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**QUR'ANIC ENCOURAGEMENT
TO
SCIENTIFIC RESEARCH
AND
ACQUISITION OF KNOWLEDGE**

COMMITTEE OF EXPERTS

Indian School of Excellence Trust
(INDSET)
Hyderabad - IDIA

**QUR'ANIC ENCOURAGEMENT TO
SCIENTIFIC RESEARCH
AND
ACQUISITION OF KNOWLEDGE**

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FOREWORD

It is a distressing fact that most of the Muslims lack proper understanding about the universal relevance of the Qur'anic Message which was revealed to Prophet Muhammad (SAWS) for the guidance of all mankind. There is considerable misapprehension too about Islam and the message of the Qur'an in the minds of Non-Muslims. The **Indian School of Excellence Trust (INDSET)** is making an humble endeavour through a series of monographs on Islam and Qur'an to project the image of Islam in its proper perspective and to explain the significance of the Qur'anic Message in a scientific and systematic way.

This monograph entitled: **QUR'ANIC ENCOURAGEMENT TO SCIENTIFIC RESEARCH** highlights the fact that the Qur'an accords supreme importance to the acquisition of know-ledge. According to Qur'an it is only by acquiring knowledge that the attributes of Allah as the Creator and Sustainer of the Universe can be better appreciated. Prophet Muhammad (SAWS) in one of his Traditions has made acquisition of knowledge obligatory for both Muslim Men and Women. He also encouraged Muslims to go even to China, if necessary, in search of knowledge.

The Qur'an strikes against superstition and encourages application of intelligence, rational thinking, objectivity and repeated observations, in order to discover the truth and unravel the mysteries of the Universe. It is only through persistent research that man will be able to know the "unknown" and reach the apex of his intellectual achievements.

Inspired by the Qur'anic vision of knowledge the Muslim scientists made path-breaking contributions to the development of science and technology from the 8th to the 11th century and thereby laid the foundation for scientific and technological revolution in Modern Europe. The spectacular contributions of the Muslim scientists are highlighted briefly in the concluding part of this monograph.

We conclude with a prayer to Allah (SWT) to graciously bless our efforts with success. (*Aameen*)

وَأَخِرُ دَعْوَاهُمْ أَنِ الْحَمْدُ لِلَّهِ رَبِّ الْعَالَمِينَ

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QUR'ANIC ENCOURAGEMENT TO SCIENTIFIC RESEARCH & ACQUISITION OF KNOWLEDGE

SUMMARY

The Qur'an consistently encourages acquisition of knowledge. The Qur'anic vision places the acquisition of knowledge, whether moral or material, social or scientific in intensely divine and totally human perspective. It treats the acquisition of knowledge as of supreme importance. Education is essential to read, recite and understand the Qur'an. The Qur'an therefore accords a much higher status to those who are equipped with knowledge (Az-Zumar; 39:9). For this reason the Qur'an urges man to constantly pray to Allah (SWT¹) to enhance knowledge (Taha; 20:114). The Prophet Muhammad (SWT) made the acquisition of knowledge obligatory for Muslim men and women (Bukhari). He encouraged them to go even to China, if necessary, in search of knowledge. The Prophet (SAWS) also warned that only those who have acquired knowledge will be the trustees of Allah (SWT) on earth and will inherit the legacy of the Prophet (SAWS²) and of Islam. It may thus be noticed that the Qur'an and the traditions of the Prophet (SAWS) excite in man the spirit of inquiry,

¹ SWT stands for "*Sub'hanuhu wo Ta'la'*", meaning 'Pure and Exalted.'

² SAWS stands for '*Sallallahu 'Alaihi wo Salaam*', meaning "Blessings of Allah and Peace be upon him.'

adventure, and search for the truth in a most systematic and scientific way.

Educational skill is essential to acquire knowledge with competence and to communicate it skillfully.

record the facts faithfully in order to reach the truth. The earth and the vast space between the earth and sky constitute the divine laboratory. The occurrences of such natural phenomena as the flight of birds, migratory movement of birds and fishes, wind movement, rainfall, volcanic eruption, oceanic movements are all visible to the naked eye. Man has to exercise his intelligence to realise their true significance.

While inviting man to observe objectively and discerningly, the Qur'an seeks answers to many pertinent and perceptive questions. For instance the perfectly balanced and smooth flight of birds is a remarkable phenomenon. The Qur'an asks, '*...but for Allah (SWT) who could have endowed birds with this quality.*' (An-Nahl; 16:79).

Human ingenuity and intellect are being constantly challenged by such verses: *Do they not look at the camels, how they are made, and at the sky, how it is raised high, and at the mountains, how they are fixed firm, and at the earth, how it is spread out.*" (Al-Ghashiyah; 88:17~20)

These remarkable divine creations are all for the benefit of mankind in one way or the other. Not only these but all that has been created in the universe is for the benefit of mankind. (Al-Jathiyah; 45:14) Man has only to use his intellect, do intensive research and invent new technologies to utilise these resources. Man is being consistently urged to constantly research in diverse fields in order to realise the full potentialities of the resources on

earth such as the medicinal qualities of honey, (An-Nahl; 16:66~69), and the invention of new modes of transport to facilitate travel and trade. (An-Nahl; 16:8; and Yaaseen; 36:41~43) However man must express his profound thanks to Allah (SWT) for making available this vast reservoir of resources without which human civilization could not have survived.

Man has been endowed with the creative power of Allah (SWT) but his power to create is of a secondary nature. He cannot create things out of nothing which Allah (SWT) alone can do. For instance man can split the atom but cannot create an atom which Allah (SWT) alone can do. Hence man must be conscious of his own limitations. It is beyond his intellectual capacity to comprehend the full significance of divine creations in the universe which are of colossal dimensions and extreme complexity. Nonetheless the Qur'an exhorts him to continue to strive to unravel the mysteries of the universe to the extent possible, and discover resources and develop technologies to ensure progress, peace and prosperity of mankind.

The scientific method however has its own limitations. It may be most effective in the acquisition of knowledge but is not intrinsically capable of dealing with the totality of human experiences. Scientists can never be sure that they have included all the variables that influence a particular part of the system. Hence science can never tell us the whole truth and scientists can never be sure that they have reached the ultimate end of their discovery. New facts may be discovered leading to newer theories. It happened in Physics twice. First, the discovery

of the relativity of time and space by Einstein and later the Quantum theory and the newer theories prove to be more comprehensive, still more embracing. This is all the more likely with the introduction of more sophisticated equipment and experiments. They may bring to light new facts which may challenge and even disprove old theories. It must however be admitted that despite phenomenal scientific achievements, our knowledge of the universe is still inadequate for a scientific and rational explanation of its structure and behaviour.

The Muslim scholars during the Medieval Age (9th~14th century A.D.) motivated by the Qur'anic vision of knowledge, inspired by the exhortations of the Prophet (SAWS), and encouraged by the liberal and secular outlook of Muslim *Khalifahs* towards scientific development attained enviable heights in the field of science and technology. Thus under the liberal rule of Muslim rulers scientific studies flourished phenomenally. In contradistinction they had languished under the suffocating control of the Roman Church. Deviations from the statements in the Bible on scientific themes were not tolerated and scientists were either forced to retract or punished under the draconian laws of the Inquisition.

Eminence of Science in Islamic Realm:

There was spectacular political expansion of Islam in the 7th and 8th centuries A.D. By the middle of the 8th century (750~756 A.D.) the political control of Muslims was firmly established from Iran, Babylonia and Anatolia in the east and north, to Spain in the west. Baghdad,

Damascus, Cairo, Cordova and Toledo were the leading centers of religious and secular learning. The Abbasi and Umawi *Khalifahs* (Caliphs) established *Bait-ul Hikmah* (Advanced Centre of learning), and employed Christians, Jews, Hindus and Muslims to translate the entire corpus of scientific knowledge left behind by Greek and Indian scholars such as Aristotle, Plato, Socrates, Galen, Hippocrates, Ptolemy, Euclid, Archimedes, Pythagoras, Aryabhata and others. Thus the major centers of learning in the Arab dominated world became vast depositories of scientific knowledge. This stimulated the Arab scholars to generate a new corpus of knowledge. Encouraged by the Muslim *Khalifahs* and inspired by the Qur'an, the Arab scholars accepted the challenge and ushered in an unparalleled intellectual and scientific revolution during the Medieval Age when Europe was steeped in darkness due to the prejudices and dogmatic intolerance of the Christian clergy. The world of Islam generated the growth of an intellectual and scientific atmosphere, which surpassed in brilliance the Greco-Hellenic culture. The Islamic scholars improved all branches of science and excelled their Greek and Hindu predecessors in scientific thought and skill. Al-Farabi learnt logic from Aristotle's works but lent a new life to this discipline through his original skilful and forceful application. Al-Khawarizmi learnt numbers from India but gifted the discipline of Algebra to the world using the same numbers.

