosophy, unlike natural science, metaphysics was a part of the whole enquiry, although the hypotheses of these were also conjectural, speculative and unprovable. Later when Kant and Kantians argued that metaphysics is unknowable for experience cannot go beyond the 'thing-in-itself', science was conceived and interpreted as demonstrable knowledge - knowledge of the phenomenon, not noumenon, that can be demonstrated through experiments.

However, the rejection of metaphysics never implied for most of the empiricists the rejection of the existence of something Super or Great or that which is unreachable. We can easily discern such an uneasy state of mind through the following lines of Hume:

> *We are ignorant, it is true, of the manner in which bodies operate on each other. Their force of energy is entirely incomprehensible. But are we not equally ignorant the manner or force by which a mind, even the Supreme Mind, operates, either on itself or on body. (Hume, 1955*: *VII, Pt. 1)*

A frank acceptance of ignorance by Hume needs due appreciation. The acceptance of ignorance is acknowledged due to skepticism - whether a radical scepticism or a gentleman's scepticism. But what is important to understand is, as pointed out by Peter T. Manicas, this scepticism is 'not about the existence of an external world' or the reality of space and time, but a scepticism about any theory which is not logically implicated in experience (Peter,1987:15).

Similarly, in Newton, we find a frank acknowledgement of his ignorance of the cause of gravity. He writes:

> *it is inconceivable, that inanimate brute matter should, without the Mediation of something else, which is not material, operate upon, and effect other matter without mutual contact, as it must be, if Gravitation in the sense of Epicurus, be essential and inherent in it… gravity must be caused by an Agent acting constantly according to certain laws; but whether this Agent be material or immaterial I have left to the consideration of my readers. (Quoted by Harre, 1964, p. 108)*

At some other place, on the same issue, he writes "*You sometimes speak of Gravity as essential and inherent to matter. Pray do not ascribe this notion to me; for the cause of Gravity is what I do not pretend to know, and therefore would take more time to consider it*". *(Quoted by Harre, 1964, p. 108)*

All this clearly means the failure of the quest for absolute certainty and Absolute Reality, not the very absence of absolute certainty and Reality. However, the later empiricists, positivists or Comteists, who are all empiricists with some differences, completely denounced any sort of metaphysical reflections as unscientific and hence no knowledge as such. Hence, Peter aptly pointed out, the two epistemologies and the initial misconception of 'science' have virtually given rise to a series of problems and complications. He observes:

The first alternative, 'empiricism', in its many modern varietye - empirical realism, phenomenalism, pragmatism - eschews the need for retroduction. Science proceeds without it. The second argues, in effect, that while knowledge must be restricted to the realm of the 'empirical', empiricists cannot account for science, that on their grounds, sciences is not possible…these two epistemologies have been the substantial competitors now for about 250 years - with implications regarding the understanding of science which have been nothing short of disastrous. It is not merely that our philosophy of science is bad - so much the worse for the philosophers! It is rather that, as I shall argue, the very genesis and articulation of a scientific psychology and of social science has been powerfully distorted by a series of ideas which follow from this initial misconception (Peter, 1987: 11).

Having thus acknowledged the disastrous implications of such a conception and interpretation of science, the West has now lately realized the importance and essentiality of metaphysics for the foundation of science and argues for a new metaphysics for physics. (Kitchener, 1988). Ivor Leclerc says: "*…There has been manifest a very effective and fruitful partnership between theoretical physics and experimental physics. The time has evidently arrived for a third partner to be added, namely, metaphysics*" *(*Leclerc,1988:36*)* But the whole matter of merely an introduction of metaphysics to physics is not so simple as it appears *prima facie*. There is an inherent problem in the modern conception of science and metaphysics that developed from such a science. With the development of positivism, the theory of quantum mechanics was developed on the quantum phenomenon, discovered by Marx Plank. With this, science is no longer conceived predominantly as a systematic inquiry but as mechanics, i.e., the mathematical investigation of motion. This completely disintegrated 'mechanics' from 'metaphysics'. Whereas earlier in *philosophia naturalisa* there was an integration of 'mechanics' and 'metaphysics'.

