

**CULTIVATION
OF SCIENCE
BY THE
MUSLIMS**

A LECTURE DELIVERED BY

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Ladies and Gentlemen,

The subject of my discourse at the present occasion is:

“The Cultivation of Science by the Muslims.”

Before I enter into a discussion of the subject I regard it my pleasant duty to thank the Oriental Culture Society of Tokyo for so kindly providing me with an opportunity to speak to such a distinguished assembly.

As I have already pointed out in my previous discourse, my speech from this platform shall not be in the capacity of a preacher of Islam or an advocate of Muslim cause. I shall rather confine myself to a purely historical survey of the glorious intellectual achievements of that virile and powerful nation of the world which is known by the appellation of Muslim. My treatment of the subject shall therefore be a purely impartial one.

But before I proceed further let me emphasize two important points:

Firstly, that “Muslim” is a purely religious concept and has nothing to do with racial, linguistic or geographical affinities. A Muslim is a product of the Islamic religion and is out and out a religious individual in his being and mission.

Secondly, that it is a common belief that there is a perpetual conflict between religion and science which goes far back into the dim and distant past.

Keeping these facts in view it seems extremely strange that the Muslims should have been the foremost in the cultivation of science, and not only this... they have been the sole teachers of science for several centuries.

While speaking before the Royal Asiatic Society of Shanghai I expounded the view that to regard science and religion as opposed to each other was based on a misconception of facts and it gave me great pleasure to note that my view was highly appreciated. In fact, those who hold the view of conflict between religion and science labour under a wrong notion of religion, those notions and ideas to which they give the name of religion are not really religion but mythology and superstition. The fact is that religion is itself a science. It carries its investigation into the realms of spiritual and moral values while physical science concerns itself with material entities. The main difference lies in the methods employed in physical science and the science of religion. The criterion of reason, however, works in the domain of religion as much as in the field of physical science.

Islam has been defined by its holy book, the Qur'aan, as a code of the laws of nature. Concerning the relation of man with the rest of the universe – spiritual and material – a perfect union in the actions of man and the actions of nature. Now just as in the case of investigation of the “physical laws,” there have been men in all ages who have devoted their lives to the study of material bodies and physical phenomena, There have similarly been persons whose lives were devoted to the science of religion – who knocked at the gates of religious knowledge and, having received it, delivered it to others. These persons are called “Prophets” and “Messengers” in Islamic terminology.

It will be a long digression from my subject if I enter into a theological discussion of the ways and means for obtaining a right knowledge of religious verities which the prophets employ. At the present moment I have only to point out that the Holy Prophet Muhammad (peace and blessings of Allaah be upon him) is a most important figure amongst this class of men and the philosophy of life which he gave to the world is termed as the Religion of Islam.

The basic principle of Islam, or in other words, the goal of a Muslim is the gnosis of the Creator of the universe. The philosophical speculation and the principles of harmony and design working in nature plainly point to the fact that there is a Creator of the universe and that this whole universe is His creation and a manifestation of His attributes. Guided by this belief, a Muslim ponders over every phenomenon which he comes across and strives to attain to its reality, so that he may be able to arrive at a knowledge of the Absolute Reality and that the study of the manifestations of the Creator's attributes may lead him to the knowledge of the Creator Himself.

A Muslim consequently probes into the realm of physical science with the aim of grasping the reality and does not stop at the surface view of things.

In the Holy Qur'aan the mission of the Holy Prophet Muhammad (peace be upon him) has been described in these words:

“He (i.e., Allaah) it is Who hath sent among the unlettered ones a messenger of their own, to recite unto them His revelations and to purify them, and to teach the Book and the Wisdom though heretofore they were indeed in error manifest.”

(Al-Qur'aan, LXII: 2).

It is evident from the above statement that it was the Holy Prophet Muhammad's mission to awaken humanity to the importance of cultivation of learning and that the Holy Qur'aan was revealed by the Almighty to open the gates of Knowledge for mankind and guide them towards scientific research. The Holy Qur'aan does not only propound laws relating to worship and religious ceremonies; its broader mission and main thesis is to teach us laws pertaining to every walk of life and to act as a perfect guide for humanity.

Just listen to what certain non-Muslims have to say regarding the Qur'aan and what conclusions they have arrived at after casting only a cursory glance at its teachings:

“If it is not poetry...” writes Johnson, “and it is hard to say whether it be or not – it is more than poetry. It is not history, nor biography. It is not anthology like the Sermon on the Mount, nor metaphysical dialectics like the Buddhist Sutras; nor sublime homilectics like Plato’s conference of wise and foolish teachers. It is a Prophet’s cry Semitic to the core yet of a meaning so universal and so timely that all the voices of the age take it up willing or unwilling and it echoes over palaces and deserts, over cities, and empires, first kindling its chosen hearts to world’s conquest, then gathering itself up into a reconstructive force that all the creative light of Greece and Asia might penetrate the heavy gloom of Christian Europe when Christianity was but the queen of night.”

Emmanuel Deutsch, another eminent European orientalist, remarks:

“A book by the aid of which the Arabs conquered a world greater than that of Alexander the Great, greater than that of Rome and in as many tens of years as the latter had wanted hundreds to accomplish her conquests; by the aid of which they alone of all the Semites came to Europe as kings whither the Phoenicians had come as tradesmen and the Jews as fugitives or captives, came to Europe to hold up together with these fugitives the light to humanity: they alone while darkness lay around to raise up the wisdom and knowledge of Hellas from the dead, to teach Philosophy, Medicine, Astronomy and the golden art of song to the East as to the West, to stand at the cradle of modern science and to cause us late epigone for ever to weep over the day when Granada fell.”

It requires a lengthy discourse to discuss in detail how beautifully the Qur'aan has hinted at and described important problems of various sciences in its own inimitable style and how wisely it infused the spirit of learning in a race which besides being illiterate and steeped in ignorance went so far in its indifference to learning as to despise even the art of reading and writing.