The original contribution of Muslim scholars in all branches of science was so remarkable that George Sarton in his "Introduction To the History of Science" (1950~53 A.D.) points out that during the period

750~1100 A.D. the contribution of Arab scholars was unmatched in its brilliance and included such intellectual giants as Al-Razi (Rhazes), Al-Farabi, Ibn-Haitham (Al-Hazen), Al-Masudi, Al-Khawarizmi, Ibn Sina (Avicenna), Al-Biruni and Omar Khayyam. These luminaries dominated the domain of science like the Colossus and dazzled the world with their brilliant scientific theories and discoveries. George Sarton specifically points out that "9th Century was essentially a Muslim Century. To be sure, intellectual work did not cease in other countries, far from it, but the activity of the Muslim scholars and men of sciences was overwhelmingly superior,"(27). He designates the first half of the eleventh century (1000~1050 A.D.) as Al-Biruni's period and remarks that "it marked the climax of medieval thought - the great leaders were so many: Ibn Yunus, Ibn Haitham, Al-Biruni, Ibn-Sina, Ali Ibn Isa, Al-Karkhi, Ibn Gabriel (all Muslims except the last one who was a Jew) - of these, two stand out head and shoulders above the others, Al-Biruni and Ibn Sina."(28) In the next 250 years (1110~1350 A.D.), again according to Sarton, Muslims shared honours in the field of science and technology with European scholars.

These brilliant Muslim scholars by their path-breaking contributions not only carried forward the scientific legacy of the Greeks but also corrected some of their wrong notions and revolutionised the scientific temper in the Medieval Ages. Al-Farabi, (870~950 A.D.) the greatest peripatetic philosopher of Islam excelled Aristotle and Plato in eminence in the science of logic and was known as the "Second Teacher" the "first" being Aristotle. Al-Khawarizmi (died; 863A.D.) the mathematical

genius invented Algebra, Al-Masudi (died; 956A.D. and Al-Biruni (973~1051 A.D.) were among the greatest encyclopaedic scholars. The former made monumental contributions in historical and earth sciences while the latter was at once a brilliant mathematician, an eminent astronomer, an outstanding geographer, geologist and mineralogist and an excellent pharmacopoeist. Ibn Al-Haitham revolutionized the science of optics and Ibn-Sina dominated the medical sciences like the Colossus till the end of 18th Century. Al-Razi (1126~1198 A.D.) gave new directions to clinical methods of diagnosis and medical treatment. Finally modern social sciences and the science of historiography owe their origin to Ibn-Khaldun the founder of modern social sciences.

In conclusion it may be stressed that it is only through proper understanding of the Qur'an and Qur'anic inspiration to acquire knowledge that the spirit of educational excellence and scientific eminence can be rekindled in the minds and hearts of Muslim intellectuals.

The Qur'anic approach is rational and logical to the core. It strikes against superstition and encourages scientific thinking to appreciate the existence of Allah (SWT), the Supreme Being, the Creator and Sustainer of the universe. The Qur'an consistently invokes man's power of observation, challenges his intellect and provokes his capacity to think, reflect and rationalise about the existence of Allah. It may thus be observed that in its approach the Qur'an stresses on the scientific methods of observation, objectivity and rationality. Hence, the Qur'an

encourages learning and assigns a very respectable status to a learned man:

“Say: ‘Are those equal, those who know, and those who do not know?’ It is those who are endowed with understanding that receive admonition.” (Az-Zumar; 39:9)

Similarly, Prophet Muhammad (SAWS) also stressed the importance of the acquisition of knowledge. He made it obligatory for all Muslims. In this monograph it is proposed to examine objectively the role of the Qur'an in inculcating scientific thinking in man, stimulating his quest for knowledge, and sharpening his capacity to think rationally and articulate logically. The high level of intellectual and scientific achievements in the Islamic realms, during the Middle Ages, inspired by the Qur'anic vision of knowledge testify eloquently to the miraculous effect of the Qur'an on the development of science and technology.

Fundamentals of the Scientific Method:

In order to appreciate clearly the Qur'anic role in exciting the scientific spirit and rational thinking in man we must understand the fundamentals of the scientific method. One of the basic objects of science is to describe the reality faithfully without distortion or falsification. This can be obtained through repeated observations of the phenomena in nature and experimentation in laboratories. An odd or single observation or isolated result obtained through

experiments cannot be considered adequate for acceptability. These observed phenomena should be systematically classified in order to understand their interrelationships. The raw facts of observation may apparently look like "disorganized aggregates or flux," (1) but they may bear a causal relationship governed by certain principles or rules. The ultimate objective of science is to bring out cogently, and coherently, the inter-relationships of the varied aspects of the natural phenomena, and to explain the underlying principles and forces governing these relationships rationally and logically. These are expressed in terms of scientific laws, principles, and theories. These laws, principles, theories, and forces are inductively obtained based on specific observations. And sometimes from these general theories, the scientists can deductively account for specific experimental results. Despite the validity of the scientific method its limitations should not be overlooked.

Limitations of Science and Scientific Method:

We must also acknowledge the limitations of science. It "may be most effective in furnishing knowledge of the world we live in, but it is not self-sufficient methodologically, nor is it intrinsically capable of dealing with the whole of human experience."(2) The canvas of science is not wide enough to accommodate the totality of nature; hence scientific explanations will always leave something unexplained. The scientists do admit that they "are never sure that they have included all the factors that influence a particular part of the system".(3) Further they also realise the enormity of their task "of

putting all the puzzle pieces of land, sea, air and life together into a coherent picture that reveals how the Earth, despite all the shocks it has absorbed over the aeons, has been capable of steadfastly harbouring living creatures for nearly all of its existence."(4)

Moreover science can never tell us the whole truth and scientists can never be sure that they have reached the ultimate end of their discoveries. The expanding universe with its new galaxies, the increase in the number of elementary particles of the atom, and the discovery of new moons in the planetary system testify to the absence of finality in scientific discoveries. The scientists are just "beginning to unravel the tenuous link between sunspots and earth's complex weather machinery."(5) Scientists have, therefore been able to obtain only a minute fraction of the knowledge of the earth and other components of the universe. They are also aware "that newer facts may be discovered which, without falsifying the earlier discoveries, may lead to generalisations; in turn, necessitating revolutionary changes in our "concepts" and "world view".

In physics, this happened twice in the beginning of this century; first with the discovery of relativity of time and space and secondly with the quantum theory. It could happen again with our present constructs appearing as limiting cases of the newer concepts - still more comprehensive still more embracing."(6)

We are being told now by the physicists that the building blocks of matter belong only to three families

or generations of fundamental particles unlike the earlier concept of 5 to 6 families as established by the atom smasher experiments. With this new discovery of three fundamental particles Dr. Ricordan of the Standard Linear Accelerator Centre claims that "it means somehow that the universe is comprehensible, that it is not a total mystery, that it can be grasped by the human mind. It puts a lid on the complexity of nature at its most fundamental level."(7)

This claim seems to be a little premature when the physicists themselves admit that "to understand matter we need to look at its behaviour at very high energies. The energies required will never be accessible in the particle accelerators - the laboratories of particle physics.... the biggest accelerator has an energy about a trillion times lower than the energies at which GUT (General Unified Theory) effects are significant".(8). With the introduction of more sophisticated equipment and experiments new facts will come to light and the existing fundamental concepts will continue to be challenged.