With the disintegration of'mechanics' and 'metaphysics', emerged the modern conception of science as 'mechanics' and underneath it had a few metaphysical presuppositions. The three most important metaphysical presuppositions pointed out by Leclerc, are:

- ❖ The conception of nature as matter, wholly inert and in itself changeless, with locomotion, that is, change with respect to place, the only change nature is capable of;
- ❖ The conception of this matter has been inherently mathematical in nature and structure, that is, it is essentially quantitative, not qualitative; and
- ❖ The conception of matter and its locomotion as being exhaustively understandable in terms of mechanics, that is, the applied mathematics of motion. (Leclerc, 1988:30).

Thus, the world is conceived as a mathematical structure, and science as the mathematical investigation of the structure. This can be further explained in terms of Einstein's theory of relativity and more precisely through his own words *"I am convinced that we can discover by means of purely mathematical constructions, the concepts of laws connecting them with each other, which furnish the key to the understanding of natural phenomena" (Einstein, 1935: 136).* Hence, Leclerc argues, what is needed is a metaphysics which should critically evaluate the earlier metaphysical presuppositions. He writes *"there is today an urgent task of metaphysics, namely, the discernment and critical evaluation of the implicit metaphysical pre-suppositions operative in enquiry in the natural sciences" (Leclerc,1988:32)*

Here arises the primary question again - whether a purely human discernment of the presuppositions will bring the real metaphysics we aspire for? How can we be certain that our discernment this time will bring forth the certain and definite facts which lie at the basis of natural phenomena or whether they will again be challenged by others as mere presuppositions? An answer from the West can be cited here, in the words of Errol E. Harris:

> *The questions have also been raised whether the physical universe as described and envisaged by modern scientists is anything more than a temporary conceit, doomed, like so many of its predecessors, to be superceded by others, unlike it and contradictory of it. The real universe, it has been maintained, is inaccessible to our knowledge and our science is no more than how we conceive it. Past eras have concocted various conflicting pictures of the universe, each of which has been held as the final truth, only to be refuted, rejected as false, and superceded by another. Our own is in no better situation. If these were indeed true, it*

would be vain to recommend a new metaphysics for that would be similarly tainted. (Harris,1988 :168).

Obviously, it would be similarly tainted if again it would be founded on the unproved, conjectural and speculative pre-suppositions of man who denies Absolute Reality, theoretically or practically or both, as a means to understand universe, nature and man - as a primary means to science and broadly knowledge. To be sure, to have an authentic, reliable method which can present an authentic and real picture of the universe, nature and man, we have to:

❖ First come out of this fallacy that our power of intellect and observation cannot penetrate into noumena and therefore we have to deny the reality of the existence of noumena.

❖ Secondly, we have to give up all our false assumptions and build our method on the basis of absolute certainty instead of speculation and conjecture.

❖ Thirdly, we have to be reasonable and scientific and should avoid prejudice and bias in our approach. We cannot give any room to our vain desires and whims and fancies. We have to develop our method on the basis of absolute certainty.

With all the order that pervades the whole expanse of the cosmos, wonders of nature and the highest faculties of man and many things around him, it seems absolutely unreasonable and unscientific to deny the existence of the Absolute Truth, Certainty and Reality behind all these things. Our sense perception demands from us that we must acknowledge that this world exists because of the existence of the Absolute Truth. Can we prove any disorder in the nature and even in man, whereas the scientists themselves accept that there exists some order in nature. In the very existence of man and nature, there lies a strong 'empirical evidence' and 'reason' to understand and accept the omnipresence and mnipotence of the Creator. But if man is self-created, or say, merely evolved through the process of evolution without reference to his Creator, what is the empirical evidence?

An empirical evidence requires an empirical reality and from the theories which nullify the study of realities it is foolhardy to expect any empirical evidence and as such any empirical reality. All this evidently points to the very existence of Absolute Reality - Creator of man and nature - the Absolute Truth on whom not only 'reason' but all other senses of man and every thing depend. Hence, what is more reasonable is the recognition of Absolute Reality and the submission of reason and observation to the Creator prior to the rational and empirical investigation.