The stress which the Holy Qur'aan has laid on the scientific study of the universe is a phenomenon unique in the religious literature of the world. Repeatedly it calls our attention to the multifarious phenomena of nature occurring around us. Repeatedly it exhorts the Muslims that the pursuit of scientific knowledge is one of their religious duties. Repeatedly it emphasizes the great truth unknown to the pre-Qur'aanic world that everything in nature is for the service of man and should be harnessed by him for his use. It exhorts us to study the structure and functions of human organism, the structure, functions and distribution of animals, the form, structure, functions, classification and distribution of plants, and these are the problems of modern Biology. It exhorts us to study the order of nature and the general properties of matter as effected by energy, which is the problem of modern Physics. It exhorts us to study the properties of substances both elementary and compound and the laws of their combination and action one upon another, which is the problem of modern Chemistry. It exhorts us to study the

structure and mineral constitution of the globe, the different strata of which it is composed, the changes that take place in its organic and inorganic matter, etc., etc., which are the problems of modern Geology. It exhorts us to study the general description of the earth, its physical divisions into seas, rivers, mountains, plains, etc., and the minerals, plants and animals in each, and its political divisions, which are the problems of modern Geography. It exhorts us to study the causes which bring about the alternation of day and night and the variation of seasons, the movements of the planets and other celestial phenomena, which are the problems of modern Astronomy.

It exhorts us to study the movements of winds, the formation and evolution of clouds and the production of rain, and other similar phenomena, which are the problems of modern Meteorology.

Allow me now to quote a few verses from the Holy Qur'aan which explain wisdom as synonymous with science and which refer to the whole universe as the field for scientific enquiry and investigation, thus making a comprehensive appeal for the cultivation of every conceivable branch of science. The Holy Book says:

“Lo! In the creation of the heavens and the earth, and the alternation of night and day, and the ships which run upon the sea with that which is of use to men, and water which Allaah (i.e., God) sendeth down from the sky, thereby reviving the earth after its death, and dispersing all kinds of beasts therein, and (in) the ordinance of the winds, and the clouds obedient between heaven and earth: are signs for people who have sense.” (Chap. 11: Verse 164).

“Lo! In the creation of the heavens and the earth and (in) the difference of night and day are signs for the wise.” (Chap. III: Verse 190).

“Lo! In the difference of day and night and all that Allaah hath created in the heavens and the earth are portents, verily, for people who ward off (evil).” (X:

7)

“And in the earth are portents for those whose faith is sure.” (LI: 20).

“Will they not regard the camels, how they are created?

“And the heaven, how it is reared aloft?

“And the mountains how they are set up?

“And the earth, how it is made a vast expanse?”

(LXXXVIII: 17-20)

As regards the formation of the universe with all the multifarious forms of life existing in it, the Qur'aan clearly teaches the process of evolution. The very first attribute of Allaah given in the first chapter of the Qur'aan is ***Rabb-ul-Alameen***, i.e., one who has created the universe by a process of evolution, which process is still in progress in various forms.

Now listen to the beautiful scientific passages of the Qur'aan relating to human organism and life:

“What aileth you that ye hope not toward Allaah for dignity. When He created you by (divers) stages?...” (LXXI: 13-14)

“Verily We created man from a product of wet earth: then placed him as a drop (of seed) in a safe lodging; then fashioned We the drop of clot; then fashioned We the clot a little lump; then fashioned We the little lump bones; then closed the bones with flesh: and then produced it as another creation. So blessed be Allaah the best of creators.” (XXIII: 12-13-14).

“He created you in the wombs of your mothers, creation after creation in a threefold gloom.” (XXXIX: 6).

As regards the physical ailments of human organism, the Qur'aan refers to natural products as the remedy in such pregnant words as these:

“And thy Lord inspired the bee saying: choose thou habitations in the hills and in the trees and in that which they thatch; then eat of all fruits, and follow the ways of thy Lord, made smooth (for thee). There cometh forth from their bellies a drink diverse of hues, wherein is healing for mankind. Lo! Herein is indeed a portent for people who reflect.” (XVI: 68-69).

Now let me quote a few verses relating to the scientific study of plant life. How irresistible is the appeal contained in these words:

“He (i.e., Allaah) it is Who sendeth down water from the sky, and therewith We (i.e., Allaah) bring forth buds of every kind; We bring forth the green blade from which We bring forth the thick-clustered grain; and from the date-palm, from the pollen thereof, spring pendant bunches; and (We bring forth) gardens of grapes and the olive, and the pomegranate, alike and unlike. Look upon the fruit thereof, when they bear fruit, and upon its ripening. Lo! Herein verily are signs for a people who believe.” (VI: 100).

The animal world is no less important according to the teachings of the Qur'aan. It says:

“And lo! In the cattle here is a lesson for you. We give you to drink of that which is in their bellies, from betwixt the refuse and the blood, pure milk palatable to the drinkers.” (XVI: 66).

“And Allaah hath created every animal of water. Of them there is (a kind) that goeth upon its belly and (a kind) that goeth upon two legs and (a kind) that goeth upon four. Allaah createth what He will. Lo! Allaah is able to do all things.

“Verily We have revealed clear communications...” (XXIV: 45-46).

But the Qur’aan does not stop at merely calling our attention to the study of the worlds of minerals, plants and animals. It teaches some great fundamental truths unknown before and of which modern scientists have only recently caught but a faint glimpse.

Before the advent of the Qur’aan scientific thought classified the world into four divisions:

- (1) Rational animals, i.e., mankind, who possessed sex-distinction and were endowed with the faculties of reason and articulate speech and a spiritual consciousness;
- (2) Irrational animals, who, though possessing life and having sex-distinction had neither any spiritual consciousness nor enjoyed the gifts of reason and articulate speech;
- (3) plants, who, though possessing the quality of growth and decay, were totally devoid of consciousness, reason, articulate speech and sex-life;
- (4) The rest of the world was constituted of “inanimate” objects totally lifeless and completely devoid of the qualities of growth and decay, consciousness, reason, language and sex-life.

Then came the Qur’aan and revolutionised the whole scientific outlook.

It proclaimed that the tiniest particle and the frailest leaf possessed consciousness peculiar to their own types of life. It asserted that the gift of language was not confined to mankind alone but extended to the worlds of irrational animals, plants and even what are called “inanimate” objects. Nay, it went further and thought that this gift was employed by them to hymn the praises of their Creator of whose existence and of their relationship with Him they were thoroughly conscious:-

“And Solomon was David’s heir. And he said, O mankind, Lo! We have been taught the language of birds, and have been given abundance of all things. This surely is a manifest Grace.” (XXVII: 16)

“... and there is not a thing but hymneth His praise; but ye understand not their praise.” (XVII: 44)

“Hast thou not seen that Allaah, He it is Whom all who are in the heavens and the earth praise, and the birds in their flight? Of each He knoweth verily the worship and the praise: and Allaah is aware of what they do.” (XXIV: 41)

The Holy Qur’aan taught that sex-distinction was not restricted to the animal worlds alone but existed in the world of plants and even minerals:

“And all things We have created by pairs (male and female) that haply ye may reflect.” (LI: 49).