Scientists are also conscious of the weakness of their experimental methods, Heisenberg's Uncertainty Principle which deals with the existence of a conceptual limitation of our knowledge affirms that "no physical measurements can tell you simultaneously that there is an electron on the table - here and also that it is lying still. Experiments can be made to discover precisely where the electron is; these same experiments will then destroy any possibility of finding at the same time whether the electron is moving and if so at what speed".(9)

The limitations of science and scientific methods expose the limitations of human knowledge and intellect. Until now, we recognise that light travels the fastest. We cannot rule out the possibility that in course of time we might discover something moving faster than light. If experiments with superconductivity and cold fusion processes succeed then we might, in the not too distant future, live in a totally transformed society with a revolutionary production and communication system.

Physicists have identified the electro-weak, strong nuclear force and gravitation as the fundamental forces. They are currently experimenting to unify the electroweak force with the force of gravity and the strong nuclear as part of "Super Symmetric String Theories in ten dimensions". (10) This may eventually lead to a "theory of everything" (T.O.E.) Even if the scientists succeed in developing TOE there will always be something beyond the comprehension of science and scientists. Scientific advances may break the genetic code, send man in space, make satellites swirl round the planets of the solar system but science can never claim to have discovered the totality of life-nature relationship in all its facets. Despite phenomenal scientific achievements our knowledge of the universe is still inadequate for a scientific and satisfactory explanation of its behaviour.

Al-Qur'an: Transcendental and Natural Phenomena:

The Qur'anic references relate both to the transcendental and natural phenomena. Transcendental phenomena have been referred to occasion-ally in order

to assert the supremacy of Allah (SWT) and to testify to the Qur'anic claim that:

"...when Allah (SWT) intends a thing, His command is 'Be' and it is done." (Yaaseen: 36:82)

They also bear testimony to the proclamation in the Qur'an that Allah (SWT³) is the Sustainer of life and will resurrect the dead on the Day of Judgement (*Qiyamah*). This has been accomplished through irrefutable transcendental occurrences on the earth, which stand established as historical facts. As for instance, the birth of Christ (SAWS) to Virgin Mary stands testimony to the fact that Allah (SWT) has the power to create human life without the cohabitation of man and woman.

"Lo! The Angels said, O Mary! Behold, God sends the glad tiding, through a word from Him (of a son) who shall become known as the Christ Jesus, son of Mary, of great honour in this world and in the life to come, and (shall be) of those who are drawn near unto God. And he shall speak unto man in his cradle, and as a grown man, and shall be of righteous. Said she O my Sustainer How Can I have a son when no man has ever touched me?" The angels answered. Thus it is: God creates what He wills: when He wills a thing to be He but says unto it, Be - and it is done." (Al-e Imran; 3:45-47).

The story of the Companions of the Cave (18:9-22 and 25-26) unravels unmistakably that the dead shall be resurrected the same way as the Companions of the Cave

³ SWT stands for "Sub'hanuhu wo Ta'la", meaning 'Pure and Exalted'.

were brought back to life after being dead or having slept for nearly 300 years in a mountain cave. However, it is not these supernatural occurrences alone that can convince the non-believers in the supremacy of Allah (SWT). Despite the miraculous powers bestowed upon some prophets such as Moses and Christ, the obstinate, proud and arrogant non-believers like Pharaoh and the early Roman Emperors refused to believe in the Unity of Allah (SWT) and His Supremacy. The Qur'an, therefore, invites man to observe repeatedly and minutely the natural phenomena and exercises his mind to appreciate the manifestations of the supremacy of Allah (SWT) as in the following verses:

"Behold as in the creation of the heavens and the earth and the alternation of night and day there are indeed signs for men of understanding. Men who celebrate the praises of Allah standing, sitting and lying down on their sides and contemplate the (wonders of) creation in the heavens and the earth (with the thought): Our Lord not for naught has thou created (all) this! Glory to Thee! Give us salvation from the chastisement of fire." (Al-e Imran; 3:190,191)

The Qur'an cogently argues that these natural phenomena furnish incontrovertible evidence and definite proof of the Oneness of Allah (SWT) and His being the creator of the earth, and heavens and all that exists in between them.

The Qur'an encourages man to adopt rational and scientific thinking and urges him on to an unceasing search for knowledge, on the mountains, in the seas, in the sky and on the earth. It also impresses upon man to

observe carefully, discern meticulously and search relentlessly the bounties of Allah (SWT) for the benefit of mankind.

Qur'anic Stress on Scientific Observation and Logical Thinking:

One of the key scientific methods is to observe meticulously and record faithfully without any distortion and falsification. The whole scientific discovery will crumble to pieces if observations are not accurately recorded. Incorrect recordings may give totally false results whose veracity will always be suspect. It is this faculty of observation of man which has been constantly challenged in the Qur'an. He has been asked to record the facts faithfully to reach the Truth. The earth and the vast space between the earth and the sky constitute the divine laboratory. The occurrences of natural phenomena such as the flight of birds, migratory movements of birds and fishes, wind movement, rainfall, mountain formation, volcanic eruption, the wild growth of forests and flowers, oceanic movements etc., are visible to the naked eye. Man has to exercise his intelligence to realise their true significance.

"We did not create heaven and earth and all that exists in between merely in idle sport."(Ad-Dukhaan; 44:38)

They constitute part of a complex system with a definite structure and a distinct purpose and design as the Qur'an points out:

"Not without purpose did We create heaven and earth and all between..." (Sad; 38:27)

While inviting man to observe objectively and discerningly, the Qur'an seeks answers to many perceptive questions. As for instance, the perfectly balanced and smooth flight of birds is a remarkable phenomenon. The Qur'an thus asks:

"Do they not look at the birds held poised in the midst of the air and sky? Nothing holds them up but the power of God..." (An-Nahl; 16:79)

The ground is thus prepared to challenge human intellect, ingenuity, innovativeness, and skill in order to motivate him to acquire more and improve upon the existing knowledge. This is best expressed in the following verses:

"Do they not look at the camels, how they are made, and at the sky how it is raised high, and at the mountains how they are fixed firm, and at the earth, how it is spread out?" (Al-Ghashiyah; 88:17~20)

These verses urge man to observe faithfully, scrutinise closely, and analyse critically for a realistic appraisal of the value of these marvellous creations of Allah (SWT) for the benefit of mankind and express profound gratitude to Allah (SWT) for his unbounded generosity. This is best expressed in the following:

"It is He Who sends down water from the skies; you drink thereof, and thereof (drink) the plants upon which you pasture your beasts; (and) by virtue thereof

He causes crops to grow for you, and olive trees, and date palms, and grapes, and all (other) kinds of fruit: in this, behold there is a message indeed for people who think! And He has made the night and the day and the sun and the moon subservient (to His command: in this behold, there are messages indeed for people who use their reason. And all the (beauty of) many hues which He has created for you on earth: in this, behold, there is a message for people who are willing to take to heart! And He it is Who has made the sea subservient to His laws) so that you might eat fresh meat from it, and take from it gems which you may wear. And on that (very sea) one sees ships ploughing through the waves, so that you might (be able to) go forth in quest of some of his bounty, and thus have cause to be grateful (to Him). And He has placed firm mountains on earth, lest it sway with you, and rivers and paths so that you may find your way, as well as (various other means of orientation: for (it is) by the stars that men find their way." (An-Nahl; 16:10~16)

In the aforesaid verses the use of intellect, rational thinking, and factual observation has been repeatedly stressed in order to appreciate adequately the creation of numerous bounties by Allah (SWT) for the benefit of mankind. This is reiterated equally forcefully in other verses as well and particularly verses 20-27 of **Surah AR-Rum** (Chapter 30).

It is important to note that the Qur'an emphasises the point that the abundant resources on earth are for the

benefit of mankind. We should express our profound gratitude to Allah (SWT), for without these resources the survival of mankind would have been impossible.

