INTERNATIONAL ISLAMIC
PUBLISHING HOUSE
AND
THE INTERNATIONAL INSTITUTE
OF ISLAMIC THOUGHT

ISLAMIZATION OF KNOWLEDGE SERIES NO. (9)

Islamization of Attitudes and Practices in Science and Technology

Edited by
M.A.K. Lodhi

بسم الله الرحمن الرحيم

الحمد لله رب العالمين

والصلاة والسلام على خاتم الأنبياء والمرسلين

In the Name of Allah,
the Compassionate, the Merciful,
Praise be to Allah, Lord of the Universe,
and Peace and Prayers be upon
His Final Prophet and Messenger.

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

اقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ ﴿١﴾ خَلَقَ الْإِنسَانَ مِنْ عَلَقٍ ﴿٢﴾ اقْرَأْ وَرَبُّكَ
الْأَكْرَمُ ﴿٣﴾ الَّذِي عَلَّمَ بِالْقَلَمِ ﴿٤﴾ عَلَّمَ الْإِنسَانَ مَا لَمْ يَعْلَمْ ﴿٥﴾

العلق ١-٥

Read in the name of your Sustainer, Who has Created man out of a germ cell.
Read – for your Sustainer is the Most bountiful One.
Who has taught (man) the use of the pen.
Taught Man what he did not know.

(Qur'an 96:1-5)

وَاللَّهُ أَخْرَجَكُم مِّن بُطُونِ أُمَّهَاتِكُمْ لَا تَعْلَمُونَ شَيْئًا وَجَعَلَ
لَكُمُ السَّمْعَ وَالْأَبْصَارَ وَالْأَفْئِدَةَ لَعَلَّكُمْ تَشْكُرُونَ ﴿٧٨﴾

النحل ٧٨

And Allah has brought you forth from your mother's wombs knowing nothing – but He has endowed you with hearing, and sight, and minds, so that you might have cause to be grateful.

(Qur'an 16:78)

Islamization of Attitudes and Practices in Science and Technology

Islamization of Attitudes and Practices in Science & Technology

Proceedings of the Workshop on the Islamization of Attittudes and Practices in Science and Technology
Herndon, Virginia
(*Jumāda al Ākhirah 28th-Rajab 1st 1407 AH*/February 27-March 1st 1987 AC)

Edited by
M.A.K. Lodhi

The International Institute of Islamic Thought

Islamization of Knowledge Series No. (9)

REPRINT
(1415 - 1994)

Library of Congress Cataloging-in-Publication Data

Workshop on Islamization of Attitudes and Practices in Science and Technology (1989: International Institute of Islamic Thought) Science: Attitudes and Practices: proceedings of Workshop on Islamization of Attitudes and Practices in Science and Technology 1989/M.A.K. Lodhi, editor. p. cm.

ISBN 0-912463-42-2

1. Islam and science – Congresses. 2. Technology – Religious aspects – Islam – Congresses. I. Lodhi, M.A.K. II. Title. BP190.5S3W67 1989
297' .1975 – dc20 89-15332
CIP

نشر وتوزيع:
الدار العالمية للكتاب الإسلامي
نشر وتوزيع الكتاب والشريط الإسلامي بسبعين لغة
الإدارة العامة: ص.ب. ٥٥١٩٥ ـ الرياض ١١٥٣٤
هاتف ٤٦٥٠٨١٨ ـ ٤٦٤٧٢١٣ ـ فاكس ٤٦٣٣٤٨٩
المكتبات: الرياض ٤٦٢٩٣٤٧ ـ ١ / جدة ٦٨٧٣٧٥٢ ـ ٢ / الخبر ٨٩٤٥٨٢١ ـ ٣

INTERNATIONAL ISLAMIC PUBLISHING HOUSE
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INTRODUCTION:

A Step Towards Reevaluating the Attitude of a Muslim Scientist

The Workshop on "Islamization of Attitude and Practice in Science and Technology" was held in Washington, DC, 28 *Jumādā al Ākhirah*-1 *Rajab* 1408 AH. February 27-March 1, 1987. This Workshop was the first of its kind on the subject. It evolved out of some informed discussions held at other conferences and conventions among Muslim scholars in the United States. They observed that some of the most talented Muslims in various disciplines live in North America. They expressed concerned with the malaise of the Ummah and offered plans to resolve the plight of the Ummah. Thus an humble attempt was made to bring some of those concerned scientists, engineers and medical practitioners together to critically analyze and seek solutions to contemporary problems in their respective fields, and to ultimately bring this Ummah back in its original state of being the best of all nations as proclaimed by Allah. The Workshop focused on problems and challenges of science with respect to the ideology, personality, education and environment of a Muslim scientist in the contemporary world, in relation to the past and the future. The Workshop, however, should be viewed only as a pragmatic step rather than simply the idealization without testing the validity of the concepts by their practical results.

The Muslim Ummah is destined to be the best, offering the rightly guided leadership. Unfortunately, this Ummah has been subjected to humiliation and persecution. On the whole, the Ummah is militarily weak, technologically underdeveloped, far behind in science and devoid of education. The Workshop brought together many Muslim leaders, thinkers, scholars, scientists, and other professionals living in North America, in an effort to enable this Ummah to assume its role of world leadership. The developing of the Muslim personality and society by Islamizing all contemporary fields is essential.

At the outset of this humble effort, the Workshop provided a forum to contribute and contemplate on some of the challenges that the Muslim Ummah has been facing in the scientific field. Our concern, in the Workshop, has not been to eulogize our past and to blame others for what we are suffering. Our major concern has been to first develop an understanding of ourselves,

our personalities, and the reasons why we, as individuals and as a nation, are not more serious about achievements or exploring new frontiers. We need to know why, in recent centuries, we have tended to be limited to imitation at best. We also lack originality. What is in us that keeps us the way we are today while others are moving forward with ever-increasing speed?

The attitude and knowledge of Muslim scientists can play an important role in the efforts for the Islamization of Knowledge. The intent of the Workshop was to discuss how to instill Islamic attitudes and practices among specialists in their respective fields. As a first step in the direction of Islamization, efforts should be made to describe and discuss appropriate methodology in each field, and then prescribe ways and means to permeate Islamic attitude and spirit into the contemporary knowledge, and methodology. Fortunately, the process of Islamization has been effective in various forms since the time of Prophet Muhammad (ṢAAS). Islamic jurisprudence is, perhaps by far, the most developed subject area both in theory and practice which is solely responsible for the evolution of the principles of Islamization. Unfortunately, all sciences including engineering and technology of today which flourished at the hands of Muslim scholars in the medieval age are void completely of Islamic attitude and spirit. The Muslim scientists of today are obligated to the Muslim Ummah to bring the spirit of sciences back in accordance with the spirit of Islam. Concrete proposals with specific plans ought to be further pursued, both academically and practically in the process of Islamization implementing, in collaboration with Muslims in North American and other places.

The Workshop sessions were designed to include informal discussions. These informal discussions helped in the exchange of ideas and in identifying future trends and goals in the specific fields.

The sessions consisted of not more than twenty people in an informal setting. Although informal, short expositions by the participants were allowed, each session had a particular subject around which the discussion revolved to serve the following aims: a) discussion of new work, b) clarification of disagreements and differences of opinions between workers in the field, c) the strengthening of the ties between concepts and relevant methodology, d) the formulation of some sort of consensus on the outstanding problems and on work to be done. About eleven participants of the workshop who had submitted their papers, were given, in the beginning, about ten minutes for formal presentations to generate a lively discussion. These participants stayed throughout the session and participated in the discussion as panelists. Each session's rapporteur gave a five to ten minute summary in a plenary session followed by a panel discussion. The rapporteur of the last session of summaries gave a 15 minute summary. The rapporteur was aided by

discussion secretaries (one for each session) equipped with tape recorders and other technological aids.

The Workshop was broken down into the following sessions: Islamization of Attitude and Practice in:

1. Research and Research Administration in Science and Technology in the Muslim World.
2. Research and Education in Science and Technology in a Hostile Environment.
3. Particular fields of Science and Technology.
4. Future Science and Technology: What it ought to be.

All Workshop participants were expected to have read the papers submitted by the speakers. In the first instance only questions were asked following the presentation by the speaker. This led to broad generalization of the subject from which participants made statements of problems to solve. They then offered solutions and made recommendations.

We hope that the Workshop will enable us to crystallize the problems and their possible solutions to be pursued further to achieve the above-stated objectives.

With this humble effort there is the hope that our coming generation will be brought up in better shape, with a better social system, and equipped with better mentality, determination, originality, capabilities and environment, *in Shā'a Allah*.

M.A.K. Lodhi
Lubbock Texas

Muḥarram 1410 AH
August 1989 AC

ACKNOWLEDGEMENT

The Foundation of International Development (FID) organized this Workshop in collaboration with the Association of Muslim Scientists and Engineers (AMSE), the Islamic Medical Association (IMA), the Association of Muslim Social Scientists (AMSS), the International Institute of Islamic Thought (IIIT) and SAAR Foundation. The FID is indebted to SAAR Foundation for providing facilities, staff and financial support. Without any one of these, the Workshop would not have materialized.

The editor gratefully acknowledges the help in editing and proofreading rendered by Abdir Rahman Abokar, Ahmad Azlan Mohamad Yasir, Ghayth Nur Kashif and particularly 'Alī Ramaḍān for his untiring effort in overseeing the details of the publication of this book from the collection of the individual manuscripts. (ed.)

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Islamization of Attitudes and Practices in Science and Technology

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The International Institute of Islamic Thought
Herndon, Virginia, U.S.A.

Islamization of Attitudes and Practices in Science and Technology*

Ṭāhā Jābir al 'Alwānī

The seminar held by the International Institute of Islamic Thought on the **Islamization of Attitudes and Practices in Science and Technology** was a landmark in the series of seminars on the Islamization of Knowledge. Indeed, while all the seminars held by the Institute have addressed one aspect or another of the all-important issue of the Islamization of Knowledge, this seminar was the first to approach the issue from a standpoint other than that of the social sciences. This broadening of the Institute's intellectual horizons is a significant development for, while the social sciences are perceived as the true focal point for the Islamization process, there can be no doubt about the relevance of the natural and applied sciences as fertile ground for the same process.

In fact, given the priorities of Muslim states and societies today, it is clearly essential that the attention of our thinkers be directed toward the Islamization of the academic disciplines which constitute the basis for serious scientific inquiry and the development of appropriate technology. The time has come to do away with the myth that science is essentially secular. In particular, when we consider the astounding findings in Physics concerning the influence of the observer on events, findings which force us to rethink our concepts of objectivity, we have every reason to suppose that the Muslim scientist who approaches his work from an Islamic point of view will indeed produce solutions with an Islamic tinge. More important, however, is the perception that there is indeed a significant role for faith in science.

As yet, however, if the Algerian Symposium on Islamic Thought is any yardstick, such a notion is still without many supporters. Indeed, before the 20th Annual Symposium, to which prominent international scholars were

*This is an edited translation of the opening address delivered by the president of the International Institute of Islamic Thought.

invited to discuss a wide range of topical issues, the organizers considered and then rejected a proposal to include the Islamization of Science and Technology as a subject for debate.

So, while the International Institute of Islamic Thought feels that the crisis of the Muslim Ummah is essentially a crisis of thought, and is thus rooted in the social sciences, the fact remains that any attempt at a solution to the problems that beset the Ummah must include the ways and means to uplift the material needs of Muslim society and its citizens. Thus, while by definition the Islamization of Knowledge includes all the academic disciplines, it must be emphasized that the natural and applied sciences certainly fall within the legitimate ambit of the Islamization process.

It is important here to shed light on the place of science and technology in the overall scheme of the Islamization of Knowledge advocated by the International Institute of Islamic Thought. In order to do so, however, we will need to consider whether the traditional division of knowledge into social and natural sciences is one that is related to the essence and substance of these disciplines, or whether it is merely an arbitrary and utilitarian division. In fact, the teachings of Islam would lead one to favor the latter opinion.

Without unnecessarily prolonging the matter, it should suffice here to say that the sources of knowledge for a Muslim are two; (1) revelation as represented by the Qur'an and Sunnah, and (2) nature, or life and the universe. In order to benefit from these sources, furthermore, the individual is in need of (1) the means of perceiving, and (2) the faculty of reason.

A second issue to be considered in this connection is that of the nature of knowledge itself; is it inborn or acquired? This question has been subjected to no end of debate, particularly among the logicians and philosophers. Thus, there are those who insist that knowledge is totally acquired, those who insist that it is totally inborn, those who insist that it is partly this and partly that, those who say that knowledge grows within man as he grows, those who say that man is born merely with the capacity to experience and thus acquire knowledge, and so on. Today, while people talk in terms of someone's having been born the "black sheep" of the family, experts speak of society and the home environment as factors in the intellectual development of the individual.

The teaching of the Qur'an on this matter is that individuals are created in the wombs of their mothers knowing nothing; and that then Allah bestows upon them the faculties of hearing, seeing, comprehending, and reasoning. Through the utilization of these faculties, considered a part of man's *Fiṭrah* or nature, and by interacting with the world around him, man may grow in knowledge and accomplishment.

Indeed, the Qur'an is unsparing in its condemnation of the disbelievers

for their misuse of the natural powers of intellection granted to them by Allah. Thus, the disbelievers are compared by the Qur'an to people who have hearts that do not see, and ears that do not listen, so that they are little better than animals. Thus, it may be seen that knowledge is an essential element in the ultimate salvation of man.

Furthermore, access to the first sources of knowledge hinges on certain prerequisites. Time does not permit us to dwell on this issue, but it is certainly well-documented in the corpus of scholarly Islamic literature. With regard to the other sources of knowledge, Imam Fakhr al Dīn al Rāzī states that man's attaining knowledge from life and the universe is contingent upon three things: (1) the existence of natural phenomena, (2) the experiencing of emotion, and (3) the exercise of reason. Thus, while the human mind is not itself a source of knowledge, it can be relied upon to acquire and store knowledge, to analyze and classify it, and to make it available when it is needed.

According to some scholars, there is another important aspect to this matter; that the human mind is a source of moral and aesthetic values. This, too, however, has been the subject of much discussion, with those who opine that these are acquired, and those who opine that they are inborn, and so on. The *Fiṭrah* spoken of in the Qur'an, however, includes the ability of the individual to instinctively recognize the Oneness of Allah and that He alone is worthy of worship, and to appreciate truth and higher moral values for their own sake. Indeed, the Qur'an calls upon man to use this faculty in order to discriminate between what is wrong and right, true and false, moral and immoral. Thus, the human mind is both a source and a means of knowledge.

We may now move on to consider another philosophical question; what is the difference between science and knowledge? Like the other issues, this too has been the subject of much learned consideration. One answer that stands out is that science is that which represents the fruition of knowledge, something logically or empirically demonstrable; whereas knowledge is something that is acquired but not necessarily capable of being proved. Indeed, this difference is hinted at in the Qur'anic verse that says you shall not claim *'Ilm*, which we will interpret to mean science, about things you cannot fully understand. This is because Allah will question you about how you used your faculties of seeing, hearing, and comprehension.[1] Thus, if something is to be accepted as science, it must be established by means of proof, it must have a source, and the method or methods used to reach it must be valid.

Indeed, the same is true with regard to the sciences of the Shari'ah. In order for anything to be valid it must have its basis in either the Qur'an or Sunnah, or in the *Ijmā'* or *Qiyās* (both of which are based essentially

[1]See Qur'an, 17:36.

on the Qur'an and Sunnah). Moreover, all such details in the Shari'ah-sciences must have been obtained by valid methods. It is not sufficient for one merely to suppose that the Shari'ah dictates a certain thing, in a certain way, and only under certain conditions.

Now, to return to our discussion of what we mean by the Islamization of Knowledge, it should first be clear that the sources of knowledge should be Islamic sources, ie. revelation as represented by the Qur'an and Sunnah, and nature as manifested in the natural universe. Secondly, the methods used for obtaining knowledge must be Islamic methods, so that the God-given faculties of reason and the rest are used alongside the *Fiṭrah*-powers of discretion. Finally, the results obtained by this formula must be consistent with the following criteria:

A. Human nature
B. The natural laws of the universe
C. Islamic teachings: principles and injunctions
D. Islamic values: both moral and aesthetic

Indeed, the Islamization of Knowledge is something that we feel to be the duty of everyone capable of contributing to it. Indeed, like Jihad, unless someone undertakes it, the entire Ummah will be held responsible for negligence in the fulfillment of their duties. Perhaps this will appear to some readers as representative of a certain recalcitrance or inflexibility on the part of the Institute. Yet, in our estimation, it is the lack of a truly Islamic approach to the academic disciplines that is at the core of the crisis confronting the Ummah today. While it is true that the majority of the Ummah is uneducated, and that basic literacy is a problem in its own right, the problem is compounded when we see that those who do manage to acquire for themselves an education, acquire with it the biases and attitudes that come part and parcel with the curricula and syllabi that frame that education. Thus, while the majority of the Ummah is simply ignorant, the majority of the Ummah's educated lacks an Islamic identity or sense of Islamic individuality. And this is the result of an education bereft of even the least significant Islamic inputs. A Western observer, commenting on the state of education in Turkey during the last years of the *'Uthmānī Khilāfah*, wrote, "If the dead-point of a society is reached when the educational forces are no longer effective to influence or direct its development, it must be admitted that the dead-point was long since passed in Islamic society."[2]

[2]Gibb, H.A.R. and Bowen, Harold, *Islamic Society and the West*, Vol. One, Part II, p. 159-60, Oxford University Press, UK, 1957.

Thus, in order to revitalize the Ummah, it is essential that its educational processes be revamped to reflect its own identity rather than the Pythagorean world view of the available Western models.

Toward this end, we believe that the following guidelines may prove to be beneficial:

A. Whatever knowledge can be proven to be scientific fact may legitimately be accepted as Islamic.
B. All knowledge must be fixed in the overall framework of the Islamic scheme of things with regard to life in the universe. In other words, the Muslim should never be allowed to lose his perspective. Indeed, the Qur'an is severe in its condemnation of the disbelievers over their inability to understand natural phenomena within the larger context of Allah's world-order.
C. Anything found contrary to the universal principles of Islam must be rejected. This is where the efforts of Muslim social scientists will contribute to those of Muslim scientists and technologists in the establishment of an integral Islamic society by means of which man may fulfill his mission on earth.

Of a certainty, when Allah is the Creator and Author of both the universe and the universal religion, no article of religion will ever be found contradictory to the laws of the universe. The implications of this simple truth on the entire scope of academic and intellectual activities are legion. Indeed, we are charged with putting to use the social and material imperatives governing life in the universe for the purpose of doing the will of Allah. But, unless the Ummah is infused with the spirit and dynamism of Islam, it will never realize its goals.

Thus, the burden to be shouldered by the Muslim scientist is indeed a ponderous one; as it is his or her task to acquire knowledge, to interact with it, and then to put it in a proper Islamic perspective so that it may be imparted thereafter from an Islamic point of view to younger, and increasingly more Islamically oriented minds.

In this context, then, the significance of the Hadith of the Prophet of Islam, (ṢAAS):

> "The ink of the scholar is as precious to Allah as the blood of the martyrs." becomes all the more obvious.

Moreover, the reward Allah has promised them will be great:

For they will be in the company of those on whom is the grace of Allah, of the prophets, of the sincere, of the martyrs, and of the righteous; and how fine is their fellowship![3]

May Allah grant that we should be counted among them!

[3]See Qur'an, 4:69

Science Research in Muslim Countries

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Science Research in Muslim Countries

Syed M. Amir

I. Science in Developing Countries

In a recent issue, the Christian Science Monitor published an interview with Professor Abdus Salam, the only Muslim to receive a Nobel prize in science. Professor Salam related an interesting story about his recent trip to South Korea. He said he was much amused by the remarks of a TV reporter who told him that his country had made it a national goal to win Nobel prizes and then asked him if he could give them any helpful tips.

Whereas the reporter's question may be dismissed as facetious, there is no doubt that it reflects the importance with which South Korea attaches to its scientific development program. In its pursuit of scientific excellence, South Korea cannot be rated among third-world countries. Several others, including India and Argentina, have made impressive gains in recent years in strengthening their scientific and technological bases. Unfortunately, the picture is not so bright for Muslim countries.

This trend can be illustrated by the recent findings of the Philadelphia-based Institute of Scientific Information. Based upon a survey of the number of articles originating in the top twenty-five countries of the world in the year, the U.S. ranked highest, contributing some 43% of the total. India and Israel were eighth and fifteenth respectively; however, not one Muslim country was included in this list.

II. Impact of Educational System

Some of the historical causes that led to the decline of science in our countries and continue to retard its progress today are easy to recognize. In common with most countries in Asia and Africa, the Muslim world remained

under colonial rules for the better part of the past century. Characteristically, the educational system was designed to produce low level bureaucrats needed to run the colonial administration. Scientific education received low priority and, worse yet, was often spurned by Muslims themselves who viewed all forms of Western education as anti-religious. This bias against the new knowledge, although understandable, was incompatible with the teachings of the Prophet (ṢAAS) who urged Muslims to acquire knowledge even if it meant travelling to China, one of the most difficult-to-reach countries in his day. In the ensuing discussion, most examples cited are based on my experience in the Indian subcontinent, but, in many cases, have a much wider applicability.