“Glory be to Him who created (wedded) pairs of all things of that which the earth growth and of themselves, and of that which they know not!” (XXXVI: 35).

“...And of all fruits He placed therein two spouses (male and female)... Lo! Herein verily are signs for people who reflect.” (XIII: 3).

The Holy Qur’aan invited our attention to the social life of animals. How remarkable are the words:

“There is not an animal in the earth, nor a bird that flieth with its two wings but they are communities like unto you. We have neglected nothing in the Book. Then unto their Lord will they be gathered.” (VI: 38).

Let me now quote a few verses which invite our attention to the fundamental problems of chemistry, the properties of substances and the principles governing their combination and action one upon another:

“And whatsoever He hath created for you in the earth for diverse hues, Lo! Therein is indeed a portent for people who take heed.” (XVI: 13).

“And He it is who hath given independence to the two seas; one palatable sweet, and the other saltish, bitter; and hath set a bar and a forbidding bar between them.” (XXV: 53).

Geological and Geographical and Meteorological studies have received due consideration in the pages of the Qur’aan. The mineral constitution of the globe with special reference to the strata of which it is composed, the phenomena of night and day and of rain and snow-fall, the classification of land into plains and mountains, the diversity of peoples and fauna and flora have been beautifully mentioned to arouse our scientific interest. Thus says the Qur’aan:

“Hast thou not seen that Allaah causeth water to fall from the sky, and We produce therewith fruits of diverse hues; and among the hills are streaks white and red, of divers hues and (others) ravenblack;

“And of men and beasts and cattle, in like manner, of divers hues? The erudite among His bondmen fear Allaah alone. Lo! Allaah is Mighty, forgiving.” (XXV: 27-28).

“Hast thou not seen how Allaah wafteth the clouds, then gathereth them, then maketh them layers, and thou seest the rain come forth from between them: He sendeth down from the heaven mountains wherein is hail...”

“Allaah causeth the revolution of the day and the night. Lo! Herein is indeed a lesson for those who see.” (XXIV: 43:44).

“And of His signs are the creation of heavens and the earth, and the diversity of your languages and colours. Lo! Herein indeed are portents for the learned.”
(XXX: 22).

“Allaah sendeth down water from the sky and therewith reviveth the earth after her death. Lo! Herein is indeed a portent for a folk who listen.” (XVI: 65).

“A sign unto them is the dead earth; We revive it, and We bring forth from it grain so that ye eat thereof:

“And We have placed therein gardens of the date-palm and grapes, and We have caused springs of water to gush forth therein that they may eat of the fruit thereof, and their hands made it not. Will they not, then give thanks?”
(XXXVI: 33-34).

Repeated appeals have been made in the Qur’aan to study the celestial phenomena, with special reference to the revolutions of the planets in their orbits and their measurements, the alternation of day and night, and so on. So says the Qur’aan:

“And among His signs are the night and the day and the Sun and the Moon.”
(XLI: 37).

“He, it is Who appointed the Sun splendour and the Moon a light, and measured for her stages, that ye might know the number of years, and the reckoning. Allaah created not all that save in truth. He detaileth the revelations for people who have knowledge.” (X: 6).

“He is the Cleaver of the day-break, and He hath appointed the night for stillness, and the Sun and the Moon for reckoning. That is the ordinance of the Mighty, the Wise.” (VI: 97).

“And the Sun runneth on to a term appointed for it (or the termination of its course). That is the ordinance of the Mighty, the Wise.” (XXXVI: 37).

(It was discovered in the 19th century that the Sun with the whole solar system is running with a very high velocity towards the Dog Star to a term appointed for it.)

“And for the Moon We have ordained stages till it becomes again as an old shrivelled palm-leaf.

“It is not for the Sun to overtake the Moon, nor doth the night outstrip the day; and all float on in a sphere.” (XXXVI: 38-39).

This signifies the movement of our solar system in space.

Several references to the problems of physics have already occurred in passages quoted in connection with other subjects. Here I might quote only two particularly beautiful passages relating to the phenomenon of light and heat.

“Hast thou not seen how thy Lord hath spread the shade – And if He willed He could have made it still- then We have made the Sun its pilot;

“Then We withdraw it unto Us a gradual withdrawal?” (XXV: 45-46).

Count Ramford describes heat – a form of energy that could be produced by mechanical work. How beautifully did Qur’aan explain it long before:

“He hath made for you fire from the green trees, and behold: ye kindle from it.”
(XXXVI: 79).

Another particularly remarkable passage refers to the principles of aerostatics:

“Have they not seen the birds obedient (to the Law of Allaah) in mid air? None holdeth them save Allaah. Lo! Herein, verily are portents for a people who believe. (XVI: 79).

In short, the Glorious Prophet of Islam spiritualised science by including its acquisition among the duties of a Muslim. He placed the study of science on a level higher than worship, thus pointing to the fact that pleasure obtained by worshipping the Creator is increased according as one’s knowledge of His creation increases. I may cite here a few sayings of the Holy Prophet relating to this phase of his teaching.

He said:

“One hour’s meditation on the work of the Creator is better than seventy years’ prayer.”

“To listen to the instruction of science and learning for one hour is more meritorious than standing up in prayer for a thousand nights.”

“To listen to the words of the learned and to instill into the hearts the lessons of science is better than religious exercises.”

Inspired by these exhortations of their Teacher, the Muslims focused their attention on the cultivation of philosophy and science. But to talk of learning and wisdom before a savage and ignorant world and to present a rational religion which cuts at the

very roots of credulity and superstition was not easy task. Hence if on the one hand the Arabian Prophet had to count with the wild opposition of the savage hordes of Arabia which could be made to subside only after years of wise and patient handling, his followers had also to face similar situations wherever they went.