At this point, we may bring in the Messengers of the Creator who claimed that they have 'knowledge' about the Reality. Whatever we present, they argued, before you O mankind, is neither on the basis of our own philosophical creativity nor on the basis of our conjecture or speculation; rather it is on the basis of 'the knowledge' which we receive from the Creator Himself. Now, it is up to your 'reason' and 'observation' to critically examine our claim and recognize the Truth of the world. The last Messenger of the Creator, Prophet Muhammad presented his case in the following words from the book of the Creator - the Qur'an:

> *O, Mankind: Serve your Lord, who created you and those before you; so that you may ward off evil. Who has appointed the earth a resting place for you, the sky a canopy and who causes water to pour down from the heavens, thereby producing fruits as food for you? So do not set up rivals to Allah, when you know better? (Al-Baqarah 2:21-22).*

Further, man was reminded to recognize the Creator of this universe "*O, Mankind: call unto mind the grace of Allah unto you: Is there any Creator, other than Allah, to give you sustenance from heaven or earth? There is no god but He, how then are you deluded from Truth?". (Fatir 35:3).*

For the acceptance of Absolute Truth there is no compulsion, rather it is left to the 'reason' and 'wisdom' of man.

4. **Conclusion**

ViceChancellor, Sir, so far, in this inaugural lecture, the conceptual framework within which this work has been carried out has been stated. The theological and historical relationship between Islam and science has been explored; and the modern challenges facing the Muslims and scientists have been identified. The followings are the inferences which can be drawn from the study:

The universal recognition of science and technology as means of development of humans and modernization cannot be over-emphasized. Scientific and technological knowledge is a universal heritage to which contributions have been made from pre-historic, Greco-Roman, Chinese, Indian, Islamic and Western civilizations. In the past, moral considerations were a concern of all believing scientists, both by the ancient Greek and early Muslim thinkers, who took an ontological view of knowledge which went beyond observable reality. This perspective has dramatically changed in our era. The development of science and technology under a secularist - materialistic worldview has led to grave consequences for humankind. In this worldview, "the ethical, philosophical and religious dimensions of science and technology are neglected and humankind's physical comfort is confused with true happiness".

There is an interface between religion (Islam) and science because the knowledge of both are derived from 'revelation' from Allah – the Creator – God. Religion is based on the revealed word of God, while science studies the phenomenal world as a result of which Allah revealed the nature, purpose and use of His creation (i.e., phenomenal world) to the scientists. Science is considered as language of fact which leads to discoveries, while religion is the language of value which deals with evaluation of human thought and action. Thus, Albert Einstein is reported to have said that "Science without Religion is lame and Religion without Science is blind". Islam and science are not two separate entities that need to be related through an external process; rather, there is an underlying unity in the domains of knowledge based on the concept of *Tawhid* (Unity of God) – the most fundamental principle of Islamic epistemology.

Man is a constituent of body and soul – he is at once a biological and spiritual being. The development of one at the expense of the other results in a disequilibrium. It is theocentrism when only matters of spirit are emphasized; while it is anthropocentrism when man is regarded as constituting the measure of every thing – the starting point of all thinking and action. Man as a denizen of the natural world must pursue science and technology; and as a spiritual entity he must listen to and follow the divine guidance in his earthly sojourn – most especially in the application of science and technology.

Despite the apparent similarities in the understanding of the nature of phenomenal reality and in the methods of inquiry pertaining to it, the underlying "profound differences" between Islamic and Western philosophies of science are due ultimately to the affirmation of revelation (Qur'an) and the tradition derived from it – as the source of true knowledge of ultimate reality. In other words, the noumenon exists and it can be discursively referred to, through the study of phenomena, and this discursive knowledge is in turn both confirmable subjectively through direct personal intuition and objectively through authoritative revelation and tradition, and the shared experience of the *Sufis* (mystics).

There have been in the West, internal critiques of the modern science that rejects belief in God by believing scientists and religious ministers. A number of centres and institutes has been established for constructive engagement between science and religion and for networking between scientists and religious individuals. Among others are:

- The Centre for Theology and the Natural Sciences, (CTNS), Berkeley, California, U.S.A.
- Philadelphia Centre for Religion and Science/ Metanexus Institute (PCRS/Metanexus). Metanexus is an international online forum on religion and science with thousands of subscribers in 57 different countries.
- Institute on Religion in an age of Science, Allentown, PA18102, USA. They envision the relation of science to religion not as an ideological warfare but more like the constructive relationship of science to medicine.
- There is also the Centre for Islam and Science (CIS), Canada. It is dedicated to promotion of research and diffusion of knowledge on all aspects of Islam and science. It also encourages a creative exploration of the Islamic worldview of science, fusion of

contemporary scholarship with the traditional sources of Islamic thought without sacrificing anything theological or neglecting the discoveries of science.