The Qur'an clearly defines the purposes of the acquisition and application of knowledge. Firstly the acquisition, advancement and application of knowledge should aim at the progress and harmonious development of human civilization. Secondly they should lead to a keener appreciation and gratitude to Allah (SWT) for his generous and marvellous creations for the benefit of mankind. Finally one should also realise that he/she will be accountable to Allah (SWT) if the acquired knowledge is not utilised for the benefit of mankind. The Qur'an urges man to unceasingly search for these natural endowments, visible and invisible, seen and unseen, open and concealed, material and spiritual gifted by Allah (SWT) for the benefit of mankind:

“Are you not aware that God has made subservient to you all that is in the heavens and all that is on earth, and has lavished upon you His blessings both outward and inward? And yet among men there is many a one that argues about God without having any knowledge (of Him), without any guidance and without any light giving revelation.”(Luqmaan; 31:20)

It is however beyond the intellectual capacity of man to acquire a comprehensive knowledge of all that exists in the universe. The immensity of knowledge concealed within the universe is forcefully expressed in the following verse:

“And if all the trees on earth were pens and the sea (were) ink, with seven (more) seas yet added to it the words of God would not be exhausted: for verily God is almighty, wise.” (Luqmaan; 31:27)

In the background of the infiniteness of divine knowledge, the human capacity to learn is extremely limited as pointed out in the Qur'an:

“And they will ask thee about the nature of the divine inspiration Say this inspiration (comes) at my Sustainer's behest; and (you cannot understand its nature, O men since) you have been granted very little of real knowledge.” (Al-Isra; 17:85)

Nonetheless, the Qur'an encourages man to acquire knowledge, and apply it for the benefit of mankind. However, the focus for the acquisition, advancement, and application of knowledge shall be to benefit mankind in order to improve the quality of life.

Besides, the Qur'an in a very subtle way hints at the direction of researches in a number of Qur'anic verses. As for instance while testifying to the medicinal qualities of honey the Qur'an suggests:

“And, behold in the cattle (too) there is indeed a lesson for you: We have given you to drink of that (fluid) which is (secreted from) within their bellies between that which is to be eliminated (from the animal's body) and its life blood: milk pure and pleasant to those who drink it. And We grant you nourishment from the fruit of date palms and vines: from it you

derive intoxicants as well as wholesome sustenance, in this beholds, there is a message indeed for people who use their reason. And (consider how) thy Sustainer has inspired the bee: Prepare for thyself dwellings in the mountains and in trees, and in what (men) may build (for thee by way of hives); and then eat of all manner of fruit and follow humbly the paths ordained for thee by the Sustainer. (And Lo) there issues from within these (bees) a fluid of many hues wherein there is health for man. In all this behold there is a message indeed for people who think.” (An-Nahl; 16:66~69)

The honey bees draw their nectars from diverse varieties of flowers and therefore possess a variety of medicinal qualities. They yield natural ribose, which is a basic component of DNA. It has B complex vitamin and a special type of hormone called royal jelly. Its enzymes, vitamins and minerals are all useful for human beings of all ages from infant to adult. It is hygroscopic and never dries. It is of great value in the treatment of chronic alcoholics. Latest researches have shown that honey dehydrates bacteria, either kills them or renders them weak and fragile (11). Hence it serves as an excellent anti-septic. The bees also treat honey with enzymes, which eventually sterilize honey with hydrogen per-oxide (Asian Age 26 July 1995). This categorical Qur'anic statement about the medicinal qualities of honey should naturally excite the interest of scientists to investigate into the full medicinal potentialities of honey for various diseases.

Similarly there are Qur'anic verses that excite our research interests regarding modes of transport as in the following verse:

“And it is He Who creates) horses, and mules, and asses for you to ride as well as for their beauty. He will create things of which today you have no knowledge.”(An-Nahl; 16: 8)

This verse not only points out to the modes of transport then available but also suggests that in future man using his divinely gifted intellect, ingenuity, inventiveness and skill will be able to create new modes of transport which could not even be visualised when the Qur'an was revealed. This is inclusive of land, water, airborne and spacecraft. In another verse, the Qur'an declares:

“And (it ought to be) a sign for them that We bear their offspring's (over in the laden ships). And that We create for them things of a similar kind, on which they may embark (in their travels). And (that) if such be Our will, We may cause them to drown, with none to respond to their cry for help: and then they cannot be saved.”(Yaaseen; 36:41~43)

In these verses there is a clear prediction regarding the improvement in shipping technology, construction of improved and safer ships through persistent research; nonetheless they will be subservient to the commands of Allah (SWT) and none can save them from sinking if Allah (SWT) so wills. These two verses thus not only excite our research interests but also broadly hint at the direction of

research so that advancement of knowledge and improvement in technology should improve the quality of human life both materially and spiritually. They also inspire man to a persistent quest for knowledge in order to understand and unravel the mysteries of the universe.

Qur'anic Challenges and Inspirations to Human Intellect and Quest for Knowledge:

Man as the Vice-Gerent of Allah (SWT) on earth has imbibed His creative and innovative spirit. Man however, cannot create things out of nothing, which Allah (SWT) alone can do. As for instance man can split the atom but cannot produce an atom. Man's creative power is of a secondary nature, which is subservient to Allah (SWT). But he has been invested with the urge to acquire knowledge right from the day Adam was created. By virtue of this divine gift, man was elevated in rank above the angels. The Qur'an reads:

"And he taught Adam the nature of all things, then He placed them before the angels: tell Me the nature of those if you are right....They said glory to Thee, of knowledge we have none save what Thou has taught us...." He said to Adam to tell them their nature. When he had told them, God said "Did I not tell you that I know the secrets of heaven and earth, and I know what ye reveal what ye conceal?"(Al-Baqarah; 2:31~33)

Allah (SWT) has endowed man with the capacity to use his intellect, reflect upon things and express his ideas by speech and in writing:

"He has created man. He has taught him speech (And Intelligence)." (Ar-Rahmaan; 55:3, 4)

As regards the gift of writing the Qur'an proclaims that:

"Thy Lord is most bountiful. He who taught (the use of) the Pen." (AL-'Alaq; 96:3-4)

Together with the power of speech and the ability to write man has also been gifted with an innate desire to acquire knowledge right from the inception of his creation. This is reinforced by the Qur'anic proclamation that Allah:

"teacheth man that which he knew not." (Al-'Alaq; 96:5)

This divine gift in man to acquire knowledge of the unknown has been a motivating factor accounting for the advances in science and technology and progress of human civilization with the passage of time. It is this irresistible urge in man to acquire and improve upon existing knowledge inspired by the Qur'an and encouraged consistently by Prophet Muhammad (SAWS) that provide a refreshingly unique dimension to the acquisition of knowledge under the inspiration of the Qur'an.

Qur'anic Injunctions on Acquisition and Importance of Knowledge

Al-Qur'an treats the acquisition of knowledge as of supreme importance, and hence accords a more respectable status to a person, man or woman, who has acquired knowledge. The Qur'an rhetorically asks the question:

"Are those equal, those of you who know and those who do not know?"(Az-Zumar; 39:9)

The Qur'an explicitly states that people with knowledge and understanding alone can comprehend better the message of Allah (SWT) as given in the Qur'an. It however points out that only a selected few are gifted with knowledge and wisdom. They alone can interpret and visualise the message of Allah (SWT) in its right perspective (Al-Baqarah; 2:269).

The Qur'an therefore urges man to constantly pray to Allah (SWT) to enhance knowledge and understanding (Taha; 20:114).

It is equally emphatic that some of those who have the mental ability to acquire knowledge and to appreciate fully the creations and the majesty of Allah (SWT), and yet refuse to apply their mind are treated, according to Qur'an on par with animals or as even inferior to them:

"They have hearts wherewith they understand not, eyes wherewith they see not, and ears wherewith they

hear not. They are like cattle--nay more misguided: for they are heedless (of warning)." (Al-A'raaf; 7:179).