Europe, which is intoxicated today with material progress was then enchained in the fetters of superstition and rendered meek submission to the idol of church authority. The dignitaries of the Church, whose very first basic doctrine was “*beyond the most extended limit of human intellect fully to comprehend*” and “*a profound mystery*” in the words of Dr. Robinson and thus beyond the reach of reason perceived in the intellectual movement of Islam and its rational religious spirit was a real danger to their dogmas and their personal prestige. The rational spirit of Islam and the dogmatic teachings of the Church could not be reconciled. Consequently the whole Christendom rose like one man to thwart and throttle the Islamic civilization, not with the weapons of logic but with fire and sword, with the result that though the cultivation of learning had been one of the main factors in the scheme of Muslim society from the very first, the followers of Islam had to spend one full century in breaking up the forces of opposition before they could find a safe and cool atmosphere for their intellectual mission.

The first foreign intellectual current which Islam experienced after setting its foot beyond the territory of Hedjaz was Greek Philosophy and Science which, owing to lack of patronage and indifference, nay violent opposition of the Christian Church, was more dead than living and Muslims, who had been taught by their Glorious Teacher that “*All knowledge was the lost property of the Believer, he should take hold of it wherever he finds it,*” devoted themselves with full enthusiasm to their study and soon mastered them. Draper, the reputed historian of Europe, in his remarkable book “**Conflict between Religion and Science**” refers to this fact in these words:

“In less than a century after the death of Muhammad translations of the chief Greek philosophical authors had been made into Arabic.”

And these were only the beginnings of a great movement. The scientific spirit of Islam manifested itself at its full when the Abbasids came to power in Bagdad, and the Muslim nation which had till then won laurels on the battlefields busied herself heart and soul in intellectual pursuits. A modern Muslim historian, the Rt. Hon. Syed Ameer Ali, P. C., in **The Spirit of Islam** page 370) refers to this fact in these eloquent words:

“Each great nation of the world has had her golden age. Athens had her Periclean era; Rome her Augustan age; so too had the Islamic world its epoch of glory; and we may with justice look upon the period which elapsed from the accession of Mansur to the death of Mutazid-billah, with only a brief intermission during the reign of Mutawakkil, as an epoch of equal, if not of superior greatness and magnificence. Under the first six Abbasid Caliphs, but especially under Mamun the Moslems formed the vanguard of civilization. The Saracenic race by its elastic genius as well as by its central position – with the priceless treasures of dying Greece and Rome on one side, and of Persia on the

other, and India and China far away sleeping the sleep of ages – was pre-eminently fitted to become the teacher of mankind. Under the inspiring influences of the great Prophet, who gave them a code and a nationality, and assisted by their sovereigns, the Saracens caught up the lessons of wisdom from the East and the West, combined them with the teachings of the Master, and ‘started from soldiers into scholars’.”

“The Arabs,” says Humboldt, “were admirably situated to act the part of mediators, and to influence the nations from the Euphrates to the Guadalquivir and Mid-Africa. Their un-examined intellectual activity marks a distinct epoch in the history of the world.”

Though there is not a branch of knowledge which is not indebted to the Muslims. I shall, owing to the shortness of time at my disposal, confine myself only to some important sciences by way of illustration and it shall reveal to you that they not only made a great advance in the realm of science but were proud originators of many of its branches.

I have said at the very outset that it is one of the principles of Islam not to accept anything without a thorough investigation. So when in the case of religious beliefs, a belief in which is usually demanded by other religions on the basis of the pleas that reason has no right to interfere in matters of religion, the Muslims were taught the principle: ***“first satisfy your intellect through sound reasoning; faith will automatically spring up,”*** how was it possible for them to be credulous in their views of the physical world and to form their opinions without thorough investigation and sound experiments? This mentality, once created, gave them a scientific vision and made them pioneers in the field of science. Their fundamental advance in science was the introduction of Inductive Method, which they had been taught by the Qur’aan, and but for this, science would never have emerged from its primitive character and attained to its modern usefulness. According to an eminent historian, ***“The method of experimentation was substituted for theorising and the crude ideas of the ancients were developed into positive science.”*** Briffault in his **Making of Humanity** makes these thought-provoking observations (pp. 202, 190).

“It was under their successors at the Oxford School that Roger Bacon learned Arabic and Arabic Science. Neither Roger Bacon nor his later namesake has any title to be credited with having introduced the experimental method. Roger Bacon was no more than one of the apostles of Muslim Science and method to Christian Europe; and he never wearied of declaring that knowledge of Arabic and Arabic Science was for his contemporaries the only way to true knowledge. Discussions as to who was the originator of the experimental method... are part of the colossal misrepresentation of the origins of European civilization. The experimental method of Arabs was by Bacon’s time widespread and eagerly cultivated throughout Europe.

“Science is the momentous contribution of Arab Civilization to the modern world; but its fruits were slow in ripening. Not until long after Moorish culture had sunk back into darkness did the giant to which it had given birth rise in his might. It was not science only which brought Europe back to life. Other and manifold influences from the civilization of Islam communicated its first glow to European life.

“For although there is not a single aspect of European growth in which the decisive influence of Islamic culture is not traceable, nowhere is it so clear and momentous as in the genesis of that power which constitutes the permanent distinctive force of the modern world and the supreme source of its victory – natural science and the scientific spirit.

“The debt of our science to that of the Arabs does not consist in startling discoveries of 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 astronomy and mathematics of the Greeks were a foreign importation never thoroughly acclimatized in Greek culture. The Greeks systematised, generalised and theorised, but the patient ways of investigation, the accumulation of positive knowledge, the minute methods of science, detailed and prolonged observation and experimental enquiry were altogether alien to Greek temperament. Only in Hellenistic Alexandria was any approach to scientific work conducted in the ancient classical world. What we call science arose in Europe as a result of a new spirit of enquiry of new methods of investigation; of the method of experiment, observation, measurement; and of the development of mathematics in a form unknown to the Greeks. That spirit and these methods were introduced into the European world by the Arabs.”