Besides an aversion to science, there were other practical problems. Muslim Institutions in Pakistan have traditionally lacked adequate facilities for the teaching of the sciences. Even today, many laboratories are poorly equipped, teaching methods are antiquated and the material taught frequently out-dated. One cannot entirely fault the teachers for the poor quality of education because they rarely have access to modern textbooks or exposure to new techniques. For students however, any deficiencies in early education are often hard to make up later in life. This point was specially appreciated by those of us who, after completing undergraduate studies at home, proceeded to do graduate work abroad. Some took extra courses to correct the problem but a few could never completely overcome it.

The poor quality of education is not the only problem. The ability to think freely, to question established theories, and to formulate independent ideas indispensable for original research is usually not acquired in our schools and colleges. Not surprisingly, therefore, the students coming out of our institutions are hesitant to take new and innovative directions in their professional life.

Of late, there have been some welcome indications of a shift away from this pattern. Recently, I was invited to sit through a biochemistry lecture being given to students at the Aga Khan Medical University in Karachi. I was pleased to see that the students felt sufficiently at ease to ask questions and to participate in classroom discussions.

Despite the relaxed classroom atmosphere however, there were few signs that the overall quality of education has substantially improved. Universities in Pakistan presently enjoy huge enrollments, sprawling campuses, and large teaching faculties. Yet, last year, on my visit to one of the premier universities there, I noticed no overwhelming enthusiasm for scholarship, and no credible research activity in progress. Instead, I found the campus nearly desolate by late afternoons and most students far more interested in promoting political and regional causes than in pursuing knowledge.

The lack of serious interest in intellectual endeavors on the part of these students is less worrying than that on the part of teachers. For if the faculty members are not actively involved in research, the younger generation will receive neither the motivation nor necessary training to pursue research. Absence of research activity ultimately affects the quality of teaching as well. The teachers, unaware of the advances in their own subjects, are not able to communicate them to their students.

III. Mechanism of Research Support

It may be useful to pause and examine the mechanism by which scientific research is supported in the U.S. and to compare it with the system in effect in Muslim countries.

In the U.S., by far the largest support is derived from Federal Government sources. There is fierce competition for grant money and the vast majority of researchers who depend on it, exist in a state of permanent uncertainty in respect to the continuation of their grant support. There is now an ever-increasing tendency on the part of universities to expect the faculty to generate their own research funds to pay for their salaries.

The U.S. research support system, according to many of its critics, is ruthless and promotes the growing tendency on the part of unscrupulous investigators to publish fraudulent data in order to survive. It also discourages exploration that needs perseverance and is unlikely to yield quick results. In the eyes of its supporters however, it is believed to have the most desirable effect of keeping conscientious scientists under constant pressure and on their toes.

I do not regard the U.S. system as entirely desirable or necessarily a model to be emulated elsewhere. A better alternative would be the European system which is less intense and closer to our temperament and traditions. In European universities, most academic appointments tend to be permanent but further career advancements are strictly contingent upon an individual's performance as a teacher and investigator.

At present, we follow neither the U.S. nor the European system. In Pakistan, for example, most academic faculty appointments are tenured. The sense of stability provided by this system is not bad, except that no method of faculty performance appraisal exists. Absence of competition and excessive job security tend to give rise to a sense of complacency. The perception is widespread that promotions are granted on the basis of a seniority system which does not take into account quality of research or teaching performance.

IV. The Role of the Government

What has been discussed thus far can readily give the impression that our academic institutions are entirely to blame for our plight and that they have the ability to transform this situation into a happier one. Not true!

The extent of government patronage and financial support is a major determinant of the health of scientific research in any country. The adoption and management of science policy is beyond the purview of university academicians. Also, because of the inability of the private sector to finance any significant research, the role of government vis-a-vis science is particularly crucial in Muslim countries.

Our countries are, by and large, ruled by dictatorial regimes having a greater stake in self-preservation than in scientific development. A major share of financial resources goes to military establishments while only a minor portion is invested in education and science. Occasionally, even the meager sums earmarked for scientific institutions are not wisely spent. A few years ago, the staff of the Council of Scientific Research in Pakistan was so bloated that their salaries alone ate up nearly 80% of the organization's budget. Since not much money was left for buying equipment and supplies, the staff had virtually nothing to do except wait for their monthly pay checks.

V. How Can We Improve? Some Thoughts

The Muslim world stretches from Morocco to Indonesia and beyond; and, consequently, each country has its own unique social, political and financial considerations that shape its policy toward science and technology. Because of this vast diversity, effective solutions have to be individually tailored. However, some of the following suggestions may have a wider, even universal applicability.

An evaluation of contemporary scientific capabilities of most Muslim countries reveal that none have reached a stage, at least in biomedical research, where it can interact with more advanced countries. For the present, a closer collaboration among the Muslim countries would be beneficial. For example, a free and open exchange of scientists and scholars within this community should be encouraged and hands-on workshops aimed at teaching specific methodologies to investigators should be organized. The Pakistani government has recently launched a scheme under which expatriated Pakistani scientists are invited back to teach new techniques to scientists there. Schemes like these have a great potential for success and should be adopted by others.

The present trend in some of our countries to hold annual conferences to which Western scientists are principally invited and treated like royalty does not benefit indigenous science even though it may promote some interest in tourism. Most of the local scientists do not contribute significantly to these seminars and do not absorb what is presented by the outsiders. For a limited period, it would be more advantageous to invite scientists primarily from third-world countries such as India and South Korea with whom we can relate somewhat better and can engage in healthy competition.

Some laboratories in Pakistan are becoming graveyards of expensive equipment, because neither the needed spare parts nor repair services are available. If needs and resources of even a few Muslim countries could be pooled, a ready market for these services would materialize, large enough to attract the interest of international companies.

At the present time, all radioisotopes as well as radio-immunoassay kits for diagnostic tests have to be imported from Japan or Europe at great cost of time and money. Not one Muslim country can, by itself, provide sufficient market to make the local production of these items profitable. Again, if the needs are pooled, they would support a local manufacturing industry. For the success of biomedical research, it is imperative that a close collaboration between basic scientists and those engaged in clinical practice at hospitals be forged. Most of the clinicians receive little or no exposure to research as medical students and are not trained to pursue studies on the epidemiology or pathophysiology of diseases prevalent in their countries. In Karachi, for example, no substantial research on diabetes or cardiovascular disease is known to be in progress although these two are the most common afflictions there.

Library facilities at most of our academic and research facilities are woefully inadequate, making it almost impossible for scientists to stay abreast of the latest progress in their research areas. Technical journals and books are expensive and the financial needs of libraries usually receive a low priority. Close cooperation in the exchange of information among libraries of our countries should be instituted. Conflicting views have been expressed regarding whether we need to invest efforts in producing high quality journals to disseminate the results of research. In my view, such journals need not be a high priority, at least not in the present phase. It would be more advantageous to subject the research work to a critical peer review process similar to the one operated by Western journals.

It is unrealistic to expect all universities to become centers of research. Most should concentrate on achieving excellence in teaching while a few should be designated as research universities. The latter should be provided with the best affordable facilities and staffed with the most talented researchers available. It is absolutely essential that some system of accountability in research

be instituted, and those who consistently fail to produce good work should be encouraged to seek alternative occupations.

Once the laboratories achieve reasonable productivity, further growth will become self-sustaining. Given the perseverance of the scientists and the consistent support from governments, I feel sanguine that the future of science in the Muslim countries is bright. One day, in the not-too-distant future, we shall reclaim some of the eminence in the sciences that Muslims once enjoyed and cherished.

Incorporation of Islamic Values in the Administration of a Science Research Institute

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Incorporation of Islamic Values in the Administration of a Science Research Institute

S. H. Durrani

Many Muslim countries have established modern research centers in the last 40 years. In spite of large expenditures on facilities and personnel, however, the output of most such institutions has been modest. The reason for this can often be traced to the lack of Islàmic values in the administration and operation of these institutions.

The administration of a science or engineering research center can have a great influence on the quality of work done there. This is so because of the administration's power to hire the staff and set the priorities for various projects. An administration which has the correct Islamic attitude will treat this authority as a sacred trust, thus hiring the right staff and providing the necessary resources to each project. In practice, however, many other considerations (nepotism, personalities, regional prejudices, etc.) play a role, thus undermining the center's foundation even before it starts operating.

The operation of such a center depends primarily on the caliber of staff; the best physical facilities and instruments are useless without the right people. For the center to be successful in the professional sense, at least a majority of the staff must have a sense of mission, and must work toward the common good in line with Islamic values. This requires considerable self-discipline, suppression of self-interest, and honest work for honest pay. However, in a majority of cases, the staff members tend to worry more about their individual status and pay scale than about their work. They spend most of their energy on getting office "perks" and keeping up with the "Joneses" of the civil service, and very little on the research they were expected to perform. Naturally, the results are dismal.

The situation can be improved by inculcating Islamic values at all levels of the hierarchy. For instance, the top director of the institute should be chosen

not only for his ability as a scholar and administrator, but also for his character as an individual. He should have a secure and mature ego, which does not need to feed on insecurity of others. He should seek ability in his staff, not obedience and "yesmanship." He should be able to encourage younger staff to take the initiative where needed, and to treat them as colleagues instead of subordinates. Only if he creates the right climate can he expect new ideas to take root and flourish. Similarly, the staff should come to the institute with Islamic values. Their goal should be advancing the state of knowledge, not personal advancement. They should recognize that the wealth and trappings of this world are nothing compared to the true rewards of service to science and service to the community.

Let us hope we can implement some of these ideas in a small way in one or two institutes in the world. Perhaps the best chance of success will come in a pilot project in a country "isolated" from the Muslim world, so that some of the pressures and social ills noted above are absent.

Profiles of Muslim Students in the U.S.: Population and Orientation

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Profiles of Muslim Students in USA Population and Orientation

Essam Ismail

Abstract

An overview of international students studying in the United States and throughout the world is given. Summary of available statistical data on the international exchange of students in higher education is also reported.

Muslim students studying in the United States' institutions of higher education are at least 30% of the total number of international students. Details are given as to their geographic origin, academic and personal characteristics. Their distribution in the United States regions and states, proportion enrolled in two and four-year colleges as well as in public and private institutions, and expenditures for living costs can be provided in another research paper.

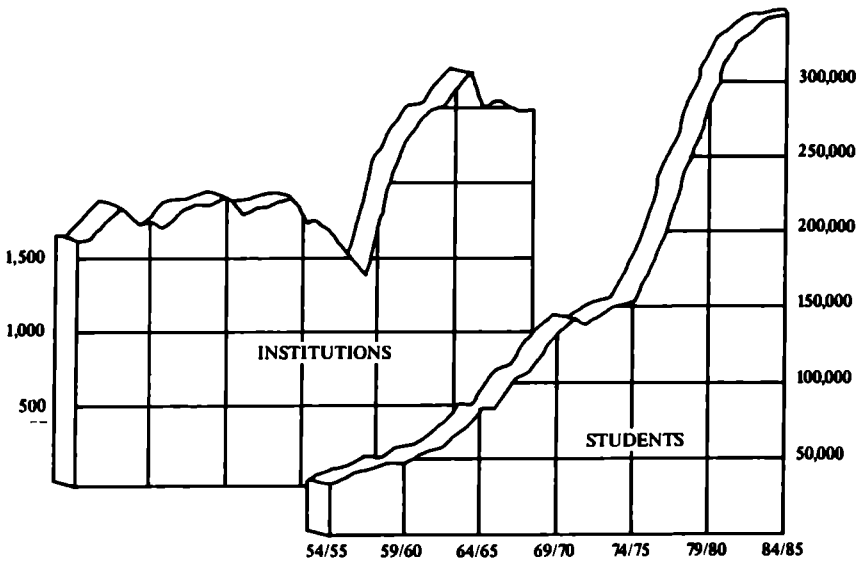
Universities conduct orientation programs to enhance the educational experience of international students and to help them adjust to their new environment. The usual contents of such programs are outlined. Inadequacies of the existing programs as they pertain to the needs of Muslim international students are given along with suggestions for improving the situation.

I. Population of International Students in the USA

Since 1949, there have been annual reports kept about the influx of international students who are studying in the United States' institutions of higher education. These reports show that the second half of the 1970's witnessed the largest influx with an overall increase of 73.9%. The census data of these reports also shows that international student enrollment in the United States reached a plateau at the beginning of the 1981 academic year. There was an increase of only 31,000 international students studying in the

United States from 1981 until 1984. Figure 1 shows the rate of increase during the second half of the 1970's or the beginning of the plateau reached in 1981. Table 1 further provides data on international student enrollment and institutions reporting international students from 1954/55 to 1984/85[1].

Figure 1: International Student Enrollment and Institutions Reporting International Students, 1954/55-1984/85



In 1981, there were 912,377 international students reported to be studying in 137 countries worldwide[2]. The United States' institutions of higher education hosted 326,299 international students during that year, almost 36% of the total. Table 2 shows international student enrollment in host world regions in 1981. It also provides statistical data as to the international students and total enrollment in leading host countries in 1981. One notices that the United States led in enrollment, reporting three times the number of international students as France, the second largest host country. They reported 326,299 and 108,607 respectively.

A. Muslim Students in USA:

Of the 342,110 international students reported in 1984/1985, Muslim students from Africa, the Middle East, and South East Asia constitute 101,659

Table 1: Foreign Students Reported and Institutions Reporting Foreign Students, 1954/55-1983/84

Year	Foreign Students	Number of Institutions	Year	Foreign Students	Number of Institutions
1954/55	34,232	1,629	1969/70	134,959	1,734
1955/56	36,494	1,630	1970/71	144,708	1,748
1956/57	40,666	1,734	1971/72	140,126	1,650
1957/58	43,391	1,801	1972/73	146,097	1,508
1958/59	47,245	1,680	1973/74	151,066	1,359
1959/60	48,486	1,712	1974/75	154,580	1,760
1960/61	53,107	1,666	1975/76	179,344	2,093
1961/62	58,086	1,798	1976/77	203,068	2,294
1962/63	64,705	1,805	1977/78	235,509	2,475
1963/64	74,814	1,805	1977/79	263,938	2,504
1964/65	82,045	1,859	1979/80	286,343	2,651
1965/66	82,709	1,755	1980/81	311,882	2,734
1966/67	100,262	1,797	1981/82	326,299	2,454
1967/68	110,315	1,827	1982/83	336,985	2,529
1968/69	121,362	1,846	1983/84	338,894	2,498

Table 2: Foreign Student and Total Enrollment in Leading Host Countries, 1981

Host Country	Foreign Enroll-ment	Total Enroll-ment	% of Total Enroll-ment	Host Country	Foreign Enroll-ment	Total Enroll-ment	% of Total Enroll-ment
U.S.A.	326,299	12,371,672	2.6	Sweden	13,182	198,798	6.6
France	108,607	1,076,717	10.1	Austria	12,885	140,720	9.2
Germany, F.R.	67,216	1,325,179	5.1	Brazil	12,800	1,409,243	0.9
				Belgium	12,260	213,281	5.7
U.S.S.R.	62,942	6,146,491	1.0	Spain	10,997	704,310	1.6
U.K.	50,684	858,416	5.9	Australia	10,921	334,030	3.3
Canada	32,303	924,445	3.5	Greece	8,304	117,407	7.1
Italy	27,784	1,117,742	2.5	Vatican City	7,417	7,417	100.0
Lebanon	26,343	70,314	37.9	German, D.C.	7,411	404,618	1.8
Romania	16,962	190,903	8.9	Japan	7,182	2,402,725	0.3
Saudi	16,469	70,657	23.3	Turkey	6,378	240,680	2.6
Egypt	16,297	567,128	2.9	Iraq	5,580	240,680	6.5
Switzerland	15,515	88,385	17.6	Philippines	5,091	1,335,889	0.4
India	14,710	5,345,580	0.3				

representing 30% of total international students enrolled in the United States' higher institutions (3). Table 3 presents the distribution of Muslim international students in the United States by countries from these continental subregions.

The 1984/1985 census of Table 3 clearly indicates that Middle Eastern countries sent the most number of students (48,421) representing 14.16%, followed by countries from South and East Asia (38,115) which represent 11.13%. Lastly, African countries send a total of 15,123 students representing 4.42%. However, the largest number of Muslim students by far are from Malaysia (21,720), followed by (16,640) students from Iran and the small group (30) of Muslim international students cam from Brunea. Malaysia is considered the second leading country in the world, after Taiwan, in sending their students to the United States (1).

B. Muslim Students from OPEC Nations:

Ten of the 13 OPEC nations send their Muslim students to the United States. The total 1984/1985 enrollment of Muslim students from these 10 OPEC nations was 49,813 representing 51.63% of Muslim international students in the United States and 14.56% of all international students in the United States.

II. Academic Characteristics

A. Academic Level:

The 1984/1985 census of academic level has not come out yet. Therefore, we used the published statistical data of 1983/1984 which provides information for only ten of the Muslim countries listed in Table 4(1). Muslim international students from these countries however, constitute 76,051 from a total of 101,374 students enrolled during 1983/1984. Table 4 lists ten (1) countries and the number of their students who enrolled for undergraduate, graduate, and other degrees (1 and 3).

The number of graduate and undergraduate Muslim students coming from these countries varied widely (Table 4). While Egypt and India send fewer students for undergraduate studies, the other eight countries send more than 60% of their students as undergraduates with an average of 71%. Malaysia leads these ten countries in sending undergraduate students (14,774), while Iran leads the Muslim countries in sending graduate students. The least number of Muslim students come from India.

Table 3: Country of Origin of Muslim International Students, 1983/84 and 1984/85

Region/Country					
AFRICA			MIDDLE EAST		
	1983/84	1984/1985		1983/84	1984/1985
North Africa			Iran	20,360	16,640
Egypt	2,340	2,410	Saudia		
Libya	1,710	1,200	Arabia	8,630	7,760
Algeria	780	780	Lebanon (50%)*	3,340	3,470
Morocco	700	770	Jordan	6,890	6,750
Sudan	730	690	Kuwait	3,810	3,980
Tunisia	58	640	Turkey	2,830	2,640
			Syria	1,940	2,180
North Africa			Iraq	1,730	1,550
Total	6,318	6,490	U.A.E.	1,260	1,270
			Qatar	780	810
			Yemen	480	541
	1983/84	1984/85	Bahrain	390	430
West Africa			Oman	360	400
Nigeria (47%)*	9,437	8,633			
Africa			Middle East		
Grand Total	15,755	15,123	Grand Total	52,800	48,421

South and East Asia					
South Central Asia			South East Asia		
India (10.7%)*	1,374	1,564	Malaysia	18,150	21,720
Pakistan	4,280	4,750	Indonesia	6,110	7,190
Bangladesh	2,150	2,010	Singapore (15%)*	484	562
Sri Lanka (8%)*	100	118	Brunei	30	30
Afghanistan	141	141			
			South East		
South Central			Asia Total	24,774	29,502
Asia Total	8,045	8,583			
South and East Asia Grand Total				32,819	38,085

Grand Total of Muslim Students in U.S.A. in 1983/1984 is 101,374.
Grand Total of Muslim Students in U.S.A. in 1984/1985 is 101,659.

*References 4 and 5. The lower percentage from the two references was used in the calculation.

Table 4: Academic Level of Muslim International Students by Selecting Countries Within World Region of Origin. 1983/1984

	Academic Level (Number of Students)			
Country	Undergraduate	Graduate	Other	Total
AFRICA				
Nigeria	6,814	2,510	113	9,437
Egypt	583	1,629	128	2,340
Libya	1,045	624	41	1,710
MIDDLE EAST	12,969	6,902	489	20,360
Saudia Arabia	5,722	1,976	932	8,630
Jordan	5,388	1,164	338	6,890
Lebanon	2,555	648	137	3,340
Kuwait	2,877	690	236	3,810
SOUTH AND EAST ASIA				
Malaysia	14,774	2,904	472	18,150
India	315	1,025	44	1,374
TOTAL	53,042	20,079	2,930	76,051
PERCENTAGE	69.75%	26.40%	3.85%	100%

B. Sex of Muslim International Students

By combining the published data (from profile) about the sex of international students with the statistical ones in Table 4, we can estimate the number of Muslim students by sex (3). The numbers of the reported ten countries are summarized in Table 5.

The highest proportion of women are from Malaysia representing 31%, followed by Iran 23.50%, and Nigeria 13% of all Muslim women studying in the United States in 1983/1984. Women from these three countries represent almost 85% of all Muslim women and 10% of all Muslim students (male and female) in the United States. Women from the other seven countries represent about 3% and less than 1% of all Muslim women and all Muslim students respectively.

The largest proportion of men are from Iran representing 25% followed by Malaysia 20% and Saudi Arabia 13% of all Muslim men studying in the United States in 1983/1984. Men from these three countries represent 59%

Table 5: Sex of Muslim International Students by Selecting Country Within the World Region of Origins 1983/1984

Country	Sex (No. of students)		
	Male	Female	Total
AFRICA			
Nigeria	7,540	1,897	9,437
Egypt	1,947	393	2,340
Libya	1,635	75	1,710
MIDDLE EAST			
Iran	15,575	4,785	20,360
Saudi	8,095	535	8,630
Jordan	6,442	448	6,890
Lebanon	3,059	281	3,340
Kuwait	3,551	259	3,810
SOUTH AND EAST ASIA			
Malaysia	12,469	5,681	18,150
India	1,120	254	1,374
Total	61,433	14,608	76,041
Percentage	81%	19%	100%

of all Muslim men. By adding men from Nigeria to those from these three countries, they represent 71% of all Muslim men and 57% of all Muslim students (male and female) in the United States.