Prophet Muhammad's (SAWS) Encouragement for Acquisition of Knowledge

The Qur'anic exhortations for the acquisition of knowledge are strongly reinforced by the teachings of Prophet Muhammad (SAWS). There is the famous story of the Prophet (SAWS) agreeing to release some prisoners of war, captured during the battle of Badr, if they agreed to make Muslims literate. Since Muslims had to be knowledgeable about the Qur'an, the Prophet (SAWS) declared that the acquisition of knowledge is obligatory for all Muslims. (12)

He also urged them to unceasingly strive to acquire knowledge from the cradle to the grave. According to one tradition of the Prophet (SAWS) Allah will lead to paradise only persons who consistently search for knowledge. (13)

Prophet Muhammad (SAWS) further pointed out that only the learned will inherit his legacy (14) and will be the trustees of Allah (SWT) on earth. (15) He is said to have encouraged Muslims to go even to China, if necessary, in search of knowledge. (16) In the Qur'an as well as in the Traditions of the Prophet (SAWS) the knowledgeable and the wise have been treated with great respect. The Prophet (SAWS) declared that a learned worshipper was ranked 70 times above the illiterate worshipper. He also categorically stated that "to rise up before day-break and

learn but a section of knowledge is better than prostrating yourself in prayer a hundred times." (17)

It may thus be noted that both the Qur'anic injunctions and traditions of the Prophet (SAWS) consider the acquisition of knowledge and its continuing enrichment to be of immense importance in the development of human civilization. They both stress the need for an unceasing urge to seek true knowledge in order to appreciate and unravel the mysteries of divine creation which, though immense and most complex, are still within the reach of man, for **Allah (SWT) has promised to make the unknown known to him.** (Al-'Alaq; 96:5)

Tools for the Acquisition of Knowledge

In order to acquire knowledge, man has to be adequately equipped with suitable tools to understand, articulate, scribe and preserve the discovery of knowledge and transmit it to posterity. It is pointed out in the Qur'an that Allah (SWT), while creating man, gifted him with the faculty to read and understand the message of the Qur'an and express himself intelligently:

"Allah most gracious it is He Who taught the Qur'an, He has created man, has taught him speech (and intelligence)."(Ar-Rahmaan; 55:1-4)

Allah (SWT) has also endowed man with the skill to use the pen for writing, so that knowledge when acquired

is preserved and the legacy is passed on to future generations for their guidance:

taught (the use of) the pen. (Al-'Alaq; 96:4)

Human beings are also gifted with intelligence and understanding:

"It is He Who has created for you (the faculties of) hearing, sight, feeling and under-standing, little thanks it is ye give." (Al-Mo'minun; 23:78)

These faculties and skills are the exclusive preserve of mankind, not shared by either the animals on earth or the angels in the sky. It was on the basis of his intellectual superiority, demonstrated by man's superior knowledge, that Allah (SWT) commanded the angels to prostrate themselves before Adam. Together with the power of speech, the skill to write, and intelligence to reflect, comprehend and rationalise, man was also gifted, right from the inception of his creation, with an innate desire to understand and unravel the mysteries of the universe, to search for the bounties of Allah (SWT), to discover and acquire new knowledge in order to ensure continuous progress of human civilization. This divine gift in man to acquire knowledge of the unknown has been a motivating factor, accounting for advances in science and technology and progress of human civilization with the passage of time.

Enlightened Islamic Realm and Dark Age in Europe

During the Middle Ages the Muslim scholars from the Islamic world which extended from Iran in the east to Spain in the west, besides being inspired by the Qur'anic vision of knowledge, also inherited the Greco-Hellenic scientific legacy. They avidly assimilated Greek and Indian scientific knowledge and Chinese technology. Subsequently they improved upon them and created a new corpus of scientific knowledge which bore distinct Islamic stamp and outshone in brilliance the Greco-Hellenic scientific tradition. While Islamic centres of learning were rapidly rising in Baghdad, Damascus, Egypt and Spain, under the benevolent and liberal Muslim Caliphs, Europe was fast sinking into the abysmal depth of intellectual darkness after the fall of the early Roman empire. The Christian church became increasingly alienated from secular knowledge and intolerant of scientific ideas. The fanatic bishops of Byzantine got the library of Alexandria, one of the finest at that time, burnt. This alienation of the Church from learning plunged the whole of the Roman empire into intellectual darkness and the Muslims emerged as the custodians and promoters of scientific knowledge.

The breakup of the early Roman empire led to the rise of numerous small principalities and monasteries in Europe ruled by lords and dukes and managed by monks and bishops respectively. Lords and Ladies of the principalities were not educated because "neither the Lords nor the Ladies thought that education was necessary and few could read and write."(18) This is

further supported by the fact that in the early Middle Ages the Church had forbidden the Greek system of medicine and cures were affected "by religious rites performed by the clergy." (19). The scientific ignorance of Europe was further accentuated by the fact that by the end of the 5th century, there was a severe economic dislocation in the Roman empire and the face of Rome was radically altered largely due to the invasion of various Germanic tribes. Consequently "for the next three hundred years (500-800 A.D.) Western Europe remained essentially a primitive culture." (20) This was further aggravated by the fact that the church leaders discouraged the questioning attitude of the Greeks. Scientific experiments were discouraged. (21) Further "learning was no longer held in high esteem, experiment was discouraged and original ideas became dangerous assets." (22). This dogmatic approach was stretched to the limit against scientists. The Aristotelian literature was considered a heresy and proscribed. Any scientific idea concerning the creation of the universe contrary to the Biblical statement was treated as blasphemy. Scientists were severely punished under the draconian laws of Inquisition. It continued long after the dawn of Renaissance when Galileo, inspired by Copernican views, proposed a heliocentric view making the earth revolve round the sun. Initially he was criticised by the Congregation of Index for "teaching a false 'Pythagorean doctrine' leading to the destruction of Catholic Truth." (23) But once the "Dialogues on Great World System" was published it was too much for the defenders of scholastic cosmology like Simplicus and Cardinal Bellarmine to put up with. Cardinal Bellarmine in his letter to one Paolo

Antoni Fascarine had this to say on the matter "But to wish to affirm that the sun is really fixed and in the centre of the heavens and merely turns upon itself without travelling from east to west, and that the earth is situated in the third sphere and revolves very swiftly around the sun is a very dangerous thing, not only by irritating all the theologians and the scholastic philosophers but also by injuring our holy faith and making the sacred Scripture false."(24) The Scholastic philosophers led by Simplicus prevailed upon the Pope to order the trial of Galileo by the Inquisition. "In 1633 the Inquisition sentenced Galileo to life imprisonment and compelled him to abjure his "errors and heresies." (25)

Eminence of Science in Islamic Realm

While scientific knowledge languished under the suffocating control of the Roman Church it flourished phenomenally under the liberal and enlightened patronage of Muslim rulers. There was spectacular political expansion of Islam in the Seventh and Eighth Centuries. By the middle of 8th Century (750-756 A.D.) the Islamic political control was firmly established from Iran, Babylonia and Anatolia in the east and north to Spain in the west. Baghdad, Damascus, Cairo, Cordova and Toledo were the leading centers of religious and secular learning. The Abbasi and Umawi *Khalifahs* established Bait-ul Hikmah (Advanced Centre of learning), in Baghdad and employed Christians, Jews, Hindus and Muslims to translate the entire corpus of scientific knowledge left behind by such Greek scholars as Aristotle, Plato, Socrates, Galen, Hippocrates, Ptolemy,

Euclid, Archimedes, Pythagoras, and scholars of India. Thus the major centers of learning in the Arab dominated world became vast depositories of scientific knowledge. This stimulated the Arab scholars to generate a new corpus of knowledge. Encouraged by the Muslim Caliphs and inspired by the Qur'an the Arab scholars accepted the challenge and ushered in an unparalleled intellectual and scientific revolution during the Medieval Age when Europe was steeped in darkness owing to the prejudices and dogmatic intolerance of the Christian clergy. The world of Islam generated the growth of an intellectual and scientific atmosphere which surpassed in brilliance the Greco-Hellenic culture. The Islamic scholars improved all branches of science and excelled their Greek and Hindu predecessors in scientific thought and skill. Al-Farabi learnt logic from Aristotle's works but lent a new life to this discipline through his original, skillful and forceful application. Al-Khawarizmi learnt numbers from India but gifted the discipline of Algebra to the world using the same numbers.

The original contribution of Muslim scholars in all branches of science was so remarkable that George Sarton in his "Introduction To the History of Science"(1950-53 A.D.) points out that during the period 750-1100 A.D. the contribution of Arab scholars was unmatched in its brilliance and included such intellectual giants as Al-Razi (Rhazes) Al-Farabi, Ibn-Haitham (Al-Hazen), Al-Masudi, Al-Khawarizmi, Ibn Sina (Avicenna), Al-Biruni and Omar Khayyam. These luminaries dominated the domain of science like the Colossus and dazzled the world with their brilliant scientific theories and

discoveries. George Sarton specifically points that "9th Century was essentially a Muslim Century. To be sure intellectual work did not cease in other countries, far from it, but the activity of the Muslim scholars and men of science was overwhelmingly superior,"(26). He designates the first half of the eleventh century (1000-1050 A.D.) as Al- Biruni's period and remarks that "it marked the climax of medieval thought - the great leaders were so many: Ibn Yunus, Ibn Haitham, Al-Biruni, Ibn-Sina, Ali Ibn Isa, Al-Karkhi, Ibn Gabriel (all Muslims except the last one who was a Jew) - of these, two stand out head and shoulders above the others, Al-Biruni and Ibn Sina," (27). In the next 250 years (1110-1350 A.D.), again according to Sarton, Muslims shared honours in the field of science and technology with European scholars.