The remarks of Draper are also worth quoting in this connection. He observes (Conflict: pp. 112):

“The essential characteristics of their (Arabs) method are experiment and observation; geometry and mathematical sciences they look upon as instruments of reasoning. In their numerous writings on mechanics, hydrostatics, optics it is interesting to remark that the solution of a problem is always obtained by performing an experimental observation. It was this that made them the originators of chemistry, that led them to the investigation of all kinds of apparatus for distillation, sublimation, fusion, filtration, etc., that in astronomy caused them to appeal to divided instruments, as quadrants and astrolabes, in chemistry to employ the balance, the theory of which they were perfectly familiar with, to construct tables of specific gravities and astronomical tables as those of Baghdad, Spain, Samarcand, that produced their great improvement, in geometry, trigonometry, the invention of algebra and the adoption of Indian numeration in arithmetic. Such were the results of their preference of the inductive methods... their declining the reveries of Plato.”

The repeated appeal of the Qur'aan to observe and study the phenomena of nature and the laws working therein was responsible for creating a taste for physics among the Muslims. They acquired the knowledge of the ancient physicists, corrected their views and made epoch-making contributions to the subject. At the height of its power the Muslim world produced thousands of physicists like Al-Kindi, Ibn-i-Sina (Avicenna) Abdur Rehman Sufi, Al-Beiruni, Omar Ibn-i-Khalladun, Yakub Ibn-i-Tarik, Muslimah al-Maghrbi, Ibn-i-Rushd (Averros) Hasan Ibn-i-Haitham (Alhazen) and Ibn-i-Yunus, the famous inventor of the pendulum and the measurement of time by its oscillations. I might briefly touch here upon the work of one of them, Alhazen, to give you an idea of the genius of Muslim physicists.

“Hasan Ibn-i-Haitham, commonly called Alhazen, and famous for the discovery of atmospheric refraction,” says Rt. Hon. Syed Ameer Ali, *“flourished about the end of the eleventh century, and was a distinguished astronomer and optician. He was born in Spain, but resided chiefly in Egypt. He is best known in Europe by his works on optics, one of which has been translated into Latin by Risner. He corrected the Greek misconception as to the nature of vision, and demonstrated for the first time that the rays of light come from the external objects to the eye, and do not issue forth from the eye, and impinge on external things. He determined the retina as the seat of vision, and proved that the impressions made upon it were conveyed along the optic nerves to the brain. He explained the phenomena of a single vision by the formation of visual images on symmetrical portions of the two retinas. He discovered that the refraction of light varies with the density of the atmosphere, and that atmospheric density again varies with the height. He explained accurately and clearly how in consequence of this refraction, astral bodies are seen before they have actually risen and after they have set, and demonstrated that the beautiful phenomena of twilight was due to the effect of atmospheric refraction combined with the reflecting action of the air upon the course of the rays of light. In his book called the Balance of Wisdom he discusses dynamical principles, generally supposed to be the monopoly of modern science. He describes minutely the connection between the weight of the atmosphere and its density, and how material objects vary in a rare and in a dense atmosphere. He discusses the submergence of floating bodies, and the force with which they rise to the surface when immersed in light or heavy media: he fully understands the principle of gravitation, and recognises gravity as a force. He knows correctly the relation between the velocities, spaces and times of falling bodies, and has very distinct ideas of capillary attraction.* (The Spirit of Islam, pp. 377-78).

The Qur'aanic exhortation to study the composition of matter led the Muslims to the cultivation of chemistry and gave them the proud position of the father of that science. The chemistry of the Greeks and their immediate successors was almost entirely concerned with the problem of transmuting baser metals into gold; their method too was, so to say, pre-scientific. It was in the hands of the Muslim chemists that it evolved itself into a positive science. It was they who established the fundamental principles on which the study of chemistry should proceed. They invented the physical balance and all kinds of apparatus for filtration, distillation, fusion, sublimation, etc., they discovered some of its most important re-agents – sulphuric acid, nitric acid, alcohol. Jabir Ibn-i-Hoyyan

(better known as Geber), Abu Bakr Muhammad Ibn-i-Zakaria ar-Razi, Ibn-i-Sina (Avicenna), Jildaki, to quote only a few names out of a long list of Muslim chemists, have left an indelible mark on the pages of history.

That the importance of experimental work in chemistry was fully recognised by Muslim scientists becomes thoroughly clear from the following words of Jabir, the true father of modern chemistry who, according to Ibn-i-Khallikan, ***“compiled a work of two thousand pages in which he inserted the problems of his master (the Imam) Jafar as-Sadique, which formed five hundred treatises.”***

He says:

“The first essential is that thou shouldst perform practical work and conduct experiments.. For he who perform not practical work nor conducts experiments will never attain to the least degree of mastery.”

Elsewhere he gives ten rules for the practice of chemistry which are of great significance: (1) the operator should know the reason for performing each operation; (2) the instructions must be properly understood; (3) impossible and profitless processes should be avoided; (4) time and season must be carefully chosen; (5) it is best for the laboratory to be in a secluded place; (6) the chemist must have trusted friends; (7) he must also have leisure to conduct his experiments; (8) and patience and reticence; (9) and perseverance; (10) he must not be deceived by appearances into bringing his operations to too hasty conclusions.

Medicine:- “Islam has laid a very great stress on physical health and has made physical culture the religious duty of a Muslim. It has itself laid down laws of hygiene and sanitation, has given instructions regarding our diet and has pointed to natural products as remedies of our ailments. The Holy Prophet is reported to have said:

“For every malady there is a remedy.”

The Muslims have consequently been the foremost in the cultivation of the sciences of medicine and physical culture. Humanity can never forget the debt it owes to them for their labours in this field of learning.

There is no denying the fact that the art of manufacturing drugs originated in the hands of the Greeks and that the idea of a systematic investigation of the properties of medicines was first conceived by Dioscorides but the credit of making medicine a full-fledged science undoubtedly goes to the Muslims. Anatomy and physiology rose in their hands from their crude state into positive sciences. The chemical pharmacy owes its existence to their genius and what are called dispensaries to-day are the products of Islamic civilization. The system of public hospitals, too, was brought into existence by the Muslim rulers.

The concern of the Muslim governments for the health of their subjects is amply borne out by the findings of Kremer and Sedillot. According to them the government

maintained a large number of public dispensaries and the persons in charge of the dispensaries were under the control of the government. Great care was taken to regulate the price and quality of medicines. The state held regular examinations for physicians and pharmacists and licenses were awarded only to passed candidates who alone were entitled to practice.