Muslim men and women from Nigeria, Iran, Saudi Arabia, and Malaysia represent 74% of all Muslim international students in the United States in 1983/1984 (Table 5).

C. Field of Study

The published statistical data of 1983/1984 which provides information for only ten countries has been used for this section. Table 6 represents the number of international students from these ten countries who enrolled in

Table 6: Field of Study of Muslim International Students 1983/1984

	Field of Study (Number of students)													
Country	Agri.	Bus/ Magt.	Educ.	Engr.	Fine Arts	Health Sci.	Hum.	Math/ Comp.	Phys. Sci.	Soc. Sci.	Other	Int. Engl.	Undec.	Total
Nigeria	500	4067	736	849	452	660	217	311	547	245	537	9	301	9,431
Egypt	126	292	100	762	58	203	91	175	292	51	67	39	77	2,333
Libya	64	143	68	76	35	32	18	265	208	70	32	10	42	1,703
Subtotal Africa	690	4,502	904	2,327	545	895	326	751	1,047	366	636	58	420	13,467
Iran	386	1,750	549	8,775	549	1,201	244	2,687	2,524	386	610	61	631	20,353
Saudi	94	2,036	517	2,364	172	146	241	888	353	586	258	673	293	8,621
Jordan	48	937	192	3,693	137	241	144	599	248	89	89	248	220	6,885
Lebanon	16	424	30	1,917	100	133	36	257	106	33	73	96	113	3,334
Kuwait	30	929	240	1,504	38	99	41	384	87	57	80	156	160	3,805
Subtotal Middle East	574	6,076	1,528	18,253	996	1,820	706	4,815	3,318	1,151	1,110	1,234	1,417	42,998
Malaysia	417	4,791	453	5,209	853	235	562	2,813	1,179	199	417	290	726	18,144
India	15	239	21	497	13	54	43	203	195	15	39	2	31	1,367
Subtotal South and East Asia	432	5,030	474	5,106	866	289	605	3,016	1,374	214	456	292	757	19,511
Grand Total	1,696	15,608	2,906	26,286	2,407	3,004	1,637	8,582	5,739	1,731	2,202	1,584	2,594	75,976
Percentage	2.23%	20.54%	3.82%	34.59%	3.17%	3.95%	2.15%	11.29%	7.55%	2.27%	2.89%	2.08%	3.41%	99.94%

different fields of studies. Over one third (34.59%) of international students studied in different areas of engineering followed by 20.54% in the field of business management. Mathematics and computer science attracted 11.29% of the international students while physical science attracted 7.55%. Muslim international students are distributed more or less evenly among other fields of studies. (Table 6)

Table 6 further records significant variation in the fields of study selected by students from African countries. While students from Nigeria showed a greater than average preference for business management programs (43% and a very small group in engineering (9%), the opposite is true for students from Egypt and Libya who selected engineering (33%) and (42%), respectively, and 12% and 8% for business management. Similarly, more students from Libya (15%) selected math and computer science than those from Egypt (7%) and Nigeria (3) (Table 6).

A major share of students from the Middle East come to the United States to study engineering (42%) (Table 6). There are proportionately eight (8) and three (3) times more students from Middle Eastern countries who selected this field as compared to those from Africa and South and East Asia, respectively. A small proportion of those students chose business and management (14%) and a much smaller proportion selected math and computer science (11%), while fewer than 7% were distributed in each of the other fields of study.

Students from South and East Africa follow the same pattern of their counterparts from the Middle East in selecting their fields of study. However, their distributions among these three fields are 29% in engineering, 25% in business management, and 15% in math and computer science. The rest of the fields drew less than 7% of each one of them (Table 6).

The fields of agriculture, humanities, and social sciences are considered the least demanded by Muslim students studying in the United States' institutions of higher education. There are only 326, 574 and 214 Muslim international students studying, respectively, humanities, agriculture, and social sciences in the United States in 1983/84.

The largest percentage of the 1984 international students who attended United States institutions for intensive English language in 1983/84 came from Saudia Arabia 42%, Malaysia 18%, Jordan 15%, and Kuwait 9%. At least 86% of students studying intensive English language are from these four countries. Efforts can be concentrated to convince officials of these four countries so that we manage training these students during their intensive English language program. We are willing to prepare a proposal along these lines.

III. Field of Study and Academic Level of Muslim International Students:

Table 7 summarizes the number of undergraduate and graduate Muslim students from the same ten countries in the various fields of study.

The undergraduate students are three times more than the graduate ones. This generality holds true for students from most of these countries except from Egypt and India where the ratio of graduate to undergraduate is 3:1 which is exactly the opposite (Table 7).

The fields of engineering and business management attracted graduate students (48%) and undergraduate students (60%), while mathematics and computer science attracted more undergraduate students (12%), and physical science drew more graduate students (11%) (Table 7).

After looking at the set of statistics, one notices that the fields of agriculture and humanities attract almost an equal number of both graduate and undergraduate students. With the exception of the field of education, all other fields attract more undergraduate than graduate students. The education field is the only one which attracts more graduate students from almost all these countries than undergraduate students (Table 7). Saudi Arabia sends the greatest number of graduate students to the education field. It is worthwhile to research the number of Muslim international graduate students in the different areas of the field of education.

IV. Distribution of Muslim International Students in the Engineering Subfields

Since about 35% of the Muslim international students came to the United States in 1983/1984 to study engineering (Table 6), it is worthwhile to find out their distribution in the various areas of engineering (Table 8).

The field of electrical engineering attracts the greatest number of Muslim students (5,292), followed by civil engineering (4,871), and mechanical engineering (2,925). However, with the exception of Muslim students from Iran, students from the other nine countries prefer civil engineering over electrical engineering. Industrial engineering drew the least number of Muslim students (735) (Table 8).

A study can be made to match the need of these Muslim countries with the number of students sponsored by each of them.

Table 7: Field of Study Academy Level of Muslim Students by Selecting Country of Origin, 1983/1984

Country	Agriculture		Business Management		Education		Engineering		Fine Arts		Health Science		Humanities		Math. Comp.	& Sci.
	U	G	U	G	U	G	U	G	U	G	U	G	U	G	U	G
Nigeria	354	181	3,169	837	381	359	559	258	341	101	484	163	95	115	232	63
Egypt	0	116	107	152	8	88	249	502	12	47	31	169	8	79	55	119
Libya	4	64	117	35	6	71	368	187	18	22	4	31	13	6	196	60
Subtotal Africa	358	361	3,393	1,024	395	518	1,276	947	371	170	519	363	117	200	483	242
Iran	233	158	1,038	497	143	400	5,447	3,340	324	179	973	262	117	110	1,751	760
Saudi	16	88	1,654	295	74	470	1,997	422	109	55	109	53	109	89	698	134
Jordan	27	25	754	135	31	165	3,415	301	119	19	151	107	49	82	448	100
Lebanon	8	11	342	69	10	22	1,561	357	74	19	97	42	18	17	187	38
Kuwait	23	9	771	184	55	167	1,407	101	32	4	26	74	26	15	293	55
Subtotal Middle East	307	291	4,559	1,180	313	1,224	13,827	4,521	658	276	1,356	538	319	313	3,377	1,093
Malaysia	205	241	3,649	1,016	222	224	4,890	464	842	52	163	81	399	128	2,452	238
India	1	15	66	159	5	16	90	407	3	10	20	35	7	35	55	138
Subtotal South and East Asia	206	256	3,715	1,175	227	240	4,980	871	845	62	183	116	406	163	2,507	376
Grand Total	871	908	11,667	3,379	935	1,982	20,083	6,339	1,874	508	2,058	1,017	842	676	6,367	1,711

Table 7 cont.

Country	Physical Science		Social Sciences		Other		Intensive English		Undecided		TOTAL		GRAND TOTAL
	U	G	U	G	U	G	U	G	U	G	U	G	
Nigeria	349	188	185	60	402	155	0	0	266	30	6,817	2,510	9,327
Egypt	43	250	14	31	10	58	0	3	45	15	582	1,629	2,211
Libya	98	100	51	22	27	13	0	3	39	4	1,041	618	1,659
Subtotal Africa	489	538	250	113	439	226	0	6	350	49	8,440	4,757	13,197
Iran	1,790	759	272	104	350	249	13	0	519	76	12,970	6,900	19,870
Saudi	166	193	412	47	160	116	11	2	206	8	5,721	1,972	7,693
Jordan	92	148	70	19	43	51	11	2	178	7	5,388	1,161	6,549
Lebanon	66	38	28	7	56	23	5	0	102	4	2,554	647	3,201
Kuwait	46	37	37	21	60	24	3	2	98	2	2,877	695	3,572
Subtotal Middle East	2,160	1,175	819	198	669	462	43	6	1,103	97	29,510	11,375	22,750
Malaysia	857	285	148	41	295	119	0	0	650	15	14,772	2,904	17,676
India	21	172	9	6	11	28	0	0	27	2	315	1,023	1,338
Subtotal South and East Asia	878	457	157	47	306	147	0	0	677	17	15,087	3,927	19,014
Grand Total	3,527	2,170	1,226	358	1,414	836	43	12	2,130	163	53,037	20,059	73,096

Table 8: Muslim International Students Within Engineering Subfields by Selected Country of Origin, 1983/1984

Country	Gen.	Chem-ical	Civil	Elec-trical	Indus-trial	Mech.	Other Eng.	Eng. Tech.	Total
Nigeria	115	30	153	104	37	47	109	252	849
Egypt	114	18	146	127	20	114	171	52	762
Libya	94	24	153	109	27	73	146	90	716
Subtotal Africa	323	72	452	340	84	236	426	394	2,327
Iran	1,544	316	1,035	2,106	176	1,316	1,071	1,211	8,775
Saudi	381	83	438	359	78	201	345	480	2,364
Jordan	1,123	92	849	591	59	292	410	277	3,693
Lebanon	472	63	418	379	40	230	188	127	1,917
Kuwait	525	33	208	186	119	84	200	149	1,504
Subtotal Middle East	4,045	587	2,947	3,621	472	2,123	2,214	2,244	18,253
Malaysia	808	260	1,380	1,214	146	484	589	329	5,209
India	41	57	38	117	34	82	107	21	497
Subtotal South and East Asia	848	317	1,418	1,331	180	566	696	350	5,706
Grand Total	5,216	976	4,817	5,292	736	2,925	3,336	2,988	26,286

V. Orientation Program

It is well known that the orientation program offered upon the arrival of international students has great affect on their academic performance (6). Since 30% of the international student population are Muslims, this research considers the orientation program as one aspect affecting their academic performance.

A. Why an Orientation Program?

The orientation program is an important and major step in putting international students on the right path to a successful and beneficial educational experience in the U.S. To achieve this goal, an orientation program should provide students with information that will enable them to deal with practical matters of daily living, cultural adjustments, and the academic system (6). Having been properly oriented to these matters, the students success—academically and socially—will be enhanced. They will be able to function effectively in various areas of their daily lives and educational and professional careers. Students who have inadequate orientation will have difficulty dealing with the many issues facing them. Their success in reaching their educational goals, maintaining positive lifestyles, and receiving fulfilling experience will be constrained and limited.

Academia:

A University's orientation program presented to new international students will concentrate on the academic system. The following aspects of the system of higher education in the U.S. need to be explained:

1. Structure of the system (academic calendar, grading, etc)
2. Organization of the university (departments, registration, etc)
3. Degree requirements (courses, exams, etc)
4. Students' responsibilities (class attendance, rules, etc.
5. Facilities (library, computer center, etc.)
6. Finances (expenses, aid, etc.)
7. Student services (health, counseling, etc.)

Daily Living:

While a major concern of students and universities is the academic situation of the students, the practical matters of daily living are also important,

not only for the students' general well-being, but also in the fact that lifestyle affects academic performance. Basic human needs must be adequately met. These include:

1. Housing (on-campus, leasing, etc.)
2. Food (foods, utensils, etc.)
3. Transportation (traffic laws, licenses, etc.)
4. Communication (telephone, postal service, etc.)
5. Finances (banking, currency, etc.)
6. Shopping and services (yellow pages, laundry, etc.)
7. Health (insurance, medical system, etc.)
8. Immigration (visas, transfers, etc.)

Cultural Adjustment:

To function effectively in the academic setting and in daily living, students need to gain some understanding of the culture. The following topics may be included to help orient international students:

1. Attitudes and characteristics (informality, time consciousness, etc.)
2. Communication (conversation, body movements, etc.)
3. Social values (manners, women's roles, etc.)
4. Holidays (specific dates, practices, etc.)

B. Orientation Program for Muslim International Students:

Any university's orientation program will include most of the above topics. However, these are usually inadequate for Muslim students and the uniqueness of their situation. Indeed, many institutions do not request information regarding students' faith or religious preference (8). This might be explained by the American attitudes of religious freedom and privacy, and secular outlook (7). Since almost none of the personnel involved in the university orientation programs are Muslim, they cannot really know the sensitive situation of a Muslim in a non-Muslim land. The Education and Career Information Bureau is one agency that is managed and staffed by Muslims who can share and understand the particular problems faced by Muslim students.

In addition to the usual information presented in universities' orientation programs as described above, other topics need to be considered for Muslim students. These are:

Academia:

1. Purpose of Study. While everyone has personal goals and motivation for wanting to continue their education, the issue of being a valued contributor to the Muslim Ummah should be raised. Progress in studies and achievement of goals are made through great efforts put forth by serious students.
2. Instruction methods and techniques (differences, suggestions, etc.)
3. Schedule (Friday prayers, excused absences, etc.)

Daily Living:

1. Housing (co-ed dorms, rules of drinking and smoking in dorms, etc.)
2. Food (lawful and unlawful, ingredients, labeling, restaurants, etc.)
3. Finances ("interest" accounts, etc.)
4. Health (female doctors, etc.)

Cultural Adjustment:

1. Friendship (co-ed, informality, etc.)
2. Dating and marriage (practices, Islamic guidelines, etc.)
3. Death (Janāzah prayers, etc.)
4. Holidays (beliefs, conflict with Islam, etc.)
5. Religion (organizations, prayer schedules, etc.)

The Muslim Ummah has an "Islamic" culture that crosses all boundaries. Muslims should keep in mind that they are not living in an Islamic country. We do not subscribe to the saying: "When in Rome, do as the Romans do." While adapting to American lifestyle, students should not forget their Islamic values and beliefs.

In summary, Muslims adhere to the belief that Islam is a way of life with guidelines to be followed in our personal lives as well as in our relations with other people. As students seek to follow these guidelines and please Allah (SWT), they will at the same time be able to handle the problems they face in their new situations.

VI. Future Directions

Muslim students, upon their return to their countries, normally assimilate into the society. In order to cope with their own society, most of them usually lose the positive attitudes and characteristics acquired during their study in USA. Therefore, we propose to develop a post-orientation program and follow-up to maintain communication with these alumni. The proposed program will, hopefully, prolong the positive affect of their experience in USA in order to serve their country and the Muslim Ummah at large.

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The Principle of Intrinsic Opportunity: Its Role in Islamization of Scientific Development

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The Principle of Intrinsic Opportunity Its Role in Islamization of Scientific Development

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Abstract

This paper will present: (a) a brief review of the historical perspective, (b) the principles derived from Islamic heritage, (c) demands placed by these principles in dealing with the scientific development, and (d) the reasons for contemporary Muslim failures as well as the means of corrections based on the principles of "Intrinsic Opportunity."

Examples will be used of such Muslim scholars as Ibn Khaldun and Sir Syed Ahmad Khan who offered pragmatic and philosophical analyses of the scientific culture of Islam and, indeed, the humanity. The principles of Islamic attitudes towards science will be derived from the Islamic heritage in the following areas: (1) The development of "scientific habit" delineating the attitudes of reason, *al 'aql, al tadabbur* and *al tafakkur* which in turn determine the processes of discovery via the "scientific method". It will be discussed how these attitudes prompt humans to question and conquer (*taskhīr*) the surroundings for the benefit of human beings. (2) Techniques of documentation and transmission of knowledge as taught by the science of ḥadīth and fiqh and exemplified by preservation of Greek science and its introduction to the modern world by Muslims. (3) Original research to establish social institutions – *irtifaqāt* and (4) the use of scientific attitudes to understand and influence social behavior.

Introduction

In contemporary terms these principles will point to the challenge involving (a) the Muslim's ability to solve community problems of daily life, (b) the

problem of intrinsic dignity, and (c) international competition. In view of the aforementioned, measures will be suggested to deal with the failures, using the principle of "Intrinsic Opportunity," which states: "Development of any kind, in any group, is a qualitative and quantitative reflection of the extent to which full opportunity was available to the individuals in that group who have both the sincerity and ability to achieve the purpose." The problem of allegiance in determining sincerity, of the norms of determining abilities and various "opportunity promoting" and "opportunity inhibiting" institutions, will be discussed.

I. Historical Basis

The anamolies of contemporary Muslim attitudes should be considered a challenge to both Muslim heritage as well as to their destiny. Before we proceed any further, it is necessary to enunciate and recognize the perspectives of scientific development as they exist in the archives of history and relate to Muslim societies. We, by no means, should try to re-invent the wheel of Islamic Development. Of the many Muslim scholars who have addressed the issues and problems of societal development, I select two, namely Ibn Khaldun (1332-1406 A.C.) and Syed Ahmed Khan (1817-1898). It is true that the recency of their discourses adds to the impact of their ideas but it is also of importance that their ideas are supported by factual observations, data and scientific treatments of societies. They are credited with comparative analyses of communities including Muslim as well as nonMuslim, and a sincere concern for Muslim nations. Both Ibn Khaldun and Khan chose not to ignore the techniques of others while improving their own. One existed at the beginning and the other at the peak of the Muslim decline. Both dealt with the issues of scientific education and methods.

Germane to the concept of scientific attitude is the very understanding of the nature of science itself. Any legitimate effort to develop any segment of the Muslim society has to employ scientific techniques. Scientific development refers to the reign of logic, common sense or in more comprehensive terms, the Scientific Method. This discussion is not confine to the pure sciences such as Physics and Biology. One must be concerned with a scientific behavior which becomes the basis of all other developments. Scientific credibility emanates from the axiom that Science is the body of knowledge which is gathered by the use of Scientific Method. Since such a phenomenon is only possible while dealing with the material things, Science means that branch of knowledge which deals with the material world.[1] Although

Unus would like to make scientific method value-dependent[2], such a thesis would compromise the credibility and universality that Science possesses and would soon make it anybody's science. The method is independent of any value system that a particular segment of the human society may have to offer. Values vary from place to place, Science does not. However the implementation of the fruits of scientific method can and are value-oriented. It is the application of this principle by Ibn Khaldun that renders credibility to his writings even among non-Muslims. It is not a matter of ordinary credence that Fagirlind and Saha consider Ibn Khaldun as the first social scientist of the world.[3] When Ibn Khaldun refers to science, he assumes a process of inquiry based on reason, logic and information. He considers:

> "Scientific instruction is a craft. This is because skill in a science, knowledge of its diverse aspects, and mastery of it are the result of a habit which enables its possessor to comprehend all the basic principles of that particular science, to become acquainted with its problems, and to evolve the details of it from its principles. As long as such a habit has not been obtained, skill in a particular discipline is not forthcoming." "The tradition of scientific instruction at this time has practically ceased among the inhabitants of the Maghrib (Muslim Spain) because the civilization of the Maghrib has disintegrated. . . . Their civilization was highly developed, and the sciences and crafts were greatly cultivated and very much in demand in them. But when they fell in ruins, scientific instruction ceased. . . . The institution of scientific instruction has disappeared among the inhabitants of Spain. Their former concern with the sciences is gone." "The only scholarly discipline remaining there is Arabic and literature. . . . Of the intellectual disciplines, not even a shadow remains. . . . Good habits in scientific instruction, in the crafts and in all other customary activities, add insights to the intellect of a man and enlightenment to his thinking. Thus people become more clever because their souls are influenced by scientific activity."[4]

Ibn Khaldun criticized the Arabs for ignoring the scientific crafts which, according to his understanding of the age included agriculture, architecture, tailoring, carpentry, midwifery, book-production, and medicine.[5] He emphasized that such auxiliary sciences as Arabic philology should be studied only "in so far as they are aids to the main purpose. The extensive involvement in such subjects should be avoided."[6]

Syed Ahmed Khan essentially voiced similar sentiments as Ibn Khaldun.