The Muslim contribution to technology was equally distinguished. They obtained the technology of paper manufacture and printing from China and transmitted it to Europe. They worked on all the metals viz. gold, silver, copper, bronze, iron and steel. They excelled in textile design and fabric and produced glassware and pottery of the highest quality. According to Rowen "they knew the secrets of dyeing; they practised farming in a scientific way. They knew the value of fertilizer. They fitted their crops to the quality of the ground." (28) This is strongly substantiated by Al-Hassan and R Hill who in their book "Islamic Technology" (1986) highlight that "Muslim Operations in agriculture, irrigation, hydraulic engineering, and manufacture were an integral part of everyday life in the southern half of the (Spanish) Peninsula, and....Muslim ideas in these fields

and in others, passed from Spain into Italy and northern Europe. Similarly, the gun powder, cannon and paper making technologies were also transferred from the world of Islam to Europe. In the 10th century A.D. Samarkhand was the premier centre for the manufacture of paper when Europe was not even familiar with its technology."(29)

This phenomenal development of science and technology in the Islamic world from Spain to Iran laid the foundation for accelerated scientific and technological development in Europe. After the termination of Islamic rule from Spain in 1085 "The City of Toledo with one of the finest libraries in the Islamic world fell to the Christians. Among the occupiers were Christian monks who quickly began the process of translating ancient works from Arabic to Latin. By the end of the 12th Century much of the ancient heritage was again available to the West,"(30). The entire corpus of Arab scientific knowledge was now available to the European scholars which ushered in the renaissance, and scientists like Copernicus managed to develop and advance further on the scientific legacy inherited from the Arabs.

This is universally acknowledged by modern scientists. Thompson and Johnson admit that "it would be hard to overestimate the magnitude of the debt that Christian civilization owes to the Mohammedans." (31) These men of erudition from the Islamic world laid the foundation the scientific and industrial for revolution in Europe. This is corroborated by Biffault: "What we call science arose as a result of new methods of experiments,

observation and measurement which were introduced into Europe by the Arabs.... (Modern) science is the most momentous contribution of the Islamic civilization,"(32) This view is strongly reinforced by George Sarton who points out that "the main and the least obvious achievement of the Middle Ages was the creation of the experimental spirit and this was primarily due to the Muslims down to the 12th Century." (33)

Muslim Luminaries in Science in the middle Ages

The glorious scientific achievements in the world of Islam during the Middle Ages can be properly visualized in the light of the original and brilliant scientific contributions of Muslim scholars in the realm of science. Of the galaxy of Muslim scientists produced within a span of five centuries, from the eighth to the fourteenth, only ten have been picked up to demonstrate their monumental, path breaking contribution in diverse fields of knowledge. Viz. Al-Khawarizmi, Al-Razi (Al-Rhazes), Al-Farabi, Al-Masudi, Al-Haitham (Al-Hazen), Al-Biruni, Ibn Sina (Avicenna) and Ibn-Khaldun. It may also be noted that even after the decline of political power of Islam, for the next four centuries, the scientific resurgence in Europe was indebted to the scientific legacy left by the Muslim scientists.

Abu Djafar Muhammad Bin Musa Al-Khawarizmi (800-847 A.D.):

Al-Khawarizmi was one of the most distinguished mathematicians produced during the Middle Ages, who

introduced a new discipline Algebra in the field of mathematics. He was a contemporary of *Khalifah* Al-Mamoon of Baghdad and had the unique opportunity of working in the *Bait-al Hikmah* or House of Learning established by the Caliph. Here he could study the Greek and Indian works on the mathematical sciences. It was in *Bait-al Hikmah* that he got introduced to Pythagorean geometry and Indian numerals. Inspired by these innovative mathematical works he produced his Algebra called *Al-Mukhtasar fi hisab al-djabr wal' Muqable* (The Art of Bringing Together Unknowns to Match Known Quantity). (34). In this book Khawarizmi for the first time deals with the problems of second degree equations and solves them. Leonard of Pisa literally imitated Khawarizmi when he enumerated six cases of Quadratic equations.

Khawarizmi was a versatile scholar who has left for posterity an encyclopedic work dealing with arithmetic, geometry, music and astronomy. (35) He had written extensively on astronomy and geography. He was familiar with the Indian astronomical tables through Siddhanta which was translated into Arabic. Khawarizmi himself had prepared a summary of these tables. His knowledge of geography was vast. He had revised substantially Ptolemy's *Almagest* and had drawn new geographical and celestial maps. (36)

He was 'arithmetic' personified for the word 'algorism' used for any recurring methods of calculation is the Latinised form of his name Al-Khawarizmi. His fame however rests on his unique and innovative creation of Algebra, one of the greatest contributions of Muslims to

science. Since its foundation by Al-Khawarizmi, Algebra was cultivated so much that within two centuries of its creation it had reached considerable proportions. (37)

Abu Bakr Zachariah Al-Razi (Latin Rhazes) (Died 923 A.D.):

Al-Razi was one of the foremost physicians produced in the world of Islam. He developed his clinical methods and lines of treatment based on the lines of the Greek physicians Hippocrates, Galen and many others who preceded him but left them far behind while developing his own methods of investigation and lines of treatment. The uniqueness of his approach is highlighted by the fact that he was once asked by the Caliph to select a site for the location of a hospital in Baghdad. In order to do so" he got some pieces of meat suspended in various localities of the city. The place where the meat deteriorated in the last was selected as the site for hospital."(38)

Although Al-Razi wrote about 117 books in the field of medical sciences, his two most valuable contributions are *Al-Hawi fil-tib* (Continens) and *Kitab al-Maliki* (Liber Regus). *Al-Hawi fil-tib* (Continens) includes twenty volumes and constitutes an excellent "repository of medical knowledge concerning hygiene, diseases, their symptoms, and treatment with medicine and diet." (39) The *Kitab al-Maliki* (Liber Regus) is medical Encyclopaedia.

This is divided in two parts. Part one deals with theoretical aspects.

In the other part the practice of medicine is dealt with including excellent sections on dietetics and "materia medica." (40) According to Al-Qifti, al-Maliki "was the splendid work and the noble treasure of the theory and practice of medicine admirably arranged." (41)

Al-Razi was the first physician to distinguish between the symptoms of measles and small pox in his *Kitabi Al-Judari Wal-Hasbah* (History of Muslim Philosophy).

He had a keen interest in pharmacopoeia and was again the first to prepare a white lead ointment which was then known in Europe as 'album Rhazes'. According to Salam, "the equipments which Al-Razi used in his chemistry laboratories are still by and large, with some improvement, the same in standard chemistry laboratories the world over." (42)

Abu Nasr Al-Farabi (870 - 950):

Al-Farabi was one of the most outstanding philosophers of Islam. It is being stated that the world has produced four genuine philosophers, of which two are Greeks: Aristotle and Alexander and two are Muslims: Al-Farabi and Ibn Sina. Al-Farabi was the most distinguished peripatetic philosopher produced by the world of Islam. He was an avid follower of Aristotle and had written excellent commentaries on his works. He was a linguist

fluent in at least five key languages viz.; Arabic, Persian, Turkish, Greek and Syriac, which were then essential for the acquisition of knowledge in all branches of science.