To discuss in detail the historic achievements of Muslim physicians and surgeons at the present occasion is an impossible task. There have been thousands among them who have devoted their whole lives to this science and whose genius has won the admiration of the world. Abu Bakr Ibn-i-Zakeria ar-Razi, Ali Ibn-i-Abbas, Ibn-i-Sina, Abul Kasim Khalaf Ibn-i-Abbas, Abu Marwan Ibn-i-Abdul Malik Ibn-i-Zuhr, Ibn-i-Rushd, of Spain, Abdullah Ibn-i-Ahmed al-Beithar, Abul Hassan Ibn-i-Tilmiz, Abu Jafar Ahmed Ibn-i-Mohammed at-Tabib and Hibatullah are some of the most brilliant physicians and surgeons whose work has immortalised their names in history. Razi “filled successively the office of principal of the public hospital at Rai, Jundshapur and Baghdad. He wrote the *Hawi*, which Sedillot calls, ‘*un-corpus medical fort estima.*’ His treatises on small-pox and measles have been consulted by the physicians of all nations. He introduced the use of *minoratives*, invented the Seton, and discovered the nerve of the larynx. He wrote two hundred medical works, some of which were published in Venice in 1510.” “Ali Ibn-i-Abbas flourished fifty years later than Rhaze (or Razi). He published a medical work, consisting of twenty volumes, on the theory and practice of medicine... this work was translated into Latin in 1227, and printed at Lyons in 1523 by Michel Capilla. Ali-Ibn-i-Abbas corrected many of the errors of Hippocrates and Galen.” “Avicenna (or Ibn-i-Sina) was unquestionably the most gifted man of his age; a universalist in genius and encyclopaedic in his writings. A philosopher, mathematician, astronomer, poet, and physician, he has left his influence impressed on two continents, and well deserves the title of Aristotle of the East. In spite of patriotic jealousy, his philosophic ideas exercised an undisputed sway for several centuries in the schools of the East as well as of Europe. Avicenna is commonly known in Asia as the *Sheikh par excellence*... He finished his medical studies in Bokhara at the age of eighteen, when he commenced an extraordinary political and philosophical career... wrote his great works, the *Kanun* and the *Arjuza*, afterwards the foundation of all medical knowledge.” “Albucasis (or Abul Kasim Khalaf Ibn-i-Abbas) was not only a physician but a surgeon of the first rank. He performed the most difficult surgical operations in his own obstetrical department. In operations on women, we are informed by him, in which considerations of delicacy intervened, the services of properly instructed women were secured. The ample description he has left of the surgical instruments employed in his time gives an idea of the development of surgery among the Arabs. In lithotomy he was equal to the foremost surgeons of modern times.” “Ibn-i-Zuhr or Avenzoar was one of the most distinguished physicians of his age. Born at Penaflor, he entered after finishing his medical and scientific studies the service of Yusuf Ibn-i-Tashfin, the great Almoravide monarch of Africa, who covered the rising physicians with honours and riches. Ibn-i-Zuhr joined, like Albucasis, the practice of medicine with surgery. He was the first to conceive the idea of bronchotomy, with exact indications of the luxations and fractures, and discovered several important maladies with their treatment. His son followed in his father’s steps and was the chief surgeon and physician of Yusuf Ibn-i-Tashfin’s army.”

“Al-Beithar (or the veterinary) travelled all over the East to find medicinal herbs on which he wrote an exhaustive treatise.”

Modern medicine has, like most other sciences, evolved out of Muslim medicine, and, as Draper points out “*the first medical college established in Europe was that founded by the Saracens at Salerno in Italy.*” (Conflict: pp. 115).

Biology:- While reviewing the Qur’aanic exhortation to cultivate science, I have already shown, though very briefly, how forcefully it has appealed to the Muslims to study plant-life. Now I shall briefly touch upon their pioneer work in this field in the words of an eminent historian:-

“Botany they advanced far beyond the state in which it had been left by Dioscorides and augmented the herbology of the Greeks by the addition of two thousand plants.

Regular gardens existed both in Cordova and Baghdad, at Cairo and Fez for the education of pupils, where discourses were delivered by the most learned in sciences.”

The works of Muslim scientists in zoology was no less remarkable, for the Qur’aan has referred to animal life as constituting a mighty sign of the greatness and glory of the Lord. Among Muslim zoologists Ad-Damiri ranks supreme. He is famous for his history of animals, a work which according to Ameer Ali, “*forestalled Buffon by seven hundred years.*”

Geology and Geography:- The Qur’aanic injunction to ponder over the problems of the formation of the earth and the conditions of life obtaining thereon was greatly responsible for infusing in the Muslims an enthusiasm for geological and geographical studies. Geology was cultivated by the Muslim scientists under the name of a “*Tashri-hul-Ard*” (the science of the anatomy of the earth) and to this branch of knowledge they made important contributions. In the field of geographical research, however, their contributions were great and glorious. They studied physical features, climatic conditions, variation of seasons and properties of the soil and arrived at important and far-reaching conclusions. They determined the form of the earth and measured its size

“On the shores of the Red Sea, in the plains of Shimar, by the aid of an astrolabe, the elevation of the pole above the horizon,” observes Draper, “*was determined at two stations on the same meridian, exactly one degree apart. The distance between the two stations was then measured, and found to be two hundred thousand Hashemite cubits; this gave for the entire circumference of the earth about twenty-four thousand of our miles, a determination not far from the truth. But since the spherical form could not be positively asserted from one such measurement, the Khalif (Mamun) caused another to be made near Cufa in Mesopotamia. His astronomers divided themselves into two parties, and starting from a given point, each party measured an arc of one degree, the one northward the other southward. Their result is given in cubits. If the cubit employed was that known as the royal cubit the length of a degree was ascertained within one-third of a mile of its true value. From these measures the Khalif concluded that the globular form was established.”*

They made maps of the worlds and, in the words of Draper, "*Al-Baghdadi left one (book) on land surveying so excellent that by some it has been declared to be a copy of Euclid's lost work on the subject.*" Their pioneering work in mathematical geography has been commented upon by the author of the *Spirit of Islam* in these words (pp.384).

"Their progress in mathematical geography was no less remarkable. The works of Ibn-i-Haukal, of Makrizi, al-Istakhri, Masudi, al-Beiruni, al-Kumi and al-Idrisi, Kazwini, Ibn-ul-Wardi, and Abul Feda, show what the Saracens attained in this department of science, called by them the rasm-ul-ard. At a time when Europe firmly believed in the flatness of the earth, and was ready to burn any foolhardy person who thought otherwise, the Arabs taught geography by globes."