He considered those nations as uncivilized which did not deal with their problems in the light of new challenges with the positive help arising from the areas of education and science. Muhammad Iqbal considered Khan as "the first modern Muslim to catch a glimpse of the positive character of the age that was coming . . . the real greatness of the man consists of the fact that he was the first Indian Muslim who felt the need of a fresh orientation of Islam and worked for it. There can be no denying the fact that his sensitive soul was the first to react to the modern age".[7] Syed Ahmad Khan studied both the culture of South Asian Muslims and Europeans, through first hand experience and logical analyses and reached the conclusion that Muslims must embrace scientific education. To achieve this purpose, he established the scientific society and the Aligarh Muslim University in India. Every modern educated Muslim of South Asia, owes his or her modern education to the traditions and practical measures, laid down by Syed Ahmad Khan. On the importance of sciences, Syed said:

> "The sciences and arts have progressed to a much higher level. The natural sciences, as far as they have been investigated critically, have reached a degree that pertains to self-evident and observable things *mashāhid*. The sciences have established that truth cannot be in contradiction to the critically established sciences, ulume muhaqqaqah. Whatever religion it may be if today it turns out on balance to be in contradiction to the science, then it cannot stand up . . . as soon as a person shares in the sciences he can never accept as true the jumble of truth and error which has been received as Islam. . . . No person has the power any more to prevent the rays of these sciences from shining forth. . . . I am certain that the pure religion of Islam is free and clear from blemishes which can befall any religion which faces the truth of the sciences. It is our wish that there may be born in the hearts of our people both the light of the sciences (as in the hearts of Europeans) and the confirmation of faith (as in the heart of Abu Bakr)"[8]

The ideas of Ibn Khaldun that permeate through his term of Qur'anic habit and the education of Syed portrayed in his phrase "to manifest the reasons" point to the attitude they and others tried to inculcate among Muslims. This attitude is a culmination of Islamic heritage in the development of what can justifiably be called the Qur'anic attitude, the Scientific attitude or Ibn Khaldun's Scientific habit. Even among Muslims of today few understand and many others conveniently chose to ignore the immense contributions of Muslim

scientists to the present accomplishments of human civilization. Many Muslims have developed the attitude of an apologist because of this misinformation about their heritage. George Sarton in his classical *History of Science* divides scientific achievements into Ages, each age lasting about 50 years. He names each age after a monumental scientific figure. He names the B.C. ages after Plato, Aristotle, Archimedes and so on. From 750 A.C. to 1100 is the Age of Muslim Scientists and we see such admissions of history as the Age of Jabir, the Age of Khwarzmi, of Razi, of Masudi, of Abu'l-Wafe, of Ibn Sina, of Biruni and the Age of Omar Khayyam. Even for another 300 years Islamic infrastructure produced Ibn Rushd, Nasiruddin Tusi and Ibn Nafis.[9,10] Six hundred years of scientific discoveries cannot be considered an accident. A good portion of this earth slept through these discoveries, which flowed from the Islamic culture that was profused with the spirit of thinking, discovery and free expression. Others were still trying to free their societies from pernicious clutches of the clergy which was trying hard to inhibit scientific development. When logic, reason and freedom to do scientific research were being curtailed, inhibited, questioned and persecuted by others, the Muslim civilization had embarked upon a journey set in motion by this Qur'anic attitude. Muslims of today have come around a circle trading places with others. Now it is the Muslims who lack the Qur'anic attitude while others have borrowed and effectively adopted this attitude to their advantage.

II. Islamic Basis of Scientific Attitude

In the evolution of Muslim attitudes the very first development was the transformation of Qur'anic attitude into the scientific habit. Let us first look at the Islamic basis of such a transformation and the forces behind it. This will not only absolve Islamic heritage from being responsible for the ailments of Muslim attitude but will also re-establish the premise of Islamization of attitudes that once prompted development. The best Qur'anic term that invites human intellect to react with the processes of cause and effect, to my mind, is *tadabbur*. That to me is the Qur'anic invitation to the development of the scientific attitude. This prompted the human being to question his surroundings and base his inferences upon solid and legitimate grounds. Exercising more common sense than dogma, observation than blind faith intellect (*al 'aql*), became prerequisite of inquisition and knowledge. Time and again the Qur'an invited, moveover challenged humans to reason and to arrive at the concept of Tawhid via observation and logic. It constantly reflected upon the laws of nature that operate in this universe and which are accessible to every human being.

> "Can they not look up to the clouds, how they are created, and to the heaven how it is upraised and the mountains how they are anchored and to the earth how it is widespread?" (H.Q. 88:17). "Surely in the creation of the Heavens and of the earth and in the alternation of the night and of the day are there signs for men of understanding" (H.Q. 3:189). "And in the earth there are signs for men of conviction, and in your souls; will you not then see?" (H.Q. 51:20-21). "Surely there are signs in this for those who have *aql*." (H.Q. 16:12)

The Qur'an even challenged human intellect and experience to find any flaw in the universe and assured man that such will not happen (H.Q. 67:3). The Qur'an asked of the disbelievers to offer their reasoning (H.Q. 2:111) Whoever died, died after (being exposed to) the clear reasoning and whoever lived, lived after (being exposed to) the clear reasoning (H.Q. 8:42). The Qur'an instructed its followers to speak to others in such a reasonable manner that it shall reach their very souls of understanding (H.Q. 4:63). Then came a simple but profound challenge to the power of human *tadabbur* about the Qur'an itself.

> "Why don't they exercise *tadabbur* over Qur'an; if it were from any one but Allah, they would have found many inconsistencies in it." (H.Q. 4:82).

What else could have been more logical. It is this habit of logic and reasoning which the Qur'an sought to cultivate among Muslims that later became the basis of *Uṣūl al Fiqh* and it is the same attitude about which H.A.R. Gibb said:

> "It is this characteristic of the practical bent of the Islamic community and of its thought, that its earliest activity and most highly developed expression is in law than in theology".[11]

This Qur'anic habit developed the attitude among Muslims that Islamized and enriched a culture for centuries and gave the civilized world its first formal lessons in approaching their problems with thinking, reasoning, observation and productive experience. It was no accident that Islamic education based upon this habit gave humanity its lasting impressions in law, science and humanities. *Islamization of Muslim's attitudes, based upon such a scientific habit, which in turn is cultivated by the Qur'an itself, is the paramount difference one should seek in developing given societies.* What

does not make sense should be rejected without hesitation and without delay. What appeals to al 'aql should be adopted. Cultivation of such a habit was indeed responsible for the development of various schools of fiqh each based upon scientific reasoning; each established the force of scientific interpretation of Qur'an and Sunnah, each reinforce the role of human intellect in reaching varying conclusions and each accepted the changing role of Islam in changing times through such scientific techniques as *Ijmā'; Qiyās* and *Ijtihad*.

My reason for placing such an emphasis on the Qur'anic habit is that the creation of such a habit opens many doors of societal development, be it purely scientific, legal, economic or political and closes many doors of societal ills such as corruption, illiteracy and priesthood. Muslims have the additional advantage of being able to draw upon the resources of their history that is an insignia of such a habit in practical settings. The West not only borrowed these principles of scientific habit from Islam and others, it recognized the role it should play in societal development. The West adopted and improved the techniques and used them to evolve institutions of democracy, science and technology, while Muslims saw the whole world slip away from their own hands into others. Let us ask some basic questions in the light of these attitudes. Pertaining to Muslim scientific development do we find our Qur'anic habit to support the following logic:

1. Is there a logic or reasoning that points to the principle that others will develop in Muslim societies? 2. Does Islamic education and history support that in Muslim societies Muslim scientists be considered aliens? 3. Is it logical to assume that non-muslims should be the bosses of Muslim scientists in Muslim organizations? 4. Does scientific habit dictate that Muslim scientists of equal qualifications be treated inferiorly compared with non-Muslims? 5. Do Muslim societies assign their projects of development to the most qualified people available? 6. Why is it that better qualified Muslims prefer to live in non-Muslim societies as second class citizens than in Muslim countries? 7. Why is it that non-muslim nations, whose dislike for Muslims is a foregone conclusion, allow Muslim scientists to occupy the positions of productivity? 8. Are Muslim organizations run by men of high caliber and proven ability? 9. How is it that Muslim societies determine personnel quality, project productivity, and institutional accountability in a manner which is not achievement oriented? 10. Why is it that the so-called scientific infrastructure which Muslim nations have developed on paper, fails to account for the lack of scientific achievement, lack of scientific independence, scientific literature, etc. 11. Why do we have universities that cannot be compared with the universities of the West, Science Foundations that fail to meet the minimum requirements of such organizations and Institutes that fail miserably with the

standard concept of such bodies? 12. What is the basis of Muslim outlays or resources allocation to scientific and educational development? 13. Does any Muslim nation have any time table for self-sufficiency in the areas of economics and technology? 14. For a religion which placed high priority on education and science why is it that more than 70 percent of its followers are illiterate? 15. Why is it that not a single Muslim nation has been able to produce a single scientific journal of any quality? Qur'anic habit demands answers to these questions. We have been pretending too long, covering up for our follies too long and coming up with unacceptable excuses for too long. Any attitude that is not overly disturbed by the lack of proper solutions in these areas defies scientific habit of Islam. Any one that does not make a positive effort to correct it, defies the Islamic mission of ma'rūf and munkar.

Logic, scientific habit, Qur'anic habit, Islamic history and Muslim experience will demand the correction of the Muslim disarray. *The basic defect in the Muslim attitude is the refusal to apply the sense of reasoning. This is my diagnosis.* This is what is happening to us. Before I discuss the basic reasons and phenomenon, and the cures of such Muslim attitude I would briefly like to deal with the three current requirements of scientific development of Muslim societies. This is necessary because Muslim nations and organizations are gathering a morass of activities under the guise of pretentious development which defies Qur'anic sense and logic.

III. Requisites of Islamic (Scientific) Development

It is important to determine the parameters of Islamic development. It is within the realm of this discussion, to relate the requirements of islamization to the challenges of the present day world. Simply by claiming that we have Islamized or have developed our societies in recent terms, we cannot achieve credibility. These claims have to be borne out by certain objectives set by the Qur'anic attitude and Islamic traditions. There are those who have little confidence in Islam's ability "to have found an answer to the overall challenge to the Western civilization"[12] or who project Israel "to be a constant reminder of their impotence and failure".[13] Some are so pessimistic as to say "Islam's gradual decay cannot be arrested by any modern palliatives however skillfully they may be applied."[14] Still other regarded Islam to be a phase of history and no more.[15] One can, however subscribe to the more realistic and fair view of Voll who said,

> "The basic question is not why did Islam fail, because it has not failed. Rather, the question is a more complex one: what are the

elements of the Islamic experience that continue to have vitality and how have they developed in the context of the modern global experience."[16]

The viability of "Islamic Experience" is governed by the vitality of the scientific attitude inherent in its education. The fact is that many scholars, Muslim as well as non-Mulsim, have either failed or refuse to recognize that the Islamic culture, no matter how dormant a form it assumes, is based on certain viable values that appeal to human intellect beyond dogma and thus, through a scientific attitude, Islam repeatedly tends to become a tool of reorganization for Muslim communities. And because of this quality, Islam is a force of benevolence for Muslim as well as non-Muslims. It is under this premise that the evaluation of development shall be examined. I would consider at least three broad criterion that need to be fulfilled and which would serve as a litmus test, for the success or failures of scientific development. These are:

A. Problem Solving.
B. Dignified Living.
C. International Obligations.

PROBLEM SOLVING: The first test of an Islamic society to show its ability to embark upon the process of scientific development is its ability to (a) identify societal problems, (b) set priorities with definite time frames to deal with them effectively and (c) actually be able to solve the problems based on its own resources and without creating new ones. Afzal in a limited sense has mentioned this factor without any elaboration.[17]

Scientific development of societies is not a hundred yard dash. Rather, it is a marathon, the success of which depends upon a multitude of factors, including the sense of direction and a steady and patient progress. Scientific development is very much like the growth of a tree. It has to be (a) properly seeded with Qur'anic attitude, (b) rooted with education, (c) nurtured with indigenous resources, (d) maintained by brotherly love, mutual respect and fair treatment of gardeners and (e) protected against the pests and parasites of all kinds. Only then are we able to harvest its fruits and which (f) should be equitably distributed. Borrowed seeds such as chemicals to establish a clinical laboratory, borrowed roots such as nuclear plants and planes to establish power and aviation services, or borrowed technology to drill oil wells and borrowed arms to defend the nation are no more than temporary measures and cannot be classified as an effective process of scientific development much less Islamization.

DIGNIFIED LIVING: No group of people can obtain a dignified living if it looks up to others to solve its problems. The Muslim historian, I. H. Qureshi said:

> "When shall we understand that no one will ever help us without a price and no one will provide solutions to our problems which do not benefit him. We must learn to rely upon our own judgement and to form opinions after due deliberation."[18]

The scientific habit developed by the Qur'anic attitude shall furnish the sense of our own judgement. The dignified living of a Muslim nation, above all, requires the maintenance of a speedy system of justice. The Qur'anic attitude makes it incumbent upon a Muslim society to institute justice not only in its archives and constitution, but in reality, not only for rich but for all, not only for the rulers but also for the common person, not only for Muslims but also for non-Muslims. No nation has ever lived a dignified existence without an efficient system of justice available to all of her citizens. For Muslims to replace their own proven and acclaimed system of justice, by a defective and inaccessible Western notion of justice, is unwarranted. The Western jargon of justice has caused the same problems in Muslim societies as it has in the West – of corruption and domination by vested interests. Qur'anic education has placed the responsibility of effective justice on the Muslims and not on aliens (H.Q.: 5:8, 5:48, 4:135). Muslim nations have lost a dignified existence because justice is not available to their citizens and in many of their countries one is not sure of his rights and obligations. Ibn Khaldun warned that "injustice brings about the ruins of civilization" and concluded that injustice in a society causes the loss of incentives for people to engage in economic activities.[19] Other factors that render societies their dignity are: a reasonably efficient government, cleanliness, proper standards of living including proper facilities for education and health.

An essential attribute of dignified living is to stop living a pretentious life. Pressed by the galloping technological success of the West and frustrated by their own shortcomings, many Muslim individuals and communities are trying to become a bad imitation of the West. We have chosen to be the pretenders of this age. We pretend to be the scholars and professionals of a specialized field without proper credentials. Our institutions fail to meet the minimum qualifications contingent upon their title. We conveniently steal the titles of the Western infrastructures without fulfilling their prerequisites and image. Our university is hardly a university, our science foundation hardly a science foundation, our institute hardly an institute, our research council hardly a research council. We publish science journals that have no standing

and our scientists have little or no credence. Our mimicry of the West gives us a false sense of satisfaction and defies the attitude necessary for genuine development. This attitude of pretension, among other problems of waste and underdevelopment has cost us our dignity. No one looks at anything we do with respect.

INTERNATIONAL OBLIGATIONS: Islamic societies have never lived in isolation. Under the doctrine of the Ma'roof and Munkar they have always been concerned about others, both Muslim and non-Muslims. The Qur'an declared that Muslims are supposed to show compassion towards each other (H.Q. 48:29) and called them (muslims) brothers-in-faith (H.Q. 35:5, 49:10). Allah reminded them that He does not like the arrogant (H.Q. 16:10) and the oppressors (H.Q. 42:40) and warned the resourceful Muslim communities that He shall call upon them to account for their wealth and deeds and upon failing will cut off the supplies of undeserved resources (H.Q. 6:44, 45). As for others the Qur'an ordered Muslims to remain fair and just to non-Muslims, in spite of their differences. The Prophet(s) urged that all human become brothers among themselves. Allah (SWT) asked Muslims to approach Christians and Jews without fighting and declared that Muslims have the same God as the Christians and Jews.[20] The very concept of Hajj, reinforces the principle of international leadership required of Muslims (H.Q. 3:96). Muslim heritage has many values that can be offered for the betterment of the world. This cannot be achieved by borrowed leadership. The Islamic leadership of resourceful Muslim nations, is obligated to respond to the Qur'anic call, for the propagation of education and fairness to other Muslims in particular, and to other nations in general. They also must play a role in fair distribution of wealth and economic activity throughout the globe. As the worldwide effort to expand food production loses momentum, global food insecurity is increasing. The grain surpluses that accumulated in the food exporting countries during the 1950s and 60s have disappeared. World food supplies are tightening.[21] At least 1/5 and perhaps 1/3 of global cropland base is losing soil by erosion. For example, in Indonesia erosion exceeds reclamation of such lands, while in Pakistan erosion costs thousands of acres of cropland every year. By 1990 the developed world will account for 24 per cent of the world population and 85 percent of the world's economic activity and about 50 percent of world grain consumption. On per capital basis the West will consume 3 times as much grain as the developing countries.[22,23] A Muslim's responsibility in restoring homeostasis and in establishing the order, lies in correcting the magnitude of imbalance that exists. Those Muslim countries which continue to transfer their resources to the West and which do not generate the economic activity in their own regions, fail to meet the obligations placed upon them by Islam.[24]

The world, at present, is divided into two main groups, the developed and the underdeveloped, the selfish exploiters and the resourceless exploitees, the free and the oppressed, the gainers at the cost of others and the losers at their own costs, the smart and the gullible. Qur'anic education and attitude defy such division of humanity. The present world is crying for the fair leadership of the human civilization. The racist Judeo-Christian societies have provided, whatever form of an anamolous leadership, but for themselves. This is, however, not to deny the courageous role the Christian clearly has, of late, played in the third world to promote human rights and democracy. Cardinal Joseph Ratzinger of the Vatican, in his document on the Theology of Liberation states,

> "Service to the poor, both through charity and by working to change oppressive political and economic structures must be a priority for Christians and that in the extreme case armed struggle may be justified as a lost resort to put an end to an obvious and prolonged tyranny which is gravely damaging the fundamental rights of individuals and the common good.[25]

While the West has not initiated the correction in the corrupt societies, it has, on occasions supported such movements. But by and large wherever they have gone as colonialists or influence peddlers they have shown callous disregard for the rights of local citizens. This was shown in the rebuke Cardinal Jaime Sin of Phillipines received from the Vatican for supporting Corazan Aquino in toppling Marcos. Their history is too full of alliances with oppressors, to give them any high marks as the upholders of common human values. The West has come to accept that all forms of emancipations are too good to be exported for the benefit of others. To say the least, Western countries do not consider it their responsibility to establish humanist institutions in other countries. Only the self serving economic hegemony is the goal. The world civilization lacks very badly a universal benefactor. Islam can provide this. This is exactly the kind of negative environment Islam came to correct. Any development on the part of Muslim countries must include such international leadership. Not only should the developing nations receive relief, the millions of common citizens of the West, who are tired of the vested interests in their midst, should feel relief and be grateful.

IV. An Approach to Solutions-Principle of Instrinsic Opportunity

Once the sense of Qur'anic attitude and the objectives of scientific

development derived from it, are established, a mechanism needs to be formulated to achieve the purpose. The Qur'anic attitude becomes the source of motivation, the defined objectives become the Islamic purpose, and the human being, the *Khalifah* in an Islamic setting becomes the hope for their implementation. Given all these, the following statement, based on the sincerity, ability, and opportunity of human endeavors, defines the principle of intrinsic opportunity and the methodology necessary to achieve the Islamic Purpose.

> Development of any kind, in any group of considerable size, is a qualitative and quantitative reflection of the extent, to which opportunity was available, to the individuals within that group, who have both the sincerity and ability to achieve the purpose.[26]

THE GROUP-UMMAH: Whatever change is needed to revive scientific development among Muslims has to come from within this group. This is the nature of intrinsic response that is required and this makes the reinforcement of the concept of Ummah imperative. The concept of the group, its size, and diversity, have created nightmares for the sincere leadership seeking Muslim national integration. In the ideal sense, it is the concept of the Ummah which is constantly being tampered with by the Muslim communities. The breakup of Pakistan[27], the quagmire of Lebanon, and the Iran-Iraq conflicts are enough to exemplify the concern. The occurrence of conflict, within a projected group, is neither new to Muslims nor unique to them. The Sunni-Shi'a conflict, originating in the beginning of Muslim history, has already dealt a severe blow to the integrity of the base-group. Ibn Khaldun was the first scholar to have dealt with the psychology of the subcultural conflicts. Hegal represents the West in dealing with the role of conflict in societal development and recently, Jalibi has analyzed its role among the Muslims of South Asia.[28] Syed referred to this group as *Qawm* and thought that "what is termed *Qawm* among Muslims is termed thus not with reference to country or race but rather purely with reference to religion, and as long as he is a Muslim he is of the same *Qawm*."[29]

A valid approach to understand the importance of a base group, is to understand the contemporary developed works. The group that has finally come together is the Judeo-Christian white community of the world. Every individual and subcultural nation within this broad group, has come to accept and identify itself in all pragmatic terms with this broadbased group. This sense of integrity was the sole motivation for the U.S. to launch the post-World War II development of Europe. This kinship helped the European colonial powers to divide up the world among them. It is the same hegemony that was able to implant Israel, Australia and White South Africa in alien

lands. Despite the fact that Japan and India have become among the world's top three scientific powers, the leadership of the scientific community has no inkling of shifting away from this group. The Jewish national itself had to go through a phase of trying circumstances before it was accepted. As late as during the sixties, American academic institutions were trying to keep the enrollment of Jewish students down in Ivy League colleges.[30] Every individual within this group is accepted as an essential member of the group, in such a pragmatic sense that his abilities are given full opportunity to express. Using this resource, the group has been able, with a high degree of success (a) to identify and solve the problems of its communities and (b) to fulfill their obligations towards international communities, primarily of their own culture and secondarily of others.

In the words of Allan Bullock:

> "The greatest resources available to any organization, are the human ingenuity, experience and loyalty it can draw on. Any investment put into tapping these by education, by securing active participation and with it the commitment of those working in any enterprise to its success, will produce greater returns than piling up investment in sites, buildings and equipment."[31]

It is common observation that the larger the base of a group the higher will be the probability of individuals, emerging from the group, with qualities of leadership. Biologically, this way the gene pool broadens and so does the diversity of Gene Expression. Since development depends upon the creative abilities of individuals involved, the more the number of creative humans the more will be the creative expression. The number of creative individuals is limited in any population. Therefore, a broader base will increase the number of such individuals. The West has not only come to grips with the design and mechanism of harnessing the fruits of human intellect, it has also arrived at the formula of defining its base-group effectively. Within this group it provides freedom and opportunity for creative expression. It will be an exaggeration to say that even the West has reached the ideal limits of opportunities available within such a group and that there are no problems within this group. But this is the group that exists, at present, without any competition from a similar body.