Al-Farabi had his rigorous training in Logic under the great Christian teacher Abu Bishr Ibn Yunus. Subsequently Al-Farabi himself became the most distinguished logician of his period, including those preceding him, even Plato and Aristotle. He was also called the "Second Teacher", the first being Aristotle. His classification of the totality of knowledge into two categories viz.; philosophy, which was based on reason and logic and *Kalam*, which is derived divinely. This classification he attempted in his book *Ihsa-al 'Uloom* (classification of the sciences). Philosophy has been subdivided into various material sciences viz. logic, astronomy, mathematics, physics and others. (43) He also attempted to reconcile *Shari'ah* with philosophy which he saw represented by the polarity of Plato and Aristotle. (44) He examined this issue critically in his book entitled Union of the Two Wise Men - Plato and Aristotle. Al-Farabi does not believe in the dichotomy of natural laws and moral laws for they stem from the same source - God. (45)

Al-Farabi had postulated a social theory as well where he very deftly reconciled the material and moral values. This is corroborated by his book: *Are Ahl Al-Madinah Al-Fadilah* in which "the ruler is at once philosopher and prophet combining the prerogatives and virtues of both." (46)

He was a keen theoretician of music and an accomplished player of musical instruments. He could play on the sitar to make people sleep. He once played on the flute, in the court of ruler Saif Al-Dawlah, three different melodies (ragas) one of which made people laugh, the other moved them to cry, and the third one finally lulled them to sleep. According to Hussein Nasr "his musical works have survived in Anatolia until modern times." (47)

He has written over seventy treatises and nearly 35 of them pertain to logic. The comprehensiveness of his scholarship is substantiated by the fact that he contributed significantly in other important fields of sciences viz. physics, mathematics, ethics and political philosophy, which he founded in Islam. (48)

As an individual Al-Farabi was extremely simple, marked for his humility and intellectual honesty. He stands head and shoulders above his contemporaries in philosophical brilliance and stands out as a unique personality. Even the modern world has yet to produce his equal in the realm of logic and philosophy.

**Abu Al-Hasan Ali Ibn Al-Masudi: (B: Late 9th
Century - Died: 957 A.D.):**

Al-Masudi is known as the Herodotus or the Pliny of Arabs but he displayed far greater skill, critical faculty, and organisational skill and he was head and shoulders above them as a historian. In fact Masudi was the first Arab scholar who combined history with scientific

geography in order to display their interdependence. This is amply demonstrated in his classical work: *The Meadows of Gold and Mines of Gems (Muruj-adh Dhahab wa Ma'adin al Jawahar)*. He stressed the need for a scientific appreciation of the social, economic, religious and cultural factors in the study of history and geography. This was a unique approach which was immensely appreciated by Ibn-Khaldun who describes Al-Masudi "as an *Imam* (Leader) for historians." (49)

Al-Masudi had originally produced a massive 30 volume study entitled *Akhbar-uz Zaman* (The History of Time). This magnum opus of Masudi did not attract much attention. Subsequently he condensed it into a single title *Muruj adh-Dhahab wa Ma'dain al Jawahar* (Meadows of Gold and Mines of Gems). This turned out to be a classic and an instant success.

Masudi was a great traveller. His travels extended from the Caspian Sea and Armenia in the north to Ceylon (Sri Lanka) and Madagascar (Malagasy) in the south and from Syria in the west to Iran in the east. What makes his "Meadows of Gold and Mines of Gems" most fascinating is that it is based on the author's personal observations and experiences. In the first part of this book he deals scientifically with the creation of the universe, describes graphically the Jewish history, provides a comprehensive account of the lands and people of non-Islamic countries in their physiographic and socio-economic setting. His treatment of the natural phenomena such as earthquakes, tides, geological structure, origin of seas, cycle of erosion, wind power etc. Are apt and scientifically correct.

By virtue of his monumental contributions in history, and scientific geography Masudi will ever live as one of the encyclopaedic figures in Islamic science and a pioneering and pre-eminent historian, geographer, geologist and naturalist.

**Abu Ali Al-Hasan Ibn Al-Haitham (Al-Hazen):
(965-1039 A.D.):**

We have observed earlier that Al-Khawarizmi made an outstanding contribution in founding the discipline of Algebra in mathematics. Similarly Ibn Al-Haitham (Al-Hazen) gave a new and unique direction to optics by proposing a new theory that "objects are seen by rays passing from them towards the eye and not by the opposite process,"(50) against the established theories of Euclid and Ptolemy that the eye sends out visual rays to the object of vision. He established this experimentally and was fully supported in his theory by Al-Biruni and Ibn Sina who researched independently.

Studies and research in optics for the next six hundred years were profoundly influenced by Al-Haitham's classical work entitled: *Kitab Al-Manazir* (The Optica Thesaurus). The Latin, Muslim, Christian and Hebrew writers such as Roger Bacon, John Peckham, Witlo, Ahmad Ibn Idris, Al-Qarafi, Qutub Al-Din Al-Shirazi, and Levi Ben Gerson extensively used it and often quoted it in their works. Thus in the field of optics he was far ahead of his age. The original text of *Kitab Al Manazir* in Arabic is lost. It was however translated into Latin as

“Optica Thesaurus” by the 12th century A.D. It is on this Latin translation that most of the medieval works on optics are based.

He carried out intensive research studies in the diverse aspects of optics and succeeded in discovering the reflection of light, and the law of refraction in transparent bodies, which later came to be called the Snell's Law. His wide-ranging experiments on spherical and parabolic aberrations almost led him to the theoretical discovery of magnifying glasses. These remarkable achievements in optics have been universally acclaimed even by modern scientists who frankly admit that in the middle Ages “the glory of Moslem science was in the field of optics. Here the mathematical ability of Al-Hazen and Kamal Ad-Din outshone that of Euclid and Ptolemy.”(51)

He also made significant contributions in the field of mathematics and astronomy but his path breaking and trend setting contribution in optics outshone his contribution in other disciplines.

Abu Raihan Al-Biruni: (947-1051 A.D.):

The One person in Islam who combined the qualities of an outstanding scientist, a dedicated scholar, a first rate compiler and historian, a meticulous observer of events, was Al-Biruni. He was at once a brilliant mathematician, an eminent astronomer, an outstanding geographer, geologist and mineralogist and an excellent pharmacopoeist. In short he was one of the most brilliant encyclopaedic scholars produced so far.

In view of the remarkable intellectual qualities of Al-Biruni the science historian George Sarton has designated the first half of 11th century as Al-Biruni's era in the development of science. Sarton admires his critical spirit, toleration, love of truth, intellectual courage and honesty and that they "were almost without parallel in medieval times."⁽⁵²⁾ Al-Biruni believed in objective and unbiased research and remarked in one of his outstanding works *Asar Al-Baqiah*: "We should get rid ourselves of those tendencies which blind us from seeing the selfishness and motivated research."⁽⁵³⁾ Al-Biruni later admitted that these norms were difficult to adhere but without them real research was not feasible. Further he acquired knowledge from whatever source he could but he was most selective: "And I have truly done what everyone is bound to do in respect of any particular science i.e. to accept gratefully the original contribution of his predecessors, to correct fearlessly the errors that come to his notice, and to preserve what he himself discovers and to leave it as a record for future generations that are to follow him in time."⁽⁵⁴⁾

Al-Biruni was also a linguist but his most remarkable feat was to learn the Sanskrit language at the age of 45. He had acquired mastery over it to such a degree that he could consult original Sanskrit sources on astronomy and mathematics and even translated them into Arabic. He entered India as a student of Sanskrit language but left India as the teacher of astronomy and mathematics to Hindu scholars in Sanskrit institutions. In his own words "initially being a stranger I was treated as a pupil by

the Sanskrit scholars. Subsequently however when we got familiarised with each other this relationship was reversed because of my expertise in astronomy and mathematics.

The Pundits were surprised at my advanced knowledge in these disciplines and asked me the name of the Hindu Pundit under whom I had learnt. It was hard for them to believe that a foreigner could excel them in knowledge. They used to consider me a magician and in their own language used to call me "Yajir" (Sagar)."⁽⁵⁵⁾ During the course of his stay in India he could manage to translate into Sanskrit Euclid, Plotemy's Almagest, and his own methods of making Astrolabe.