Astronomy:- Time and again does the Holy Qur'aan speak of heavenly bodies as manifestations of the might and majesty of the Ruler of the universe. It repeatedly refers to the revolution of the planets in their orbits, the variation and succession of night and day, the phenomena of the appearance and disappearance of the Sun, the changes of the Moon, and the immutable law pervading movements of the planets.

It is gratifying to note that the Qur'aanic invitation to study celestial phenomena has not fallen on deaf ears, for movements. Abdur Rehman Sufi is noted for his improvements in photometry of stars. Prince Jafar has given us his important observations regarding the erratic movements of comets in his very valuable treatise. The discoveries of Al-Kohi relating to the summer solstice and the autumnal equinox are a most valuable contribution to astronomical learning. The Astronomical Table of Abul Wafa called the *Zij-ush-Shamil* "*is a monument of industry and keen and accurate observation.*" He introduced the use of the secant and the tangent in trigonometry and astronomical observations.

"But this was not all," says M. Sedillot "*struck by the imperfection of the lunar theory of Ptolemy, he verified the ancient observations, and discovered, independently of the equation of the centre and the evicton, a third inequality, which is no other than the variation determined six centuries later by Tycho Brahe.*"

Ibn Yunus, the inventor of the pendulum and the measurement of time by its oscillations,
is

"famous for his great work named after his patron and saviour, Zij-ul-Akbar-al-Hakimi, which soon displaced the work of Claudius Ptolemy. It was reproduced among the Persians by the astronomer poet Omar Khayyam (1079); among the Greeks in the syntax of Chrysococca; among the Mongols of Nasiruddin Tusi, in the Zij-il-Khani; and among the Chinese, in the astronomy of Co-Cheou-King in 1280; and thus what is attributed to the ancient civilization of China is only of borrowed light from the Muslims."

The astronomical treatise, al-Kanun-al-Masudi, written by the master thinker al-Beiruni, whose work in numerous branches of learning has drawn high praise from scholars of all nations, is a ***“monument of learning and research.”***

“The astronomical observations conducted by a body of savants, with Omar Khayyam and Abdur Rehman al-Hazini at their head led to the reform for the calendar which preceded the Gregorian by six hundred years and is said by a competent authority to be even more exact. The era which was introduced upon these observations was named after Malik Shab, the Jalalian.”

Ulugh Beg, the son of the mighty Emperor Timur, was ***“an astronomer of high rank and presided at the observations which have immortalised his name... Ulugh Beg is separated by only a century and a half from Kepler.”*** The world of Islam has produced a galaxy of illustrious astronomers whose epoch making discoveries have immortalized their names in the history of progress and the Arabic names which the stars of the larger magnitudes still bear on the celestial globes shall always continue to remind students of astronomy of the genius of Muslim astronomers. It is impossible at this occasion to review at some length the researches of Muslim astronomers. Only a very brief survey is possible.

Mashaallah and Ahmed Al-Nahavendi were the inaugurators of astronomy among the Arabs. Mashaallah, ***“the Phoenix of his time,”*** according to Abul Faraj, ***“wrote several treatises on the astrolabe and the armillary sphere, and the nature and movement of celestial bodies – works which still evoke the admiration of scientists.”*** Al-Nahavendi corrected several Hindu and Greek notions in his astronomical table called Al-Mustamal. Send Ibn Ali, Yahya Ibn Abu Mansur, and Khalid Ibn Abdul Malik, made extremely valuable observations in connection with the equinoxes, the eclipses, the apparitions of the comets, and other celestial phenomena. Al-Khwarizmi translated ***Siddhanta***, the book of Indian Tables and added to it his own observation. The encyclopadist Al-Kindi, who was the author of two hundred works on diverse subjects, wrote numerous treatises on astronomy which are valuable in the extreme. ***“Abu Mashar (corrupted by the Europe of the Middle Ages into Albu-mazar) made the celestial phenomena his special study: and the Zij-abi-Mashar, or the table of Abu Mashar, has always remained one of the chief sources of astronomical knowledge.”*** The discoveries and observations of the three brothers, Mohammed, Ahmed and Hasan, relating to the evaluations of the mean movements of the Sun and other astral bodies, the obliquity of the ecliptic, the variations of the lunar altitudes, the precession of the equinoxes, and the movements of the solar apogee bear testimony to the genius of Muslim scientists. The Astronomical Tables of Al-Batani, the introducer of sine and co-sine instead of the chord in astronomical and trigonometrical calculations were translated into Latin and furnished for many centuries the ground work of astronomy in Europe. Ali Ibn Amajur and Abul Hasan Ali Ibn Amjur are famous for their calculations of the lunar ***“The first observatory in Europe,”*** says Ameer Ali, ***“was built by the Arabs. The Giralda, or tower of Seville, was erected under the superintendence of the great mathematician Jabir Ibn Afiah in 1190 A.C. for the observation of the heavens. Its fate was not a little characteristic.***

After the expulsion of the Moors, it was turned into a belfry, the Spaniards not knowing what else to do with it."

"The Arabian astronomers," says Draper (Conflict: pp. 116) *"devoted themselves to the construction and perfection of astronomical instruments, to the measurement of time by clocks of various kinds, by clepsydras and sundials. They were the first to introduce for this purpose the use of the pendulum."* To the Muslims goes also the credit of the revolutionising invention of the telescope. Its inventor Abul Hasan describes it as *"a tube to the extremities of which were attached two diopters."* It was further improved by Abul Hasan's Muslim successors and used with great success in the observatories of Maragha and Cairo.

I hope it will not be out of place to refer briefly here to what might be called Applied Science. The effects of this scientific activity are plainly perceived in the great improvements that took place in many of the industrial arts. Agriculture shows it in better methods of irrigation, the skillful employment of manures, the raising of improved breeds of cattle, the enactment of wise codes of rural laws, the introduction of the culture of rice, and that of sugar and coffee. The manufactures show it in the great extension of the industries of silk, cotton, wool; in the fabrication of Cordova and Morocco leather and paper, in mining, casting, and various metallurgic operations; in the making of Toledo blades." The invention of the mariner's compass and the introduction of navigation charts was also the product of the same scientific spirit and made Muslims the masters of the sea.