Islam had already provided the ultimate concept of such a base-group called Ummah. More than anything else and unlike the Judeo-Christian white Group, Ummah is not to be a racial entity and Islamic heritage bears testimony to this doctrine. It is based not to exclude anyone but on the basis of an

ideology that defines this group to be the one that proclaims the right, (*ma'rūf*) and forbids the evil, *Muhkar* (H.Q. 3:110). Muslims have abandoned the comprehensive concept of Ummah which act defies the very notion of Islamization. The integrity of Ummah shall provide the intrinsic base-group Muslims need for the scientific development of their societies. Muslims, no matter how able, in general, are alien in any Muslim society other than their own. Many creative Muslims are less of an alien in the Christian West than in other Muslim countries and some are aliens in their own because of subcultural differences. Thus the Ummah gets smaller and smaller. The Muslim communities continue to divide themselves initiating exclusion of individuals and classes of individuals thus reducing the spectrum and extent of creating expression. On an individual basis we exclude our brothers because we are jealous of their intellect, afraid of their productivity, or disagree with their ideas. Collectively we exclude classes of Muslims because we think the language we speak is better than their's, the clothes we wear are finer than their's or the food we eat is better than their's. Owing to the likes of the above mentioned circumstances, it should come as no surprise to anyone that the Government of Pakistan was unable to accept recommendations of a conference of highly skilled American scientists of Pakistan origin. These recommendations, led by a Nobel Laureate, tried in vain, to correct the course of Pakistan's erratic scientific development.[32] This continues simultaneously with our submission to the morality of a culture that is drastically different from ours. The U.S. is a living example of how different subcultures have created the spectrum of activity that teaches the making of the technological development to the world. To add injury to the insult, the West and in particular the U.S., have come up with the ingenius arrangement to lure the creative individuals from beyond their own base-group. This adds to the creative expression of the base-group without violating its hegemony.

SINCERITY will encompass the requirement that the individuals in charge of Islamic development should (a) belong to the base group of Ummah and (b) be fully conversant with the goals of Islamic purpose namely the problem solving, dignified living and international Obligations. This by no means excludes the minorities and other non-Muslims, who accept the benevolent role and purpose of Islam as it applies to the society at large and are sincere to its general welfare. Muslims must delegate the responsibility of solving their problems to those, who have demonstrated sincerity to their purpose of development. Money simply cannot buy sincerity. They must trust the critical phases of their development to sincere parties (H.Q. 3:118). Many Muslim communities indulge in the wasteful practice of seeking help from substandard alien sources. Both Qur'anic sense and experience refuse to accept the wisdom of such practices. For most part, these so-called alien professionals

turn out to be their society's rejects who, both because of the lack of sincerity and because of ineptitude, under estimate the challenge involved in correcting under development. At the same time, they carve out for themselves an affluent and undeserved living at the expense of the underdeveloped. They have nothing to offer in return. Sincerity, for most part, is an intrinsic quality that is difficult to acquire.

ABILITY, as it should be reflected in the human resources of an organization, is an essential prerequisite of Islamization. The Qur'an advised Muslims not to turn over their affairs to inept people (H.Q. 4:5) and warned about those who devour their assets in the name of religion and priesthood (H.Q. 9:34). Prophet Muhammad (ṢAAS) advised Muslims to select the best for their leadership and showed in practice how he selected the best available personnel to run the various departments of the Islamic State. Keeping the perspective of the contemporary world, Islamization of ability leads to these requirements: (a) Specialization and expertise, (b) practical experience in an underdeveloped setting and (c) creative expression.

When the lack of intrinsic sincerity arrives on the scene of development, it often is accompanied by the lack of ability and expertise that is necessary for the Islamization of attitudes. While serving as the only Toxicologist ever to occupy a public position in Pakistan during the sixties, I found a colony of a dozen or so foreign "experts" living on the campus of the University of Lyallpur. While each of their huge brick houses were costing, in air conditioning expenses alone, more than my salary, not a single one of them was a qualified professional of any worth. Western experts who are worth anything stay home or are there, in the phrase of Gunnar Myrdal, "to study the people they rule". While we place undue trust in others, we continue to underestimate our own. Several Muslim countries have two salary scales, the inferior one is reserved for their own brothers of equal or better qualifications. Qur'anic attitude abhors such practices and scientific habit defines this anomaly:

> Ignoring the requirement of personnel competence in Muslim organizations is a widely practiced tradition and the most damaging force against scientific development of Muslim communities

This practice of professional incompetence, inhibits proper development, discourages Islamic standards of living, encourages corruption, and unduly denies the opportunity to the qualified individuals and to their creative expression. Ability must be determined in the light of formal education, the quality of institutions attended, pertinent experience and a bonafide record of creative expression.

OPPORTUNITY is the next integral of this principle. While sincerity alone is not sufficient and ability is an essential ingredient, of absolute importance is the factor of *Opportunity* that must be provided to the expert. Sincerity and ability are worthless unless the qualified individuals are provided with full opportunity to express their intellectual aptitudes. Let the best of our human resources deliver on the promise of Islam without interference and domination from lesser men. It is imperative that we free the efforts of our gifted ones from the frustrating bureaucracies and vested interests. Once the sincere and capable human resources of the Muslim communities are allowed to surface and perform, the basic problem of development is solved. The dignified living and international leadership shall return to Muslims and Muslims shall become the best of the Ummahs that the Qur'an envisaged. During my stay in Pakistan, I found that there were areas of science in which Pakistan somehow had obtained prominent experts, but these men of great ability were being constantly frustrated by less qualified and nonqualified individuals. Those who were less qualified and least productive had generated unholy alliances of mediocrity as a force of counter–productivity. The gifted became the subordinates of the unqualified and all executive decisions concerning development were actually taken by the non-professionals. When an expert in the area of cornbreeding was invited by an international conference, an underqualified and non-productive individual from the area of wheat-breeding was sent to the corn conference. When a qualified and productive scientist tried to send his professional findings for publication, the unqualified boss insisted and succeeded in placing his own name on the paper. At one time I counted that 20 chiefs directing scientific projects had not received any training in the area of their occupation and at least half of them frustrated the efforts of an expert working under them. Time and again our sincere and able ones are denied the opportunity to become the Ibn Khaldun, Ibn Sina and Ibn Nafis of our age. This is not because we lack capable men but because we frustrate their expression and when brain drain occurs because of such frustrations, the inept are increasingly selected out to become the factotum of our affairs. Soon we reached a stage that there are no brains to drain. Our capable ones are now afraid to return to their homeland or to other parts of Muslim world. They feel so insecure and fear humiliation at the hands of their own brothers.

What governs the far-reaching factor of *OPPORTUNITY* has to come from within. It has to be intrinsic to our culture. No one else can institute such opportunities from outside. And it cannot be a sporadic effort. It cannot depend on the mere goodwill of a president, a general, or a king. It has to be an integral part of the culture. It should come as natural to a culture based on the Qur'anic logic that opportunity of creative expression is available

to every one that seeks it and is sincere and capable. Said Moudoodi (rh) "every individual in (Islamic) society is provided with opportunities adequate to the development of his personality and the attainment of the highest possible perfection according to his capacity and attitude".[33] Such an Islamic society does not exist today and I know of no one that intends to proceed in this direction.

V. Oportunity Promoting and Inhibiting Institutions

Numerous human weaknesses, when widely diffused into a society, tend to become institutionalized. Many of these unfairly inhibit opportunity for the talented. Employment opportunities in Pakistan depend on a person's place of birth called the notorious "domicile". Provincialism permeates through every sphere of such factors as nationality, language, subcultural affiliations, color, and religious subdivisions. Lack of freedom of expression, lack of democratic practices, priesthood, lack of accountability of Ihtesab, vested interests, corruption, buddy-systems, oligarchic loyalties . . . etc, are all now institutionalized inhibitions of opportunity.

Opportunity promoting institutions include: professional activities, institutions of higher learning, productive organizations, publications and the judiciary. The *less* is the impact of the Institutions-of-opportunity-inhibition, the (*al-Munkar*), and the *more* is the judicious establishment of the Institutions-of-opportunity-promotion, the (*al-Ma'rūf*), the closer the Muslim nation comes to becoming the best of the Ummah the Qur'an promised.

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Islamic Attitude and Practice in Food and Nutritional Sciences

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Islamic Attitude and Practice in Food and Nutritional Sciences

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Abstract

The subject is dealt in two parts. In the first part a foundation is laid with principles and guidelines to deal with the theme itself in general. In the second part Islamic attitude and practice in food and nutritional sciences are dealt specifically.

A Muslim's (scientist's) way of feeling, thinking and acting should manifest into his worshipful (to Allah's sovereignty) attitude. The worshipful attitude encompasses two aspects namely *Dhikr* (Qur'an 3:191) and *Fikr* (Qur'ān 2:164, 3:190). The signs and tokens of Allah's sovereignty must be discovered in each experience, phenomenon, and experimentation. The progress of science and human thought must be monitored, maintaining an independent critical attitude towards it.

Islamic teachings as laid down by Qur'ān and Sunnah must be viewed strictly as for 'guidance' (*Hidāyah*) and never as 'scientific', although no Islamic teaching is contradictory to the facts in science.

Attempts should be made to explain the Islamic practices in the modern terminology conducive with the time, people and place.

There is a science of nutritution and a practice of nutrition and the same word is used for both. The Qur'anic injunctions and Prophetic recommendations are taken as the guidance to influence the dietary practices and food habits of the people (Muslims). Scientific findings substantiating and supporting the practices are enumerated. Appropriate attitude relative to the importance of good nutrition as obedience to Allah (SWT) is instilled, thus regulating one's own health, that of the family, and the community. The existing food and nutritional sciences are reviewed in the light of Islamic Regulations. A guideline is developed to exercise care and common sense in choosing food

items and determining their acceptability, Islamically. Recommendations for research to establish the superiority of the Islamic dietary practices are made.

I. Principle and Guideline

A Muslim's (scientist's) way of feeling, thinking, and acting are manifested in his worshipful (to Allah's sovereignty) attitude. (Qur'ān 3:191 3:189).

The worshipful attitude encompasses two aspects, namely; *Dhikr* i.e., remembrance (Qur'ān 3:190; 2:164) and *Fikr* i.e., understanding (Qur'ān 3:190; 2:164).

The signs and tokens of Allah's sovereignty must be discovered in each observation, phenomenon and experimentation.

A Muslim scientist must monitor the progress of science and human thought, maintaining an independent critical attitude towards them.

Islamic teachings laid down by Qur'ān and the Sunnah must be viewed strictly as for "guidance" (*Hidāyah*) and never as "scientific", although no Islamic teaching is contradictory to the facts in science. (Qur'ān 2:2; 6:71; 16:64; 31:1-3;

Attempts must be made to explain the Islamic practices in the modern terminology, conducive with the time, people and place (Qur'ān 16:125).

II. Unity in Material and Spirit:

With the progress in science and technology the world is getting convinced more than ever about the practicality and beneficiality of the Islamic practices and recommendations. Allah (SWT), with the advancement of science and technology; is preparing the entire humanity for Islam which would provide harmony in material and spirit resulting in peace from within and without.

Following are a few examples in the field of food and nutrition:

(1) *NATURAL USABILITY*: "It is He Who created all that is in the earth for you . . ." (Qur'ān 2:29). Also see (Qur'ān 45:13)
(2) *PERMISSIBLE FOOD:* "Ye people! Eat of what is on earth, lawful and good" (Qur'ān 2:168).
(3) *SELECTION OF FOOD:* (Qur'ān 6:119).
(4) *NUTRITIONAL QUALITY:* (Qur'ān 18:19).
(5) *FORBIDDEN FOOD:* (Qur'ān 2:173;) 5:(4)(3);5:(93)(94).
(6) *EXCEPTION:* (Qur'ān 2:173). (Qur'ān 2:73)

(7) *FASTING:* (Qur'ān 2:183).
(8) *BREAST FEEDING:* (Qur'ān 2:223).
(9) *EATING LESS:* "Eat less you will be healthier" (Authentic Hadith).
(10) *AVOIDANCE OF WASTE:* (Qur'ān 7:31, 20:81)
(11) *CLEANLINESS AND HYGIENE:* Cleanse yourself, for Islam is cleanliness" (Authentic Hadith)
(12) *ORAL HYGIENE:* Miswak

III. Appropriate Attitude and Practice for Good Nutrition

Good nutrition is a foundation for good health. Eating the right amount and kind of food will affect to a larger extent one's ability to keep well, to work efficiently and to be happy.

Acquisition of the knowledge of Islamic dietary laws and the practice of it is incumbent upon every Muslim male and female. Muslims should acquaint themselves with the existing nutritional sciences. This will help one to build upon what is best in one's dietary pattern and correct the undesirable habits. The object is to acquire the proper attitude relative to the importance of good nutritional practices in regulating one's own health, that of the family and individuals in the community.

Development of a Guideline to Choose Acceptable Food Islamically:

Muslims must check and judge the lawful (*Halāl*) and prohibitive (*Harām*) nature of all the foods and drinks before consumption. They are not expected to be misled by their appetites unchecked by knowledge (Qur'ān 6:119).

A guideline must be developed so that Muslims can exercise care and common sense to decide the permissive on prohibitive nature of a wide variety of foods and drinks available.

Muslims must be made aware of most commonly used foods and *harām* ingredients and industrial processes.

Critical Review of the Existing Food and Nutritional Sciences:

(1) The existing food and nutritional sciences are certainly not directed by the Divine guidance,
(2) It takes into account only the physical being without any consideration to the spiritual aspect of human life,

(3) Profit motive is the reason behind its development rather than the total well-being of the human life,
(4) More research is needed on the effect of food and dietary habits and behavior of people, individually and collectively.

IV. Recommendations for Research:

(1) 'Ulama of all the *Madhahib* must analyze, reevaluate and reinstate fresh *Ḥalāl/Ḥarām* verdicts (given centuries ago) in the light of the modern times. *Ijtihad* can be considered if necessary.
(2) Research must be conducted on Islamic ritual (*dhabḥ*) slaughtering method with emphasis on the following factors among others:

   (a) Various methods of pre and post stunning and its effects.
   (b) definition of pain, cruelty, death, etc.,
   (c) Effect of severing four passages/three passages/ two passages on the ejection of blood from the carcass and on the quality of meat,
   (d) Difference in the quality of meat and blood ejection between Islamic methods versus modern methods of slaughtering practiced in the west,

(3) Thorough scientific documentation of the ill effects of the *Ḥarām* foods and drinks.
(4) Research on Islamic fasting documenting its physical (physiological, biochemical, clinical, immunological etc.), psychological, social, and moral effects,
(5) Research on the healing effects of honey and other *al Ṭibb al Nabāwī*.
(6) Research must be conducted to find better preservation techniques for the sacrificial meat during Hajj and *Īd al Aḍḥā* and its 100% distribution without any waste,
(7) Research strategies in good production and food technology to make Muslim communities and Muslim countries self sufficient,
(8) To find workable Islamic solutions for hunger eradication on local, national and international levels.

Islamic Perspectives on Knowledge Engineering

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Islamic Perspectives on Knowledge Engineering

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Abstract

This paper provides Islamic perspectives on the recent developments in knowledge engineering. The paper starts by introducing the concepts relevant to knowledge engineering. The use of the science of knowledge, and the scientific method for knowledge based systems is described and discussed. The role of knowledge engineering is defined. Relationship of knowledge engineering to the study of human mental faculties is described in intelligence and psychology. Finally, a brief description of the historical developments and current trends is presented.

I. Introduction

The purpose of this research is to find answers to some basic questions regarding the human mental processes that occur in dealing with knowledge, and the manner in which this knowledge is organized for innovation and problem solving.

In reading the Qur'an and literature on Hadīth of the Prophet, the basic sources of information on Islam, one finds a great deal of emphasis on knowledge and the special position given to those with knowledge. One, therefore, wonders as to why the Muslims, professing Islam, do not appear to be the leaders in knowledge. In this case however it is not only necessary to understand why that may be the case but also to search for ways to correct this situation.

Research in human problem solving has resulted in paradigms about the working of the human mind. Advances in computers and the use of computers

in problem solving, in particular the use of the techniques based on artificial intelligence, are having further impact on these paradigms. It is to be noted that while these paradigms may give a rational explanation to what we perceive through our senses, they do not necessarily represent the ultimate reality of the human mind.

Knowledge comes from learning about things, and it requires mental apprehension or cognition. The process of learning consists of using existing knowledge, gaining new knowledge, organizing, and storing the new and old knowledge. Stored knowledge is recalled and used in responding to the events in the environment. Our present understanding of how the human mind organizes knowledge points to the following two characteristics: what the mind stores is a refined form of received information, and it also retains the context of this information.

The main topic of the Qur'an is also the human mind. In particular, it deals with the question of how the humans do use or should use their mind in responding to the events in the environment. Based on our current understanding, it appears that the style of Qur'anic descriptions is well suited to human cognitive skills, e.g.,

- Details are relevant to a context.
- Reasoning is goal oriented.
- The same subject is presented using several alternate perspectives.
- The message is conveyed through patterns of things or parables, called *amthāl-ul Qur'ān*.
- Positive as well as contrary-to-positive templates of behavior, *Mūjibāt al Falāḥ* and *Mūjibāt al Khusrān*, are presented.

Phillip Selznick, in his book, *Leadership and Administration*, argues (15) that the human values are not usually transmitted through formal written procedures. They are more often diffused by softer means: specifically the stories, myths, legends, and metaphors that we have already seen. This argument is based on the impact on human mind produced by a certain style of stating facts, and it conforms well to the cognitive skills stated above.

Some examples of the concepts and terms that the Qur'an uses about knowledge are:

- Being aware of, or having cognizance of (*dirāyāh*).
- Insight, literary and spiritual.
- Reasoning and rationalizing with facts and rules (Qur'an 29:49).

- Contrary to guesswork or conjecture (Qur'an 7:7).
- Learning and discovering truth (Qur'an 22:54).

Knowledge engineering deals with building systems based on the knowledge of someone who is well experienced in dealing with the events of some domain of application. Events generate stimuli and require responses. One must properly recognize the event, and then generate an appropriate response; this process is called problem solving. In solving a problem, one must have access to what may be previously known, retrieve relevant data and rules, and apply this knowledge effectively. This may be described as a goal seeking process. Given some premise and some desired goal, one may use the knowledge to move forward from the premise toward the desired goal until that goal is reached. Alternatively, one may use the knowledge to move backward from the goal to the premise in order to establish that the goal can be reached from the premise. In either case, one goes through several intermediate steps, and collectively these steps constitute a chain of thought. Reasoning from the premise to the goal is called forward chaining, and reasoning from goal to the premise is called backward chaining; the choice generally depends on the situation.

Many people do not possess the knowledge that may be required to solve problems in a given area, or they are unable to use effectively the knowledge that they have. Those who do, are known as experts. It takes a human being many years, possibly decades, to become an expert in some area. Direct use of an expert's knowledge is limited by the possibilities of personal contacts. However, if one can acquire successfully the knowledge of how an expert solves problems then it can be put to widespread use. Furthermore, if one can successfully transfer the expert's knowledge to a machine, then the access and use of this knowledge can be increased manifold. Moreover, one is now able to exploit the inherent capabilities of the machine to store vast amounts of information, recall it when needed, and put it to use at lightning speed.

II. Knowledge Engine

A mechanism for storing and organizing facts and rules from known situations, and using them for resolution of new situations is called a knowledge engine. Designed properly, a knowledge engine can unleash the problem solving power contained in knowledge. Traditionally, the human mind has served as the knowledge engine. It is fueled by the stimuli from the environment, uses existing knowledge to process information, solves problems, acquires new knowledge in the process, organizes and updates existing knowledge, and generates information leading to the creation of new knowledge.

Before the industrial revolution, tools for enhancing the mechanical abilities of humans were rather limited. With the industrial revolution came the steam, oil, electric, hydro, and nuclear powered engines which allowed the human race to alter the physical environment for its purpose. The changes affected the quality of life dramatically. With powered machines, it became unnecessary for human beings to exert their body to lift heavy leads, walk long distances, or endure harsh climates. Moreover, the power of one such engine could out perform a large number of human beings.

The power machines of the industrial revolution gave vast amounts of physical power to the human beings for their use. However, in order to keep up with these machines, the human beings were often required to perform repetitive tasks. Also, as the power and operational capabilities of the machines were increased, they replaced an increasing number of human beings in the work environment.

In a similar fashion, knowledge engines, also called information machines in a more general sense, are bringing another kind of revolution. One may call it an information revolution. A mechanical machine can easily exceed the physical capacity of hundreds of human beings, particularly for tasks that do not require physical dexterity. An information machine, likewise, can exceed the mental capacity of hundreds of human beings for tasks that do not require mental adroitness. Furthermore, a human being can make the information machine to act as an intelligent assistant in his work, allowing him to be more productive mentally, much the same way that the mechanical machine can make him more productive physically (1, 16).

III. Of Mind and Machines

A human being has physical faculties of force and motion, sensory faculties of seeing, hearing, touching and smelling, as well as the mental faculties. Examples of mental faculties are perceiving on seeing, discerning on hearing, and reasoning with facts and rules. Other sensory faculties such as the touch and smell also produce messages to be appropriately processed by the mental faculties. The information processing machine has the potential to enhance one's mental faculties. Those who use these machines can enhance their mental faculties, produce more goods and exert greater power and control in society. Unless the overall opportunities grow at a faster rate, the potential for others will continue to diminish. Examples of these are given below in items *a* to *d*.