Al-Biruni's writings are voluminous and they are masterpieces irrespective of the subject whether history, geography, geology, mineralogy, botany, zoology, mathematics, or astronomy. He has handled the subject matter comprehensively and with the authority of an expert. However of these works his Qanun Al-Masudi (Cannon of Masudi), Al-Asar-al Baqiah and Al- Quroon Al Khaliah (Chronology of Ancient Nations) and Kitab Al-Hind (Book of India) are the most notable. His Cannon Al- Masudi is an encyclopaedia of astronomy and has the same status in astronomy as the Cannons of Avicenna in Medicine. The Chronology of Ancient Nations gives a lively account of the customs, fairs, and festivals of the ancient and forgotten tribes. The Book of India provides a firsthand graphic and scientific account of the physical, social, economic, educational, philosophical and cultural conditions of India in the first half of the 11th century.

He had also prepared an excellent lapidary containing detailed description of numerous stones and metals from the natural, commercial and medical points of view. Scholars like Al-Biruni are a rare phenomenon and are born in Millennia. No one in Islam and even outside Islam "combined the qualities of an outstanding scientist with those of a meticulous scholar, compiler and historian to the same degree as Al-Biruni."(56)

Abu Ali Al-Husain Ibn Sina: (980-1037 A.D.):

Ibn Sina, the Prince of Physicians, as he was known in the West was an intellectual genius full of physical energy and vitality. He had his training in mathematics under the guidance of Al-Khawarizmi, the mathematical genius of Islam. In medicine, he was trained by the distinguished physician Isa Ibn Yahya. Ibn Sina was a man of extraordinary intelligence who completed his education at the age of 14. He had the unique opportunity to use the excellent library of the Samanid Princes. By the time he became the court physician at the age of 18, "he had mastered all the sciences and was a mature scholar,"(57). He had developed an unmatched skill in logic. In the knowledge of logic he excelled his own teacher Al-Natili and could explain to him difficult problems beyond the latter's comprehension.

Ibn Sina was the greatest exponent in Islam of the Aristotelian philosophy. It was through Ibn Sina that Aristotle was reintroduced to Europe. Since the teaching of Aristotle was banned in the famous French University of Sorbonne, the works of Ibn Sina were also banned there

by the Decrees of 1210 and 1215 A.D. While he learned dialectics from the works of Aristotle and Galen, Ibn Sina eventually "surpassed them in dialectal subtlety which appealed to the scholastics of the Middle Ages. Hence they were greatly attracted to his works," (58).

Ibn Sina had compiled more than 200 works but only 99 were enlisted by Brock leman as his extant works. He had written on diverse themes but his two principal works the *Shifa* (Sufficiencia) and *Al-Qanun fil-tib* (the Cannon of Medicine) made him undisputed in medicine, natural sciences and philosophy. (59). While *Kitab-ash-Shifa* is a fine exposition of Aristotelian philosophy and of the natural sciences, the *Al-Qanun fil-tib* constitutes an encyclopaedia covering diverse aspects of medicine. The *Qanun* consists of five volumes each devoted to a particular theme. The first includes generalities concerning the human body, sickness, health, treatments and therapeutics, the second contains materia medica and pharmacology; the third book deals with special pathology; the fourth book opens with the famous treatise on fevers, then follows the treatise on signs, symptoms, diagnostics, prognostics etc., and the fifth book, contains the pharmacopoeia. (60). About the first volume of the *Qanun* a distinguished scholar remarked "whoever has thoroughly understood the first volume of *Qanun* to him nothing will remain hidden of the fundamental principles of medicine,"(61). Among his numerous medical discoveries the rudiments of germs theory was noticeable in his formulation that "bodily secretion is contaminated by foul foreign earthly bodies before getting the infection." (62)

In the West Ibn Sina dominated the medical sciences for centuries. His philosophical ideas deeply influenced such distinguished European scholars as Albertus Magnus, St. Thomas, Duns Scotus and Roger Bacon. Harvey treats him on par with Aristotle and Cicero. He has been described by one Orientalist as the most famous scientist of Islam and one of the most famous of all races, places and times and by another as "the greatest man that this world has ever seen". However some scholars suggest that we have not so far been able to fathom the greatness of Ibn Sina, which may become evident if "we could lay our hands on his *Kitab Al-Insaf* (the Book of Impartial Judgment) in which he has investigated 28,000 questions."(63)

**Bad al-Rahmaan Abu Zaid Ibn Khaldun:
(1332 - 1406 A.D.)**

Ibn Khaldun, a social historian of extraordinary calibre and one of the most forceful personalities of Arabo-Muslim culture lived in the world of Islam in its period of tumult, transition and decline. His own political career had its ups and downs. His political and diplomatic career received a great boost when he succeeded in his mission to Tamerlane on behalf of the Egyptian ruler. (64) He observed the rise and fall of societies and civilizations, like his own political career, and used to speculate over their causes. His brilliant academic career commenced with his imprisonment in 774 A.H. (1375 A.D.) when he found time

to collect his thoughts, organise and systematize them and commit them to writing. (65)

He started writing *Kitab Al-Ibar*, Universal History but the monumental Introduction or Prolegomena to this book turned out to be a classic contribution to the science of historiography and which also laid the foundation for the modern social sciences. Following in the footsteps of his distinguished predecessors like Al-Farabi, Ibn-Sina, and Ibn-Rushd, he also distinguished between revealed or spiritual knowledge and rational knowledge where events and matters are judged on reason and are based on causal relationship. He disfavoured the rationalization of the revealed or transcendental phenomena.

The Prolegomena spells out the philosophy and sociology of human science. He conceptualised that as there is causality in the occurrence of natural phenomena such as tides, floods, earth quakes, etc., the rise and fall of societies and civilizations can also be accounted for similarly. Anticipating Auguste Comte, the father of modern social science, by nearly half a millennium he visualised that historical events were also triggered by certain causal factors. He was therefore keenly interested in the aetiology of factors causing societal, civilizational and dynastic changes. For him history included "the study of the whole human past including its social, economic and cultural aspects." (66) Further he viewed history as the science of society wherein the facts and truths are rigorously tested before they are admitted as causal factors of historical changes.

He believed that humans are far too inter-dependent and have, therefore, to be gregarious for their own self preservation. However, their relations are substantially altered by geographical location and economic factors. These factors also determine the stages of growth of the societies, which, like the river regime or man himself "runs a course of childhood, youth, maturity and old age." (67) He identified the nomadic or badawa stage of society with childhood, followed by the stage of *Ghazwa* (aggression). This is followed by *badar* (civilization) which represents the developed stage, and finally is the decadent stage. Ibn Khaldun also advocated a cyclical pattern of development of societies which attain their climax in four to five generations where after decay sets in, and they ultimately perish.

Ibn Khaldun's scientific approach to the study of history, his search for aetiology in societal relations and his rationalization of the rise and decline of civilizations gave birth to the discipline of scientific sociology and sub-disciplines of social, economic and political sciences. He stressed links between the past, present and future of human development and therefore wanted scholars and rulers to draw lessons from the past in planning for the future. This philosophical approach to the study of societies propounded by Ibn Khaldun leaves no doubt in our mind that he was an authentic genius. In the words of Laconte, if "Thucydides is the inventor of history Ibn Khaldun introduces history as a science," But he was a loner for "he had no fore runners among Arabic writers, he had no successors or emulators in this idiom until the contemporary period." (68)

CONCLUSION:

In conclusion it is obvious that the glorious Qur'an inculcates the spirit of science and enjoins upon man to believe in Allah (SWT) on very rational grounds supported by cogent arguments. This can be carried out by observing discerningly, analysing critically, weighing meticulously, and sifting, sorting out and classifying the facts observed in the universe and thereafter reflecting upon them for a proper understanding of the scenario logically presented in the Qur'an for the acceptance of the supremacy of Allah.

The instructions of the illustrious Qur'an and the sayings of Prophet Muhammad (SAWS) exhorting Muslims to acquire knowledge from all available sources, inspired an unprecedented growth of science and technology in the political realm of Islam extending from Persia in the east to Spain in the west. During this period the world of Islam produced an unparalleled array of scientists who not only carried forward the legacy of science of the previous civilizations, but put a distinct stamp of originality in all spheres of scientific development such as medicine, physics, chemistry, astronomy, mathematics, and even social sciences. The Muslim scientists and the glorious scientific legacy they have left behind reflect the pace and quality of scientific development in the world of Islam for nearly a millennium. The frontiers of scientific knowledge which they explored and expanded, and the scientific legacy they left behind laid the foundation for the phenomenal progress in science and

technology in Europe since the Renaissance in the middle of the 15th century.

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