The intellectual upheaval created by Islam was a gigantic one. There is not a single department of learning which the Muslim scholars have left untouched and in which they have not carved out a high position for themselves. At this occasion I have confined myself to some important exact sciences. The Muslim contribution to normative sciences, philosophy, art and literature, which is a great and in some cases even greater, has been totally left out.

Ladies and Gentlemen! Before I finish I might with advantage touch upon a sad phase of the intellectual progress of the Muslim world. From the very first day of the inception of Islam, its followers had to face the fierce animosity of barbarous or semi-barbarous nations which surrounded them on all sides. The Holy Prophet Muhammad himself (may God send His peace upon him!) was forcibly drawn into war by the ignorant savages of Arabia several times and his followers have been sharing the same fates up to this day. Never were Muslims allowed peace of mind for even a short time. With the counties of Christendom on the north and in the west and Mongols and Tartars and Hindus on the east, the Muslim Empire was continuously engaged in warfare for its bare existence. For ten centuries the world of Islam persisted in its glorious march on the path of mental and material progress: but at last the forces of destruction which the non-Muslim nations of the world, to whom science was an unmixed evil because it destroyed their religious beliefs which could not withstand the light of reason, had set in motion inflicted misfortune after misfortune on the Muslim world. The two great centres of Muslim learning Cordova and Baghdad were brutally destroyed one after another by the

Christian nations of Europe and the Mongol chieftain Halaku respectively. A wholesale slaughter of Muslim scholars and a thorough destruction of Muslim libraries, academies, universities and other implements of civilization, was staged throughout the Muslim Empires of Spain and Baghdad by the enemies of scientific learning. To give you an idea of the magnitude of the calamity which befell the Islamic civilization, I shall give a brief description of the sack of Baghdad by the Mongols which exemplifies what happened in other cities in the world by the author of the *Spirit of Islam*. He says (pp. 402)

“for three days the streets ran with blood, and the water of the Tigris was dyed red for miles along its course. The horrors of rapine, slaughter, and outraged humanity lasted for six weeks. The palaces, mosques and mausoleums were destroyed by fire or levelled to the earth for their golden domes. The patients in the hospitals and the students and professors in the colleges were put to the sword. In the mausoleums the mortal remains of the sheikhs and pious imams, and in the academies the immortal works of great and learned men, were consumed to ashes: books were thrown into the fire or where that was distant and the Tigris near, were buried in the water of the latter. The accumulated treasures of five centuries were thus lost forever to humanity. The flower of the nation was completely destroyed.

The after-effects of these fatal happenings were demoralising in the extreme and exercised a far-reaching influence on future Muslim history. The moral force of the Muslim nations ebbed away with the defeat of arms and the intellectual spirit of Islam has remained passive all these centuries for the Muslim nations, surrounded on all sides by enemies, have been continuously engaged in a bitter struggle for their very existence. Literary and scientific activity has, however, appeared whenever opportunity has offered itself. Thus it was during the reigns of the Turkish Emperors, Selim I, Sulaiman and Murad; and a recent example of this in India is the revival of learning inaugurated by the learned and enlightened ruler of the premier State of Hyderabad, that prince among the learned and learned among the princes, the “*Sultan-ul-uloom*,” His Exalted Highness Asifjah Mir Osman Ali Khan. Among his numerous achievements in this direction are the Osmania University and the Translation Bureau. The Osmania University which imparts all education in ancient and modern learning through the medium of Hindustani and stands in proud contrast against other universities of India, where the medium of instruction in English, might be regarded as a modern prototype of the Nizamiah University of Baghdad established in the fifth century of the Hijra. The Translation Bureau, which bears upon its shoulders the responsibility of translating all modern knowledge as also all important books of ancient learning into the Hindustani language, may well be compared with similar institutions which flourished under Mamun and other Muslim rulers.

It may again be affirmed that Islam was in no way responsible for the intellectual stagnation of Muslim nations after the fall of Baghdad and Muslim Spain. The charge of obscurantism often leveled against Islam is thoroughly unfounded. The observations of M. Gobineau in this connection are well worth consideration. He says:

“Imagine in any European country the absolute pre-dominance of military and administrative despotism during a period of two hundred and fifty years, as in the case of Turkey; conceive something approaching the warlike anarchy of Egypt under the domination of foreign slaves – Circassians, Georgians, Turks and Albanians; picture to yourself an Afghan invasion, as in Persa after 1730, the tyranny of Nadir Shah, the cruelties and ravages that have marked the accession of the dynasty of Kajars, unite all these circumstances with their naturally concomitant causes, you will then understand what would have become of any European country although European and it will not be necessary to look further for any explanation of the ruin of Oriental countries, nor to charge Islam with any unjust responsibility.”

Another eminent writer, Pierre Loti, observes:-

“Among us Europeans it is commonly accepted as a proven fact that Islam is merely a religion of obscurantism, bringing in its train the stagnation of nations, and hampering them on that march to the unknown which we call “Progress.” Yet such an attitude shows not only an absolute ignorance of the teaching of the Prophet, but a blind forgetfulness of the evidence of history. The Islam of the earlier centuries evolved and progressed with the nations, and the stimulus it gave to men in the reign of the ancient Caliphs is beyond all question. To impute to it the present decadence of the Muslim world is altogether too puerile.”

In truth, Islam intends the Muslim community to be a community of intellectuals, and the cultivation of science and all other forms of learning is one of the primary aims of Islam. Had it not been for the Muslims, Europe would never have seen its way to the Renaissance and the modern scientific era would never have dawned. Those nations who have received their knowledge of science from Europe are in fact indirectly the disciples of the Islamic community of the past. Humanity owes to Islam a debt which it can never repay and gratitude which it can never forget.

Before I conclude, let me affirm once more that the Muslim community is out and out of creation of Islam which in its turn is rooted in Divine revelation. Nothing but a belief in and the practice of Islam can make an individual a Muslim. Islam had laid it down as a religious duty that a Muslim should enquire into the reality of objects around him, so that his scientific enquiry may lead him to knowledge of his Creator. Scientific enquiry in Islam is not an end but a means to the attainment of a higher end... the realisation of the source of all Life and Light, in one word, Allaah. And this is really the true end for humanity.

“ From God we are and unto God is our return.” (Al-Qur’aan).

THE END