An information machine consists of a computer, a knowledge base of data and models, and a mechanism for controlling the operations. Control of operations includes the selection and application of data and models relevant to a situation. There is indeed no doubt that the information machine, when

used properly, serves to increase human productivity. The machine helps to organize and store the information needed to generate responses to events in the environment, select required information from thousands of stored pages, and scan for specific items from hundreds of pages in a matter of seconds.

Machines have a potential for benefit as well as detriment. Benefits come from one's ability to enhance the mental processes. Detriment lies in letting the machine take over one's normal mental processes. With proper use, an information machine may be visualized as a mind expander. Because of the unlimited potential that these machines offer, uses and abuses of information technology are likely to be far more profound than those brought about by the industrial revolution. Consider the following examples:

a. Planning, control, and review of complex business and government enterprises requires vast amounts of rapidly accessible information. Those who have information technology can run the enterprise productively, increase their ability to produce more, enhance quality, and use less resources. They can, thus, dominate their competitors quantitatively, qualitatively, and intellectually.

b. An architect, an engineer, or an accountant may be able to do high quality work better than ten architects, engineers, or accountants, respectively by using the information technology. The other nine architects, engineers, or accountants thus replaced must adapt or be eliminated.

c. The rapid changes occurring in information technology create rapid obsolescence, and new learning requirements. There may be many who are not educated enough to adapt to this rapid change.

d. Products of information technology which successfully model human mental faculties may gradually take over the work in many areas of human services, with possible intimidating situations.

Each example points to the benefits for those who can make timely and effective use of information technology. However, the same technology becomes detrimental to those who are unable or unwilling to deal with it effectively.

IV. Knowledge Engineering Concepts

The basic material of knowledge engineering is information, in raw and refined form. This information consists of descriptions of object types covering

their explicit and implicit attributes and instances. Alternatively, we may say that an object type is described by some 'relevant' attribute names, whereas a specific instance of an object defines attribute values. Frequently, one may use the term object to refer to object name, attributes to refer to attribute names, and values to refer to instances.

As an example, consider a patient in a hospital. Here, one of the object types is patient, and the other is hospital. For the patient, the relevant attributes may be name age, symptoms, history, etc. A specific instance may be John Adams, 33, fever, none, etc. The choice of attributes for an object depends on what information needs to be represented. Furthermore, one must consider how this information should be structured to properly satisfy the requirements of the applications dealing with the objects. The extent to which an object is described depends both on our understanding about the object and the assumed context of the application.

The process of abstracting the attributes of an object may be difficult, particularly in the absence of any prior experience with it. Furthermore, the notions of how an object type should be described may change with time due to changes in our understanding about the object, or changes in the application context. One must also consider ways of collecting attribute values, and keeping them current, possibly maintaining a history of these values. For example, the current value of weight attribute may be relevant for a patient but so may be the previous history of the weight values, i.e, how the weight has been changing between checkups. It is not always possible to define precisely what attributes may describe an object adequately unless one is an expert on it. Previous knowledge about the object can be quite helpful in making the right choice.

Consider the first lesson in knowledge engineering given to Adam by God, and described in the Qur'an as: "And taught Adam the names of things." [Qur'an 2:31-33.]. It appears that in this lesson a process of synthesis of knowledge was in the making: patterns were in motion, and recognition was in action. This was the first phenomena that involved the human mind in abstracting the attributes and assigning names to things based on those perceived attributes. The Qur'an describes knowledge and the principles and tools of knowledge engineering as:

- *'Ilm al-Yaqīn* [Qur'an 102:5], certainty or knowledge gained from reasoning and inference.
- *'Ayn al-Yaqīn* [Qur'an 102:7], certainty or knowledge gained from sight (from the senses), and
- *Ḥaqq Al-Yaqīn* [Qur'an 69:51], certainty or knowledge that is absolute in truth, not subject to alternation from knowledge received through sense perceptions, reasoning, or inference.

The first two items are related to the knowledge that is acquired, and the third item points to the knowledge revealed to mankind through the ages.

Description of an object is not simply as to what it is, but also what capabilities it may have. The capabilities describe the operations the object permits, as well as those it can perform, resource requirements, and constraints. An object may be manipulated by some objects, and it may manipulate some of them. The extent of an object description, and the ability to acquire instances of this description, determine the scope of the responses which may be generated when events related to the object occur in the application environment. All these considerations are relevant to engineering useful knowledge about an object.

The product of knowledge engineering is a system consisting of a knowledge base structure, an interface for knowledge acquisition and user queries, and a mechanism for activating the knowledge base in order to generate responses all residing in a special or general purpose computer. Knowledge engineering deals with the concepts, tools, and techniques for describing the objects, structuring the description for acquiring and maintaining information, and developing mechanisms for sequencing of the operations [6, 7, 18, 21]. It also deals with the mechanisms for creating, mutating, and deleting the objects. The processor in the computer provides the raw power, fueled by the data and logic components of the knowledge base, to work as a knowledge engine.

Speaking broadly, and sounding somewhat futuristic, one may define the goals of knowledge engineering as:

- Creating intellect from knowledge, i.e., creating a machine that could reason as a philosopher, offering new insights into historical and contemporary events.
- Creating mind inside matter, i.e., creating a machine capable of independent thought.

We will elaborate these goals further in the sections that follow.

V. Role of Knowledge Engineer

A knowledge engineer is responsible for creating a mirror image of a particular reality, i.e., creating an authentic model of what exists in the application domain. This work requires discovery of what the reality is or how it is perceived, developing a representation consistent with the events

and responses in the real world, and maintaining the integrity of the representation. In order to perform this task, the knowledge engineer must understand the science of knowledge, and the manner of its application.

Knowledge comes through observations, reasoning, and reflection. There are two categories of knowledge– axiomatic and empirical. Axiomatic knowledge deals with the possibility of possible things, and the impossibility of impossible things. Given an event, and axiomatic knowledge about it, one may describe a definite response. Empirical knowledge, on the other hand deals with observation and experimentation. Given an event, and only empirical knowledge about it, one may develop a response based on experience.

In performing an analysis of the situation which is to be modeled, the knowledge engineer is required to use all sources of information, to discern specifics of the application domain, and to describe the knowledge thus gained. Generally, the knowledge engineer, or in this phase of the work one may call him the knowledge analyst, is not the creator or user of the knowledge in the application domain. He must refer to those who can validate his knowledge of the application domain. This requires tools and techniques of communication, and their use in a manner which encourages the vocalization of pertinent information. The purpose of the validation process is to remove ignorance about the application domain, and generate the knowledge for modeling and representation of the reality.

Systems built on ignorance about the domain of application either fail completely, or perform very poorly. However, at times it may be necessary to build a system based on incomplete knowledge. This deficiency may be overcome by a mechanism which explains what knowledge was used, and how it was used in generating the response to some event. In this case, the user must have the knowledge to assess the validity of the response in a given situation. The explanation facility also indicates the need for further knowledge acquisition whenever it becomes necessary. Most application domains are dynamic in nature, i.e., data values are affected by aging, and the applicable policies are affected by changes. The knowledge engineer plays a key role in maintaining system integrity with time.

The internal design of a knowledge engine, or knowledge based system, determines its space and time characteristics. One may assume that the purpose of the system is to augment human capabilities, and increase productivity of the operations. The knowledge engineer is, therefore, responsible for providing the facilities for the users to interact with the system. This interaction should allow the users to maintain their normal intellectual thought processes. The subservience, if there is to be one, should be of the system to the user, and not the other way around.

VI. Knowledge Based Systems and Artificial Intelligence

One may describe knowledge as a collection of facts and heuristics. Facts represent that part of knowledge which is widely shared, publicly available, and generally agreed upon by experts in a field. Heuristics, on the other hand, represent that part of knowledge which is mostly private, little discussed rules of plausible reasoning, good judgment, and good guessing.

Knowledge based systems store facts and heuristics for making inferences about situations. If the facts and heuristics normally used by an expert are acquired and properly represented in a system, then such a system is called a knowledge based expert system [5, 7], or simply an expert system.

Artificial intelligence is the study of mental faculties through the use of computational models [2]. If what the brain does can be modeled as a computation then the work in artificial intelligence will successfully duplicate the human mental faculties. For example, the models of human mental faculties in vision and natural language are useful in building systems for machine vision [9, 17] and machine processing of natural language [4]. Also see examples of such applications in [3, 10, 12, 13, 14]. All humans, not just the experts, have these faculties. The tools and techniques of artificial intelligence are used in building intelligent systems based on human mental faculties.

The work in psychology, dealing with the study of human mind, has influenced the direction of work in artificial intelligence. Looking at what the psychologists have to say, about the human mind, may help one better understand the current work and future trends in artificial intelligence. According to the theory of behaviorism in psychology, all human behavior can be described in terms of a cause and effect relationship between the stimuli from the external events and the responses. Once this relationship is understood and described in the form of a stimulus-response mechanism, it then becomes possible to predict and control human behavior. First definitive work on this subject was published by Watson who said [19]:

> Psychology as the behaviorist sees it is a purely objective, experimental branch of natural science. Its theoretical goal is the prediction and control of behavior. Introspection forms no essential part of its methods, nor is the scientific value of its data dependent upon the readiness with which they lend themselves to interpretation in terms of consciousness. The behaviorist, in his effort to get a unitary scheme of animal responses, recognizes no dividing line between man and brute.

Behaviorism however, has not succeeded in producing a theory of behavior that is applicable in all situations [8]. Nonetheless, it continues to play a major role in situations requiring behavior modification.

Cognitive psychology introduces the notion of thinking, i.e., people interpret the external stimuli by a thought process in order to produce a response. The passive cause and effect relationship advanced by the behaviorist is, therefore, not applicable to human behavior in all situations. The cognitive psychologist distinguishes the human from the other animals. It is, however, not clear whether the human ability to interpret, as seen by the cognitive psychologist, allows for the possibility of directing one's actions, known as free-will, without constraint by necessity or fate.

One may summarize the cognitive psychology model of the human mind in terms of the following features:

- The mind has operationally definable mediators (Logical Behaviorism),
- The mind has a central mechanism for mediators (Central Cognitive Process – Subprocesses),
- Central mechanism is not reducible to behavioral or peripheral terms (Contemporary Cognitive Behaviorism, or Information Processing Approach).

Contrast this model with the classical references to the human mind as the *tabula rasa*, i.e., the human mind is a blank tablet at birth, and the sense experience is the only source of knowledge.

In the Qur'an the words from God are: "When I fashioned him (in due proportion) and breathed into him My Spirit." [Qur'an 15:20]. Breathing of God's spirit implies giving the faculty of God-like knowledge and will. Rightly used, it distinguishes man from other creatures. The Qur'an, therefore, invalidates the common interpretation of *tabula rasa*. The cognitive psychologist seem to have come to the same conclusion in their own studies of the human mind. We may further add that the sense experience is the external source of knowledge, and this knowledge may be internally manipulated in ways that is not always predictable or reducible to behavioral or peripheral terms.

B.F. Skinner in his book, *Beyond Freedom and Dignity*, says: "We are all simply a product of the stimuli we get from the external world. Specify the environment completely enough and you can exactly predict the individual's actions." [15]. This can only be true however, if the individual does not properly use the free-will given to him by God and allows himself to be blindly shaped by the changes in the environment. Bruno Bettelheim in his book, *On the Uses of Enchantment*, sounded a positive challenge for the human mind when

he said: "If we hope to live not just from moment to moment, but in a true consciousness of our existence, then our greatest need and most difficult achievement is to find meaning in our life."

The fields of psychology and artificial intelligence will continue to cross-fertilize. Of course, a theory in psychology about the human mind does not mean that the mind actually works that way. It is important to make this distinction. Furthermore, a machine built on models of the human mind is just that, i.e., it exhibits intelligent behavior but does not necessarily duplicate human intelligence. With increasing intelligence in the model, the reality may still be distinctively different. The work in artificial intelligence does not claim that its goal is to produce methods which duplicate exactly those of the people [2]. Its goal is to build systems which exhibit intelligent behavior, solving problems in ways that resemble those of the humans. Again, it is important to make a distinction between a machine which exhibits intelligent behavior and an intelligent human being. It is necessary to keep the humans ahead of the machines, retaining the challenge to improve the machines.

VII. Development of the Human Mind

Our interactions with the environment are permanently recorded in our mind via the sense perceptions. Roger Penrose, a well known mathematician once said: "The world is an illusion created by conspiracy of the senses [15]. Our mind stores the information received from the senses in a variety of ways. All of this information can be recalled under appropriate conditions. This is a working premise of knowledge engineering. The stored information appears to not depend on the language in which the information is transacted.

Consider now what is said in the Qur'an about the sense perceptions:

- That day shall We set a seal on their mouth but their hands will speak to Us, and their feet will bear witness, to all they did. (Qur'an 36:65).
- Their hearing, their sight, and their skins will bear witness. (Qur'an 41:20).
- On the day when their tongues, their hands, and their feet will bear witness against them as to their actions (Qur'an 24:24).

Thus, the skin sends signals (speaks) to the brain from the senses of touch, taste and smell, as does the eyes on seeing and the ear on hearing. The mind can recall these signals and vocalize them in any spoken language.

The term nafs (soul) is used in the Qur'an in a manner cognate to the human mind. Consider the following quotations:

- Who created you from a single person. (Qur'an 4:1).
- No soul can believe except by the Will of God. (Qur'an 10:100).
- And the soul and the proportion and order given to it. (Qur'an 91:7).
- Do they reflect not in their own mind. (Qur'an 30:8)
- Soul prone to evil. (Qur'an 12:53).
- Self reproaching soul. (Qur'an 75:2).
- Righteous (at rest and satisfied) soul. (Qur'an 89:21).

The above characterizations in the Qur'ān point to various aspects of the development of the human mind.

VIII. Trends in Knowledge Engineering

Earlier work in the use of computers for knowledge engineering was limited to areas of axiomatic knowledge, facts consisting of data and computations. In scientific and business applications, many situations allowed descriptions of planned responses to events in the environment. These early systems were called information processing systems, or simply information systems. Gradually, the developments in information technology and the understanding of its potential in human productivity, resulted in emphasis on building systems to support decision making [11]. Often, the decision making situations cannot be described fully in terms of cause and effect relationships. The system, therefore, consists of data, models, and interfaces to interact and produce ad hoc responses which the people could analyze and choose for making decisions. These systems are called decision support systems. In many situations decisions are based on plausible reasoning, more a matter of good judgement on the part of an expert. These expert's knowledge may be represented using the tools of artificial intelligence. Systems based on this knowledge, detailed and specific to a domain of application, are called expert systems. All of the above mentioned systems may be considered as instances of knowledge based systems, created to serve the potential users.

Acknowledgements: The author gratefully acknowledges the contribution of Nejma Natalie Heisler who gave many suggestions regarding the contents, and the style of presentation.

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Use of Islamic Beliefs in Mathematics and Computer Science Education

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Abstract

This paper illustrates the use of Islamic Beliefs and fundamentals in the teaching of mathematics and computer science. Examples are drawn from symbolic logic, data structures and programming in Pascal language. *Sūrat al 'Aṣr* is taken up as a case study. A "Muslim Scientist" is a Muslim and a scientist. The two must go together in an environment which, on one hand, brings up the Islamic identity of the scientist and stimulates the Muslim to explore and observe. On the other hand, the education of a Muslim scientist, thus far, has been in two mutually disjointed environments of Islam and science. The first and foremost place for the Islamization of a scientist is an institute of learning. But this can only be achieved if we have the right textbooks. This paper gives concrete examples of what can be accomplished in the above mentioned areas.

Introduction

In this paper, we illustrate the use of Islamic beliefs and fundamentals in the areas of mathematics and computer science. We are specifically interested in the areas of symbolic logic, data structures and programming in Pascal. Symbolic logic provides a basis for theorem-proving. Propositions and truth tables are an integral part of every course in mathematics. Symbolic logic also plays an important role in the design of computer hardware. Modern computers process binary digits called bits, which are also the basis of 2-valued logic. A bit is either 0 or 1. Symbolic logic and its applications are normally

a part of a course on discrete mathematics, which is usually taught in the undergraduate curriculum of computer science. Pascal is the most popular programming language in computer science and is used to teach introductory courses. Computer programs are made up of algorithms and data structures. An algorithm[1] can be viewed as an abstract solution to a problem. Data structures implement an algorithm to a computer program. A separate course in data structures is also offered in the undergraduate curriculum of computer science.

The primary objective of any Muslim is of course to live the life of a Muslim. This objective should in fact help a muslim scientist achieve superiority in science and technology. A Muslim scientist, however, is not clear about his goal in life. He is also not clear how his being a Muslim has anything to do with his being a scientist. The root cause of this problem of perception lies in the education of a muslim scientist. The education of a muslim scientist, thus far, has been in two mutually disjointed environments of Islam and science. We must create an environment which, on one hand, brings up the Islamic identity of the scientist and stimulates the Muslim to explore and observe, on the other hand. Schools of religion and the sciences must get together and join hands to reinforce each other. We must create institutions where the education of Qur'an, Hadith, and Sharī'ah goes side by side with the education of mathematics, physics, chemistry, biology, computer science, engineering, economics, and other sciences. To this end, we also need textbooks which teach Islam and draw examples from the sciences, and textbooks which teach science and draw examples from Islamic beliefs and fundamentals. In this paper we illustrate the use of Islam in the teaching of mathematics and computer science in the aforementioned areas. *Surat Al-Aṣr* is taken up as a case study.

I. Symbolic Logic:

A proposition is a sentence which can be assigned one of the truth values-true or false. The study of propositions falls under propositional calculus and 2-valued logic. Symbols are used to represent propositions. Some examples of propositions are given below.

[1]The word *algorithm* was earlier known as *algorism*. It comes from the name of a famous Arabic scientist, Abu Ja'far Muhammad Ibn Musa Al-Khowarizmi. Khowarizm is, today, the small Soviet city of Khiva. Another word "algebra" also stems from the title of his book, *Kitāb al-jabr w'al-muqābalah*.

1. Khalil is a Muslim.
2. Islam is a complete way of life.
3. I shall perform hajj and *'umrah*. (an example of an exclusive) or;
4. If it rains then I shall pray at home.

Some examples of sentences which are not propositions are the following.

5. Are you going to the Masjid?
6. A Muslim is obligated to pray x times a day.

We use logical connectives "not", "and", "or", "if . . . then . . .", and others to form compound propositions. The truth values of compound propositions are given by giving a truth table. The following table defines the logical connective "and". The symbol $\wedge$ is used to denote "and". Let p, q denote propositions.

Table 1

Truth table for "and"

p	q	p ∧ q
F	F	F
F	T	F
T	F	F
T	T	T

T = true, F = false

Similarly the truth tables for other logical connectives can be defined. We shall use the symbols v, > to denote "or" and "not", respectively. These logical connectives satisfy various properties. One such property is known as DeMorgan's law. In symbols, it can be expressed as follows.

DeMorgan's Law: $>(p \wedge q) = >p = v >q$

In words, it states that the negation of a conjunction is the disjunction of the negations. Now the four conditions mentioned in Surah Al-Asr can be stated in the following form.

Let i, r, p, and s be the following propositions.

i: He accepts Islam.
r: He performs righteous deeds.
p: He preaches the truth.
s: He is steadfast and preaches persistence in truth.

Then, according to the Surah, we express success as

$$\text{success} = = i \wedge r \wedge p \wedge s.$$

By DeMorgan's law, the failure can be expressed as

$$\text{failure} = \text{not success} = > (i \wedge r \wedge p \wedge s) = > i \vee > r \vee > p \vee > s.$$

The truth table for "and" tells us that we are successful only when all the propositions i, r, p, and s are true. By DeMorgan's law and the definition of "or", we fail if any one of the four conditions is false. We can construct a "tree" to represent and understand success and failure as shown in Tree 1. Every left branch in the tree associates false value to the proposition, and every right branch corresponds to the true value of the proposition. Thus, we see that success is true only when all four propositions are true. In all the other 15 cases, success is false. The word failure is used to express "loss" (*khusr*) of the Surah. The tree can be used to answer such questions as

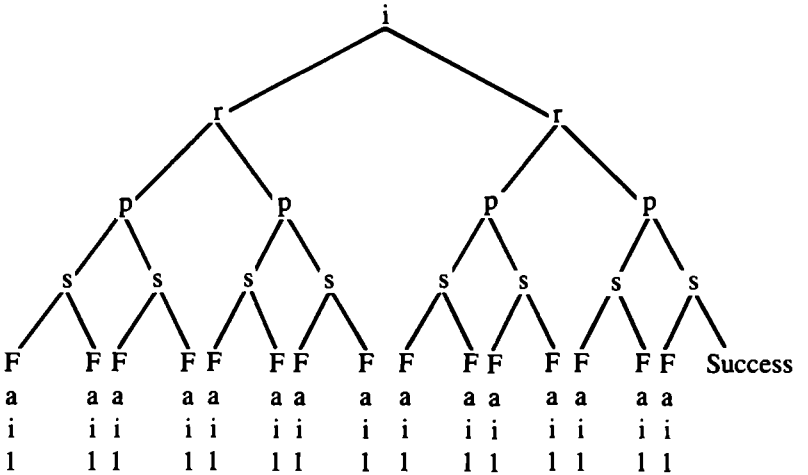
> "What can we say about a man who does not accept Islam but his deeds are righteous, he preaches truth and is steadfast in his struggle?"