Recommendations

Acquisition of knowledge in all its ramifications as enjoined by the Qur'an, is a civilizational enterprise and not a hotchpotch or pilot programme. The catchingup syndrome with modern science and technology or its transfer to the developing countries is a ruse. Moral and intellectual dynamisms are parts of the conditions for the rise of learning within a social and cultural context. It is the moral sensitiveness of the political class, coupled with the intellectual dynamisms of the academi, that are the necessary or rudimentary causes for the rise in learning.

The 'dynamism' inherent within originality and novelty (of ideas and doctrines) is what we call 'intellectual dynamism' which is set into a process of scientific advancement when there are no impediments in the way of mutual companionship between science and its community. Without originality no intellectual progress or development is ever possible. Moral dynamism of a society must also conform to the originality of intellectualism and thus enable it to flourish. The Muslim world should therefore pursue science and technology education and make history repeat itself in a positive manner – reminiscent of the golden era of Islamic intellectualism.

The three tiers of government in Nigeria should promote science and technology education as a means of human resources development and modernization. There is need for the government to invest more on education, particularly on science and technology, by adequately funding the existing polytechnics, colleges and universities. Well stocked libraries and well equipped laboratories are also to be provided. Publication and circulation of classical and modern works on science and technology are to be embarked upon by the tertiary institutions of learning and the National Library.

Patronages, endowments and scholarships from governments, members of the public and Non-Governmental Organizations (NGOs) should be readily made available to boost the educational sector. Multi-national companies are to be made to sponsor researches for national and economic development.

Moreover, there is need to establish a National Centre for Religion and Science (NCRS). The Centre, among other functions, would do the following:

- Serve as an academic forum where scientists, religious scholars and specialists in other disciplines interact for a greater appreciation of the religious and spiritual significance of science and of the value of religious insights for science and society in the areas of genetics, biotechnology, nature, culture and cosmos.
- Promote an integrated worldview through a constructive engagement of science and religion dialogue (through intellectualism and value-oriented education)
- Adopt interdisciplinary approach in conducting researches to address the moral, spiritual and intellectual questions raised by scientific and technological revolutions of the 21st century.
- Organize seminars, workshops and conferences for teachers, lecturers and researchers on the interface between science (as a systematic study of the work of God) and religion as an intellectual study of the word of God.

Barely three years ago, a number of lecturers in Lagos State University, from the faculties of Arts, Science and LASUCOM came together to form an association called LASU Constructive Engagement of Science and Religion Group (LASUCESARG). It is part of the Local Societies Initiative on the constructive engagement of Science and Religion.

Vice Chancellor, Sir, we count on the institutional and logistical support of Lagos State University; when the group approaches you formally, Sir, for assistance; judging by the intellectual reawakening in Lagos State in general and LASU in particular under your administration, we trust that you will grant our request. Permit me Vice Chancellor, Sir, to seize this opportunity to rekindle the interest of the members of LASUCESARG and to encourage other various interested academic staff members to join the group.

As for the challenges of modern science to the Muslim world, the following solutions are proffered:

- Preserve the Islamic worldview as far as science and nature are concerned.
- Protect the environment.
- Understand the Western sciences and integrate them into an Islamic perspective especially physics (i.e. quantum metaphysics).
- Create islands within the Muslim world for the continuation and practice of alternative technologies based on the Islamic view of nature and science.
- Hope for the reduction of ever more deadly weapons, then plant the seed of an authentic 'theistic' science.
- The tasks for the gifted Muslim philosophers and scientists deeply rooted in their tradition are: to integrate everything – absolutely everything – that modern science has discovered about life based on fact and not merely conjectures and unproven hypothesis into the perspective of Islamic cosmology.

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"My Lord! Grant me power and ability that I may be grateful for your favour which You have bestowed upon me and my parents, and that I may do righteous good deeds such as please You, and make my offspring good. Truly I have turned to you in repentance and truly, I am one of the Muslims (submitting to your will)" (Qur'an,ch.46:15) Glory be to Allah and praise is due to Him to the extent of the number of His creation and to the extent of His pleasure and to the extent of the weight of His throne and to the extent of the ink used in recording words for His praise. May His choicest peace and benedictions be on the noble Messenger Muhammad b. 'Abdullah.

Vice Chancellor Sir! Permit me to thank my aged and sweet mother. May Allah continue to grant her good health and bless her as she did nurture me in infancy. As for my late father Alfa Muibi Amoo alias Aniyikaiye and my late uncle Imam 'Abdul Wahhab Ajagbe, may Allah bless

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