One can answer that he is at a loss, since the basis of everything else is belief which is not there. It can also be argued that there is no such thing as righteous deed without the right belief, and so on.

Questions such as the following may be hard to answer, in general.

> "What about a person who has Īmān and whose deeds are righteous, but other two qualities are missing?

The tree clearly shows that such person is at a loss. Of course further interpretation is needed to understand the Surah in its entirety. Here we are concerned with the presentation of the Surah in a new form.



Tree 1

Tree representation of success and failure

We can further elaborate the four conditions of the Surah as follows. Some of the crucial features of our belief as a Muslim can be represented by using additional propositions. In what follows, words preceding ":" are used as propositional variables. The five articles of faith can be stated as follows. See (M) as a reference.

God: He believes in one Allah who has absolutely no associates with Him in His divinity.

prophets: He believes in Allah's prophets, and in Muhammad as His final Messenger.

books: He believes in all God's books, and in the Qur'an as His last book.

Similarly, we can define propositions **angels** and **hereafter**. Then the proposition i, defined above can be viewed as

$$\mathbf{i} = \mathbf{God} \wedge \mathbf{prophets} \wedge \mathbf{books} \wedge \mathbf{angels} \wedge \mathbf{hereafter}$$

Thus belief is the conjunction of the belief in one god, all prophets, and so on. The proposition r which represents the righteous deeds of a person can be further broken down as follows.

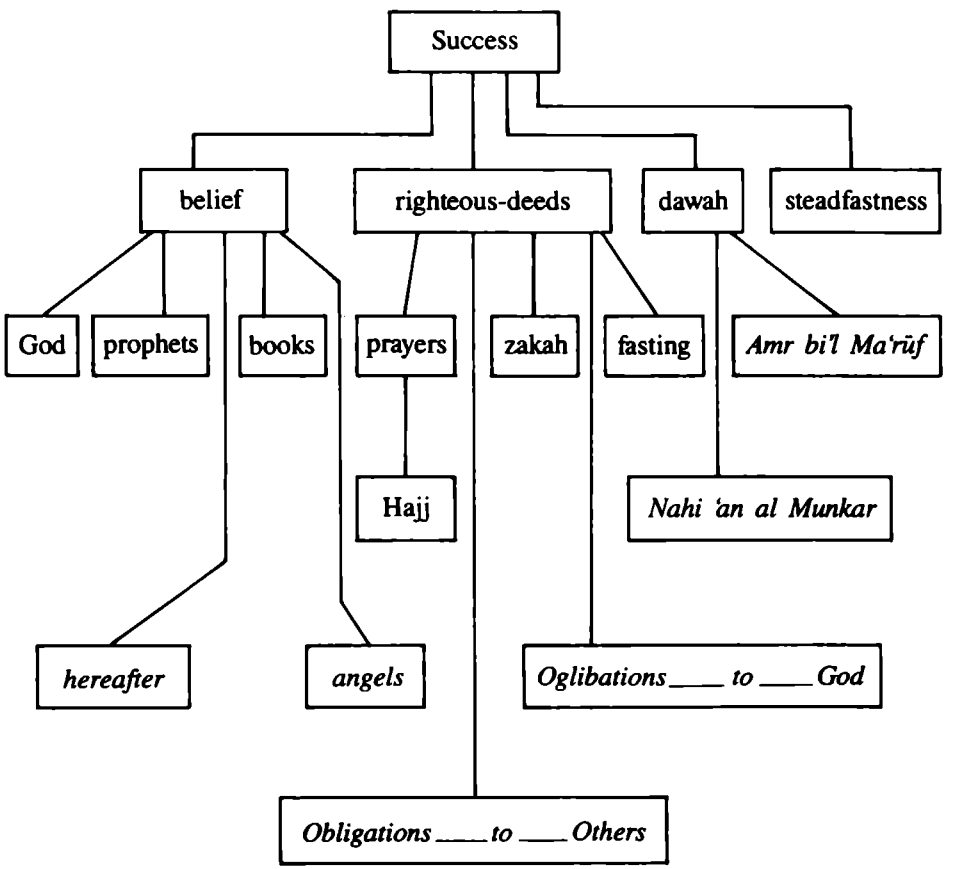
r = prayers ∧ zakah ∧ fasting ∧ hajj

Obligations ____ to ____ God ∧ Obligations ____ to ____ Others

Similarly, the proposition **p** which represents dawah can be expressed as

p = *al Amr bi'l Ma'rūf ∧ al Nahy 'An al Munkar.*

Then a hierarchical representation of success can be exhibited in the form of another type of tree as shown below (Tree 2).



Tree 2
Success as a hierarchy

An introductory study of symbolic logic and discrete mathematics can be found in (Z). We now turn our attention to programming language Pascal and data structures.

Pascal and Data structures:

Pascal is a widely used programming language in U.S. institutions. Introductory courses in computer science are taught with programming in Pascal. See (CC) as a reference for the language. A boolean variable in Pascal can take on a value of true or false only. Therefore, a boolean variable can be identified with a proposition. Success and failure can then be simply viewed as boolean variables, and can be declared as

var **success, failure:** boolean;

In more elaborate form, we shall consider the four conditions of *Surat al 'Aṣr* and continue our discussion from symbolic logic. Data structures help us organize our data in a form suitable to our abstract view of the information we are trying to represent in a computer. Programming languages usually provide a syntax to define data structures. Our first example relates to the belief of a person. In Pascal, we can define it as follows. Anything enclosed in { } is a comment to illustrate the syntax and the purpose of the variable.

```
type

belieftype = record

    gods: integer;
      {In how many gods do you believe in?}
    prophets: (none, one, some, all);
      {Do you believe in all the prophets?}
    angels: boolean;
      {Do you believe in angels?}
    books: (none, one, some, all);
      {Do you believe in all the divine books?}
    hereafter: boolean;
      {Do you believe in the hereafter?}
    end; {belieftype}
```

The above data structure provides us with a template which can be represented as in Figure 1, below.

gods	prophets
angels	books
hereafter	

Figure 1

Template for belieftype

Belieftype is an example of a simple data structure, record, which is standard in Pascal. If we assume a variable **belief** of **belieftype**, then by using the template of Figure 1, we can represent the beliefs of an atheist and a muslim as shown in Figure 2(a) and (b). A Pascal code to represent the belief of a muslim is as follows.

```
with belief do begin
        gods: = 1;
        prophets: = all;
        angels: = true;
        books: = all;
        hereafter:true
end;
```

0	none
false	none
false	

(a) Atheist's belief

1	all
true	all
true	

(b) Muslim's belief

Figure 2

Representation of deeds of a person can be similarly achieved. We can define the following Pascal record.

```
type

    deedstype = record
        prayers: integer;
    (This records the number of prayers performed during a day.)
    zakah: boolean; {Do you pay zakah?}
    fasting: boolean; {Do you fast in the month of Ramaḍān?}
    hajj: boolean; {Have you performed hajj?}
    Obligations ____ to ____ God,
    Obligations ____ to ____ Others: boolean; {Do you perform other
        obligations to God and creatures?}
    end; {deedstype}
```

Other two conditions of the Surah, preach the truth and be steadfast can simply be defined as boolean variables. Either a person observes these conditions or he does not. If he does observe these two conditions, we set the corresponding variables true, else we set them false.

Putting all the four conditions together, we can define success as a record of records and booleans as follows. We first define a **resulttype** and then declare **success** as a variable of that type.

```
type
    resulttype = record
    belief: belieftype;
    deeds: deedstype;
    dawah: boolean; {Do you preach the truth?}
    persistence: boolean; {Do you preach persistence?}
    end; {resulttype}

var success : resulttype;
```

The above examples can be used to illustrate the syntax of record types and variables. It can also serve to illustrate the generalized with statement as shown below. We initialize **success** as follows.

```
with success, belief, deeds do
    begin
```

gods: = 1;
prophets: = all;
angels: = true;
books: = all;
hereafter: = true;
prayers: = 5;
zakah: = true;
fasting: = true;
hajj: = true;
Obligations ____ **to** ____ **God:** = true;
Obligations ____ **to** ____ **Others:** = true;
dawah: = true;
persistence: = true;

end;

A simple program can be written to determine whether what a person is doing will make him successful or not. The program may be appropriately named *iḥtisāb*. The program interactively asks the user a series of questions at the end of the day. Based upon the answers to the questions, the program tells the user whether his day was a success or failure. Or it can further go into the areas where the person was deficient that day and tell the user to improve upon those areas. We shall omit any details.

Conclusion:

The simple examples given above are rich enough to draw certain conclusions. We list our conclusions below.

1. Textbooks can be written to teach science, at least in some areas, which carry an Islamic flavor. These textbooks can help a young scientist get a sense of his ideology and feel at home while studying science.
2. From an entirely opposite angle, scientific methods can be used to illustrate teachings of Islam in new ways and forms which can help us better understand Islamic concepts and ideology.
3. We need institutions which offer studies in Qur'an, Hadith, and Sharī'ah as well as studies in science and technology in a mutually reinforcing environment.

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A Blueprint for the Islamization of Attitude and Practice in Earth Sciences with Special Emphasis on Groundwater Hydrology

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A Blueprint for the Islamization of Attitude and Practice in Earth Sciences with Special Emphasis on Groundwater Hydrology

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Abstract

Earth science—a branch of the natural sciences—consists of the study of the earth. Hydrology, an earth science that relates to water, is concerned with the occurrence of water in the earth, and its physical and chemical reactions with the rest of the earth. The central concept in the science of hydrology is the hydrologic cycle denoting the circulation of water between ocean, atmosphere, and land. The science of hydrology involves the development of accurate and practical methods of making measurements of the quantities and rates of movement of water at all times and at every stage of its course, and the accumulation and compilation of the great mass of resulting quantitative data. Finally, it is concerned with making rigorous studies of all the base data to determine the principles and laws involved in the occurrence, movement, and effect of the waters in the hydrologic cycle.

All earth science and hydrology curricula offered at colleges in the Muslim countries do not mention the Creator despite the abundant signs of His infinite ability and power throughout the universe. The Islamization of these sciences should therefore begin by making Allah's guidance, as revealed in the glorious Qur'an, an integral part of the educational system.

In this paper, few verses from the Qur'an are quoted to indicate that earth sciences and hydrology are not alien to Islam. The concept of the hydrologic cycle is formulated in light of the Qur'an. We present a detailed step by step approach describing how the Islamization of attitude and practice of earth sciences and hydrology can be achieved. A concise program is outlined

to carry out the Islamization process. The proposed program requires the effort of between fifteen to thirty hydrologists, with support staff, working almost full time for up to five years. The total cost for such an effort would vary depending on the cost of living and pay scale, etc., in countries where most of the work will be performed but would be at least $500,000 annually. Because Islam is a comprehensive religion we need to emphasize the importance of adhering to its teachings in all aspects of our lives. Only then can the Islamization of attitude and practice in any profession be achieved.

Introduction

Groundwater hydrology is defined as the science of the occurrence, distribution, and movement of water below the surface of the earth. Groundwater occurs in many types of geologic formations; those known as aquifers are most important. An aquifer may be defined as a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs. Groundwater accounts for over 95% of the usable freshwater resources of the world. The study of groundwater requires knowledge of many of the basic principles of geology, physics, chemistry, and mathematics. For example, the flow of groundwater through porous media depends on the three-dimensional configuration of geologic deposits through which flow takes place. Therefore, the groundwater hydrologist or geologist must have some background in the interpretation of geologic data and environment. An understanding of the nature of surficial deposits and landforms is of particular importance of students of groundwater, because a large percentage of groundwater resource development takes place in the unconsolidated surficial deposits created by fluvial, glacial, deltaic, and aeolian geologic processes.

While geology provides the qualitative knowledge of the framework of flow, physics and chemistry provide the tools for quantitative analysis. Groundwater flow is analogous to heat and electrical flow. The flow of groundwater is governed by the laws of fluid mechanics. The analysis of the natural chemical evolution of groundwater and of the be havior of contaminants in sub-surface waters require use of some of the principles of inorganic and physical chemistry. Principle and techniques from the field of nuclear chemistry, e.g. naturally-occurring stable and radioactive isotopes, are being used to determine the age of water.

Mathematics is a principal tool of groundwater hydrology. The mathematical methods upon which classical studies of groundwater flow are based were borrowed by the early hydrologists from areas of applied

mathematics originally developed for the treatment of problems of heat flow, electricity, and magnatism. With the advent of the digial computer and its widespread use, many of the important and relatively recent advances in the analysis of groundwater systems have been based on numerical methods. In recent years, groundwater hydrologists have become increasingly aware of the need to describe the spatial variability of aquifer properties in statistical terms. This has led to the development of new theoretical models whose parameters, representing the aquifer characteristics, are treated as stochastic variables rather than deterministic functions of space.

I. An Islamic View of Earth Science and Hydrology

Most Muslim scholars would agree with the conclusion made at the 1982 Islamabad Conference on the Islamization of Knowledge that natural, physical, and medical sciences, and engineering and technology of today are void of Islamic attitude and spirit. What is puzzling is that the educators themselves lack the Islamic vision that would enable them to develop an Islamic attitude in their students.

In the case of earth science, references to the elements constituting this science including components of the hydrologic cycle are prevalent in the glorious Qur'ān. Yet, few Muslim geology professors remember to quote verses from the Qur'ān such as the following one when introducing the subject to their students:

> Behold! In the creation
> Of the heavens and the earth;
> And the alternation
> Of the Night and the Day;
> In the sailing of the ships
> Through the Ocean
> For the profit of mankind;
> In the rain which Allah
> Sends down from the skies;
> And the life which He gives therewith
> To an earth that is dead;
> In the beasts of all kinds
> That He scatters
> Through the earth;
> In the change of the winds,

And the clouds which they
Trail like their slaves
Between the sky and the earth;
(Here) indeed are Signs
For a people that are wise.

(Qur'an 2:164)

The hydrologic cycle is a useful concept which is introduced to begin the study of hydrology. The nature of the hydrologic cycle is simple. As the water circulates over the earth through this grand cycle, usable water is accessible only while it is on the land surface or in the ground.

Let us now examine how elements of this simple cycle are depicted in the Holy Qur'ān.

"See ye not
How Allah has created
The seven heavens
One above another,

"And made the moon
A light in their midst,
And made the sun
As a (Glorious) Lamp?

(Qur'an 71:15-16)

Through the energy provided by the sun, water evaporates from the land and ocean, is carried as vapor in the air, falls somewhere as rain or snow, and returns to the ocean or to the land again to go through the same process.

Allah (SWT) says:

It is Allah Who sends
The Winds, and they raise
The Clouds: then does He
Spread them in the sky
As He wills, and break them
Into fragments, until thou seest
Rain-drops issue from the midst
Thereof: then when He has
Made them reach such
Of His servants as He wills,
Behold, they do rejoice! –

(Qur'an 30:48)

Part of the precipitation accumulates and moves as streams and rivers. In *Surah* 14, *Āyah* 32 the Creator (SWT) tells mankind: ". . . and the rivers (also) hath He made subject to you," and He (SWT) also says in *Surah* 16, *Āyah* 15:

> And He has set up
> On the earth mountains–
> Standing firm, lest it should
> Shake with you; and rivers
> And roads; that ye
> May guide yourselves;–
>
> (Qur'an 16:15)

Substantial amounts of water evaporates back to the atmosphere. A small percentage of the water remaining on the earth's surface infiltrates into the soil layers and part of this water not used by plants percolates and accumulates under favorable hydrogeologic conditions forming groundwater reservoirs or aquifers. *Āyah* 18 in *Surah* 23 invites mankind to reflect on the devine Beneficence and Wisdom:

> And We send down water
> From the sky according to
> (Due) measure, and We cause it
> To soak in the soil;
> And We certainly are able
> To drain it off (with ease).

Finally, *Āyah* 22 in *Surah* 15 reminds man that he has no control over the original sources of water:

> And We send the fecundating winds,
> Then cause the rain to descend
> From the sky, therewith providing
> You with water (in abundance),
> Though ye are not the guardians
> Of its stores.

The verses quoted above indicate that the basic building blocks and vocabulary for the earth sciences including hydrology are not new to Islam. The Islamization of these sciences should therefore begin by returning to the teachings of the Qur'an. Such efforts, however, require full time attention starting with a detailed program to effect and implement needed changes as explained in the next section.

A Step by Step Program for the Islamization of Earth Science and Hydrology

The preliminary program outlined below is suggested as a framework to guide the Islamization of earth science and hydrology. It is expected that other scientists will revise and modify this program as work proceeds. The program includes nine steps that are as follows:

1) Plan and initiate a serious translation of major earth science and hydrology non-Arabic books into the Arabic language. The table below gives a tentative schedule and staffing requirements to carry out this step.

Table – Schedule and Manpower Requirements for a Translation Committee

Action/Task	Time to Complete a Task	Manpower
1. Form the Committee	6-12 Months	3-7
2. Select reference books	3-6 Months	3-7
3. Translation phase	2 to 5 Years	15-30
4. Review and editing	1 to 2 Years	15-30
5. Type Setting & Publication	1 Year	10

2) Compile and issue earth science and hydrology dictionaries to enrich the technical vocabulary of the Arabic language.

3) Prepare and write new earth science and hydrology college and graduate level books that emphasize the unity of knowledge as perceived in Islam. This stage may be pursued simultaneously with the previous two steps.

4) The above three steps require considerable planning, technical expertise, organization, movement, and adequate funding. Consequently, an organizational body, e.g. an institute or an agency to be entrusted with the above and other related tasks should be established in the United States with branch offices in a few Muslim countries.

5) Increase cooperation among geologists and hydrologists in the Muslim world and those in North America. After all the success of the Islamization process depends on the efforts

expended by these professionals in implementing it at institutions in their countries. Programs of exchange visits and extended leaves between Muslim earth scientists in the United States and those in Muslim countries should be encouraged.

6) Arrange a meeting every two years to review the progress made in the tasks suggested above to ensure adherence to the finalized program, and to address and solve any problems that may arise.

7) Publish annual progress reports to evaluate achievements and to inform concerned geologists and hydrologists of the status of the project.

The above steps alone will not lead to Islamization of attitude and practice of professionals in any field unless accompanied by an overhaul of the educational systems in the Muslim world. The overhaul is required to instill the Islamic spirit and unification of knowledge in all curricula, and to insure that educators at all levels are themselves similarly trained. The following steps were proposed in the 1982 Islamabad meeting (Al-Arabi, 1985) and are modified and listed below for the sake of completeness of the program suggested herein:

8) Make teachings of the glorious Qur'an and the Sunnah of Prophet Muhammad (SAAS) an integral part of school and college curricula. Religious courses should be treated as important subjects in most Muslim countries in which students are not required to pass tests in religious courses in their diploma years (i.e. at 6th grade, 9th grade, etc.). College students should be required to study the history of Islamic civilization regardless of their career objectives.

9) Unify current school and college curricula used in Muslim countries; abolish the unnecessary separation of knowledge into secular and religious subjects. The spirit of Islam should pervade the emerging system.

II. Attitude of the Hydrologist

A hydrologist, or any professional, who is raised and educated according to the program outlined in the previous section is expected to practice his

profession based on the Islamic law or Sharī'ah. Two examples are given in this section to illustrate the attitude of a Muslim hydrologist.

a) Scarcity of Water Resources

Arid regions today face more difficult problems than ever before. The world's sand deserts appear to be enlarging, and droughts are contributing to the economic devastation of whole nations. The six drought-stricken Sahelian nations provide an extreme illustration, but industralized and developing countries both suffer from the crisis. The southwestern United States, for example, faces falling water tables and increasing groundwater salinity.

In managing a scarce water resource, a muslim hydrologist will be guided by the Shariah that puts the public interest above that of the individual. Therefore, he will recommend the fair distribution of available water to the community depending on the needs of its members. The hydrologist's belief in his accountability before the Creator (SWT) in the Day of Judgement will reinforce his responsibility to be unbiased as practically possible.

The hydrologist and others working with him will also be guided by traditions of Prophet Muhammad (ṢAAS) relating to this subject that can be found in sources of Islamic jurisprudence. We site a related example from *Fiqh al Sunnah*. The author of this widely quoted Arabic reference indicates that it is possible for the just ruler or governor to give certain individuals from barren lands with its minerals and waters if such an action is beneficial to the individual and to the Ummah. He also sites a number of Hadiths showing that the Prophet (ṢAAS) and the Rightly Guided Caliphs distributed unused land to strengthen the love of Islam in the hearts of newcomers and to also reclaim these lands, for the good of the community.

The large increase in population accompanied by growing demands on the earth's limited water resources will lead hydrologists with the help of Fiqh scholars to revise water laws in Muslim countries.

b) Water Law

Management of water resources in most of the western European countries and the United States is based on certain surface and groundwater laws. In the United States surface water law is a combination of both state and federal regulations, agreements and laws. The laws governing surface water are the Riparian doctrine of ownership commonly applied in the eastern United States, and the doctrine of prior appropriation used in the western United States.

The Riparian doctrine holds that the property owner adjacent to a surface-water body, has the first right to withdraw and use the water. In the prior appropriation doctrine, the first person to divert water from a surface-water body has the primary water right. Groundwater use is governed by several different types of state laws. The English Rule grants the right of absolute ownership of the water under a property holder's land, i.e. a landowner could pump groundwater at any rate, even if adjoining property owners were harmed. The American Rule introduced in 1862, stipulates that a landowner can use only a reasonable amount of groundwater and also recognizes the rights of adjacent property owners.

Attitude of the Muslim hydrologists will be governed by the Sharī'ah in which the individual property is respected without jeopardizing that of the public. Islamic water law, therefore, would be closer to the American rather than the English Rule. Muslim hydrologists would also be aware of Allah's commandment in *Surah* 7, *Āyah* 31: ". . . eat and drink, but waste not by excess for Allah loveth not the wasters".

Concluding Remarks

After a brief introduction to the science of hydrology and its basic methods we have shown how the glorious Qur'ān accounts for elements of the hydrologic cycle; a central concept in the study of hydrology. From this example we have indicated that the ample references, in the Holy Qur'ān, to elements and concepts of earth science and hydrology should be an excellent starting point for Islamizing these sciences. The detailed program suggested to achieve this Islamization process is ambitious requiring a great deal of planning, coordination and follow up. For these reasons we have proposed that the formation of an institute or an agency, to be located in the United States with branche(s) in some Muslim countries, would expedite the Islamization of science and technology. A rough estimate of funds required to carry out this task is $500,000 annually.

Islam is a comprehensive religion. Therefore, for the Islamization process to affect our attitudes and practice we must live an Islamic life at home, in school and at work. Changing the vocabulary of the sciences to reflect the guidance revealed in the Holy Quran is a necessary step but it must be accompanied by more basic reforms in our educational curricula to saturate them with the Islamic spirit. Educators at all levels in Muslim countries must be similarly trained. The unification of knowledge to reflect the unity in all creations is long overdue in the Muslim World. It may be useful in this respect to revive the role that early Muslim scholars played in the advancement of

the sciences as we know them today. Glimpses of the history and contributions of these scholars should be taught in colleges in Muslim countries.

We must also critically examine our personalities, and social habits. Our personality is void of the Islamic spirit and we need to be reminded that . . . "never will Allah change the conditions of a people until they change it themselves, with their own souls" (Qur'an 13:11). This is not the first time that the Ummah has been in such a deplorable state. However, a careful study of the history of the Muslim Ummah reveals that it was able to rebound and play a leading role in world affairs only after the return of the people and their rulers to the laws and moral teachings of Islam. "has not the time arrived for the believers that their hearts in all humility should engage in the remembrance of Allah and of the truth which has been revealed to them" (Qur'an 57:16).

As for our social habits a casual look around us will confirm our lack of understanding of: "Ye have indeed in the Apostle of Allah a beautiful pattern of conduct for any one whose hope is in Allah and the Final Day, and who engages much in the praise of Allah" (Qur'an 33:21). The example of the Prophet (pbuh) should be carefully studied and adhered to as much as practically possible. Only then will Allah (SWT) enable the Muslim Ummah to reach its destiny to be the best offering the rightly guided leadership.

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Islamization of Attitude and Practice in Embryology

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Chapter 3: Implantation

> Have We not created you from a fluid (held) despicable? Which We placed in a place of rest (uterus) firmly fixed for a period (of gestation) determined (according to need).
>
> (Qur'an 77:20-23)

The fertilized ovum by successive divisions forms a ball called blastocyst or blastula (0.1 mm in diameter). The blastula reaches the uterus from the uterine tube gently moved by the cilia of the uterine tube itself in four or five days and lays free for a further two days before it clings and gets implanted in the uterine wall. The most suitable site of implantation is the upper third of the posterior wall (Fig. 1).

Figure 1. Drawing of a sagittal section of a female's abdomen and pelvis showing a fetus in utero. The "veils of darkness" are: (1) the anterior abdonimal wall; (2) the uterine wall, and (3) the amniochorionic membrane.

Ibn Hajar al 'Asqālanī, in his book *Fatḥ al Bārī, Sharaḥ Ṣaḥīḥ al Bukhārī* writes that when the semen enters the womb, it remains for six days before it is supported by the womb. He also quotes Ibn al Qayyim (13th century) who said "When the semen enters the womb it forms a ball-like structure which remains for six days before it attaches itself to the womb."[3]

Then We placed him as a drop in a place of rest.

(Qur'an 23:13)

In this verse the word drop or *nutfa* is interpreted to mean *zygote* by Moore.[4] He further says that this interpretation is supported by another verse (LXXVII : 20) in the Qur'an which states that "a human being is created from a mixed drop." The mixed drop is interpreted as a *zygote* formed by the union of a mixture of sperm and ovum. The zygote divides to form a blastocyst which is implanted in the uterus ("a place of rest").

Created man, out of a (mere) clot of congealed blood.

(Qur'an 96:2)

Moore[5] says that an implanted blastocyst or a spontaneously aborted conceptus would resemble a blood clot.

Chapter 4: Trilaminar Embryo

He makes you in the wombs of your mothers, in stages, one after another, in three veils of darkness.

(Qur'an 39:6)

As stated earlier the staging of human embryos was not described until 1941.

The three veils of darkness were explained by the commentators of the Holy Qur'ān to be (i) the anterior abdominal wall, (ii) the uterine wall; and (iii) the amniochorionic membrane (Fig. 1.).

Al-Bar[6] has made an interesting observation and states that each of these three layers is further made up of three consecutive layers. The abdominal wall is made up of the external oblique sheet of muscle, followed by the inner oblique muscle, and the transversus muscle.

The wall of uterus is made up of the epimetrium, the myometrium, and the endometrium.

The sac layers which surround the embryo are made of the amnion, the chorion and the decidua. Decidua or pregnant endometrium does not participate in the formation of the placenta. This membrane falls during parturition

(delivery of the baby), therefore it is called decidua i.e., temporary and not permanent. It is the part that is shed during either menstruation or delivery.

Chapter 5: Embryonic Period

> Then We made the drop into a leech-like structure *'Alaqah*,
> then of that leech-like structure, we made a chewed lump.
> then We made out of the chewed lump, bones, and clothed the
> bones with flesh, then We developed out of it another creature.
> (Qur'an 23:14)

The word *'Alaqah* in the Qur'an has two meanings. One meaning is something that clings or attaches to something else. This refers to the process of clinging, attachment and implantation of the blastocyst in the compact layer of the endometrium. This amazing process is revealed to man through the Qur'ān 14 centuries ago, long before any man knew anything about it.

The second meaning of *'Alaqah* refers to a leech or blood sucker. The human embryo clings to the endometrium of the uterus, in the same way that a leech clings to the skin. In the same manner as the leech derives blood from the host, the human embryo derives blood (nutrition) from the decidua or pregnant endometrium. Figure 2, shows the remarkable resemblance between a 23-24 days human embryo and a leech. At the time of this Qur'ānic revelation in the 7th century, the physicians were not aware that the human embryo had a leech-like appearance. They could not verify this statement as there were no lenses or microscopes available.

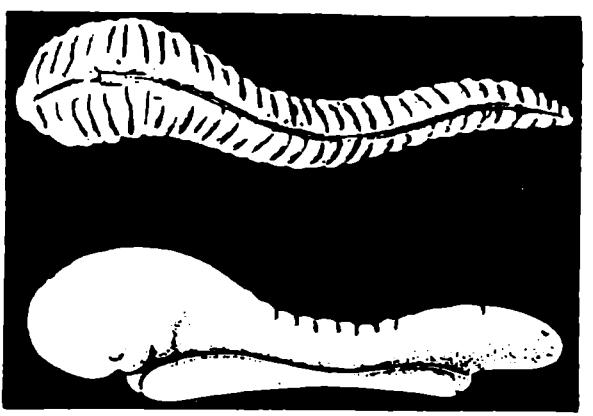

Figure 2. Top, a drawing of a leech or bloodsucker. Below, a drawing of a 24 day-old human embryo. Note the leech-like appearance of the humam embryo at this stage.

> Then of that leech-like structure (*Alaqah*), We made a chewed lump (*Muḍghah*).
>
> (Qur'an 23:14)

The Arabic word "*muḍghah*" means chewed substance or chewed lump. If one looks at a human embryo which is four weeks old, then it looks like a chewed lump of flesh (Fig. 3). The chewed appearance results from the somites which resemble teeth marks. The somites are the bases from which the greater part of the axial skeleton and musculature develop.[7]

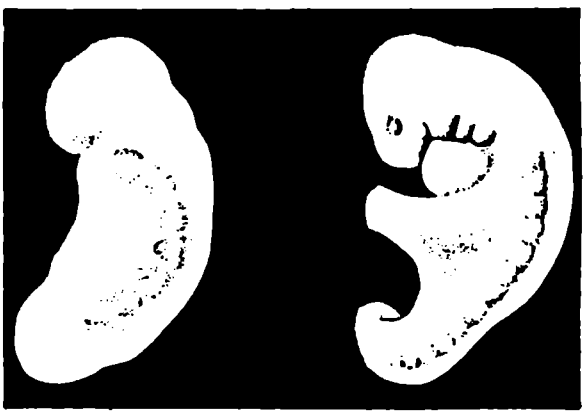

Figure 3. Left, a plasticine model of the human embryo which has the appearance of chewed flesh. Right, a drawing of a 28 day-old embryo showing several bead-like somites which resemble the teeth marks in the model shown to the left.

> The Qur'ān declares: "Then We made out of the chewed lump, bones, and clothed the bones with flesh."
>
> (Qur'an 23:14)

The bone formation precedes muscles. This is true both in the vertebral column and in the limb bones. This is astoundingly in accordance with embryological development. First the bones form as cartilage models and then the muscles (flesh) develop around them from the somatic mesoderm.

> "Then out of a piece of chewed flesh, partly formed and partly unformed."
>
> (Qur'an 22:5)

This verse indicates that the embryo is made up of both differentiated (formed) and undifferentiated (unformed) tissues. For example, when the

cartilage bones are differentiated, the embryonic connective tissue or mesenchyme around them is undifferentiated. It later differentiates into the muscles and ligaments attached to the bones.

> *Surah* 23:14 concludes with the words "Then We developed out of it another creature."

One of the arguments of the theory of Evolution is that the embryos of animals and humans look alike; therefore man evolved from lower animals.

The above quoted words of Qur'an implies that the bones and muscles result in the formation of another creature. This may refer to the humanlike embryo which is formed at the end of the eighth week. At this stage it has distinctive human characteristics and one can see that it possesses the primordia of all the internal and external organs and parts. After completion of eight weeks, the human embryo is classified as a fetus. The Qur'anic verse may be referring to this as the new creature.

> "And He gave you hearing and sight and feeling and understanding"
> (Qur'an 32:9)

This verse tells us that the faculties of hearing, seeing, and feeling are bestowed upon us in this order. Embryologists confirm that this is exactly the order of development of special senses. Moore[8] further confirms that the primordia of the internal ears appear before the beginning of the eyes, and that the brain which is the site of understanding differentiates last.

Surah 23: 14 could be quoted in the beginning of Chapter 14 and Chapter 15 on Skeletal System and Muscular System respectively.

Chapter 19: Full Term

> "And We cause whom we will to rest in the wombs for an appointed term"
> (Qur'an 22:5)

> "Who created you and fashioned you in due proportion and gave you any form He willed"
> (Qur'an 82:78)

> "And fashioned you and perfected your shapes, and hath provided you with good things."
> (Qur'an 40:64)

In the above verses Allah (SWT) says that He is the one Who determines which embryos will remain in the womb until full term. It is well known

to embryologists that in the first month of development many embryos are aborted, some due to genetic malformations, and that only about 30% of the zygotes formed, develop into fetuses that are born at full-term. Allah (SWT) says in Surah 42, verses 49-50, that He determines the sex of the embryo whether it becomes a boy or a girl and what genetic and somatic characteristics (height, color, shape, size, beautiful or ugly, etc.) it will be endowed with.

Conclusion

The foregoing is only an action plan and step-by-step methodology which is presented as a guide for textbook writers on human embryology for Muslim students.

The correct interpretation of verses pertaining to human embryology in the Holy Qur'ān would not have been possible fourteen centuries ago or even fifty years ago. The science of human embryology today is quite advanced thanks to modern electronics and instrumentation. This has enabled us to interpret and understand the Qur'ānic verses better. As our knowledge increases in the future, then other verses in the Holy Qur'ān pertaining to human development will be better understood.

TABLE 1.: CONTENTS OF A TEXTBOOK ON HUMAN EMBRYOLOGY

Chapter 1 : Introduction
Chapter 2 : Fertilization (The First Week)
Chapter 3 : Implantation (The Second Week)
Chapter 4 : Trilaminar Embryo (The Third Week)
Chapter 5 : Embryonic Period (Fourth to Eighth Week)
Chapter 6 : Fetal Period (Ninth Week to Birth)
Chapter 7 : Fetal Membranes and Placenta
Chapter 8 : Congenital Malformations
Chapter 9 : Coelomic Cavity and Mesenteries
Chapter 10: Respiratory System
Chapter 11: Digestive System
Chapter 12: Urogenital System
Chapter 13: Circulatory System
Chapter 14: Skeletal System and Ossification
Chapter 15: Muscular System
Chapter 16: The Limbs
Chapter 17: Nervous System
Chapter 18: Head and Neck
Chapter 19: Full Term

NOTES

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The Islamic Basis of the Coming Muslim Technological Renaissance

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The Islamic Basis of the Coming Muslim Technological Renaissance

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It is argued that the Muslim countries will have a technological renaissance provided they can re-introduce sufficient free competition into their economies and cultures. The Western world is moving towards a catastrophic decline due to its unreasonable delusion that exponential growth rates can be maintained in the absence of new frontiers, due to the unchecked growth of usury west of the Iron Curtain and due to the unchecked growth of state police authority east of the Iron Curtain. Millions of non-Muslims of the East and West are weary of the extremisms of the right and the left and of the attempts to impose upon them private cartelism disguised as a "free economy" or state cartelism disguised as a dictatorship of the "proletariat". They are disgusted and repulsed by propaganda presented to them by political states or "the golden calf" as substitutes for Allah. They will be attracted in great numbers to join Islam if only it can be presented as it was by the Prophet Muhammad on the basis of sincere compliance to his teachings rather than the emphasis on mechanical observances furthered by "Muslim clergy" acting as mediators in contradiction to the Prophet's admonitions. The conception of many Muslim theologists, that science and engineering (or in general innovative thinking) have nothing to do with salvation, must be modified. Their formalistic conceptions of the faith have not produced an iota of improvement in the condition of the oppressed and economically disadvantaged Muslim communities. The general decay in their condition is a message from Allah. Muslims should strive and compete freely to produce the highest level of Muslim culture, not simply lament. If every single Muslim strove continually to learn more than is required for his own livelihood, the brave Islamic *Mujahideen* would not be so oppressed by technologically superior opponents in so many places in the world.

Only Islam, among all religions, with its rejection of anthropomorphic images of the deity and its rejection of special ethnic and political privileges

is sufficiently "modern" in concept to survive a hypothetical contact with extraterrestrial races in the galaxy. The recognition that Islam is consistent with modern science should motivate all Muslim scientists and engineers to that extra effort required to return Islamic technology to the forefront of human progress.

Every sincere Muslim has a justifiable pride in the magnificient accomplishments of Muslim scientists, engineers and architects from the first to the ninth century A. H. During that period Muslim countries were at the forefront of world technological progress. To return the Muslim Ummah to this position should be the earnest desire of each technically trained Muslim. In order to do so, one must comprehend clearly the reasons for the technological decay of the Islamic countries from that position of preeminence during the last 400 years of scientific "sleep" in those countries.

Criticism is often rejected within the Muslim community because it is perceived by some as an attack against Islam itself. Such is not the purpose of this essay. It is to be pursued critically within the framework of the British concept of "the loyal opposition" which seeks to improve, not to undermine. Even as the sharp scalpel of the surgeon may hurt the patient it is used to his ultimate benefit. Those who love the patient most may be psychologically inhibited from cutting him even for his benefit. If the reader "feels the scalpel" in this discussion let him be assured that it is being wielded in the interest of the optimal development of the Islamic world. Nor should it be assumed that this technological decline after preeminence has only befallen Muslim countries.

An attempt will be made here to convince the reader that technological decay is an inevitable concomitant of the asymptotic (end) state of a society which may be characterized as "overdeveloped" and that, contrary to popular opinion, the Muslim countries are not underdeveloped but rather overdeveloped in the organization of their economic systems. In this discussion the terminology adopted will be largely economic, but the arguments may be applied in the intellectual, philosophical and religious spheres as well. The question addressed is "What causes the decline of the innovative progress in a society?". The answer to be supported here is: "Suppression of free competition". This suppression is a perfectly natural but largely unrecognized development in a society whose economy has matured. It has deep psychological roots in familial love and affection. Individuals in families do not allow free competition between members and non-members of their families. They act preferentially in favour of their family members and try to exclude outsiders from this preferential treatment. Surely this is quite natural to recognize a special obligation to one's family. Loyalty to family becomes in the context of social regroupings, loyalty to community, ethnic group, religious sect, company,

party, city, state, or country. As soon as such a group is formed, the necessity for delineating its boundaries requires the introduction of special prerogatives for its adherents. In a way this is required to clarify its definition. The advantages for members of such a group versus the opportunities available to the general public then constitute a suppression of competition with respect to the activities of that group. As groups grow in power and scope, competition is suppressed on a larger scale.

In a "newly formed" society almost everything is disorganized and free competition is rampant. There is a veritable ferment of innovations to satisfy the demands of a rapidly developing market. In this free competition groups which can organize most efficiently to satisfy consumer demand will tend to displace less efficient groups which cannot meet such a demand. By absorption of the marketing areas formerly controlled by less efficient groups the successful ones grow exponentially. Eventually they dominate the market so completely that they are able to form cartels with exclusive control over the sources of their materials and to free themselves from the necessity of competition.

When this happens, the cartels naturally wish to decrease costs and when there is no competition to which the consumer can turn they simply dictate design and price to the consumer who now has no choice but to buy from these cartels or buy nothing. It is at this stage that the quality of goods and services in the society begin to decline. Innovativeness which was at premium value to overcome competition, is no longer necessary and is viewed as an unjustifiable expense. It is more "cost effective" to use existing designs and equipment. There is so little randomness in the economy that very little "risk capital" is available to support bold new ideas. Economic opportunities which were so plentiful in the initial state of the society become seldom events. Inevitably the economically powerful groups in the society exert pressure on the government to prevent prices from falling while wages are left free to fluctuate. This is not a free economy nor should it be called capitalism, which was linked to the freely competitive growth phase of the early economic system. This leads to a stabilization of the economic structure of the society, an inhibition of opportunities for innovative progress in the society, and to a stratified society with a steady-state class structure. The socialist countries with their rigid commitments to cartelized economies rather than freely competitive ones are even closer to the asymptotic end state dominated by priviledged government officials contemptuous of the citizens they control. To be sure, there are still a few public-spirited officials here and there, but how long can "noblesse oblige" survive in such an atmosphere with no religious inhibition to stem the lust for power?

The term cartel often conjures up the image of multinational corporations of the modern period, but the concept of a generalized organization capable of suppressing free competition is what is meant here. In this sense one finds cartelism is of ancient origin and feudal cartelism is still with us today. It is a perfectly natural development in the mature stage of a society but after competition has been eliminated the society becomes stratified with a rigid class structure and change and innovative progress are viewed as disturbing elements to be suppressed.

There are extreme examples of such societies still surviving among us unchanged for millions of years and still unchanging. These are the ants and the bees and the termites. To be sure individual humans have immensely more neurons but as our societies become more rigidly organized they assume some of the characteristics of the arthropod societies in which deviations from preassigned behavior modes are punished severely. There is no individual dignity or privacy in an arthropod society. State planning has preempted all individual innovations and thinking and the State cannot be questioned. The implementation of such a government requires that its subjects continually spy upon one another to ensure compliance.

The Prophet Muhammad (ṢAAS) in his wisdom forbade such spying and clearly did not wish to establish a system of unreasoning obedience to the state. The strength of the state should derive from the unextorted consent of the governed and from their confidence in the justice dispensed to them.

Prophet Muhammad (ṢAAS) also forbade usury which is well on its way to destroying the economies of the Western world. According to the theory promulgated in the West interest is "justified" by the need for growth capital which is supposed to ultimately increase productive capacity. Under economic conditions where the increase in productive capacity is severely curtailed there is no substantial growth and the permeation of the economy with an interest system geared towards exponential growth simply produces inflation. This exacerbates the stratification of the society by widening the gap in living standard between wage-earners and wage-providers who can simply raise prices to avoid being undercut by inflation. In the West inflation is viewed as no one's responsibility but it certainly functions as an efficient mechanism for impoverishment of wage-earners quite as well as a deliberate policy.

The people west of the Iron Curtain are disillusioned by the unstemmed increase of usury, inflation, materialism and indecency. The people east of the Iron Curtain are disillusioned by the absolute authority of the state, restrictions on freedom of speech and travel, special economic prerogatives of the political minorities that rule them, continual surveillance by secret police with unrestricted authority and a judicial system with pre-arranged verdicts.

Islam offers a faith of universal brotherhood in which espionage and usury are forbidden, in which the dignity of women is protected, and in which a higher obligation of the wealthy and powerful than to the state is recognized and their commitment to assist the less fortunate clearly enunciated. As the economies of Western Europe and the Americas fail in a sea of usury and the economies of the socialist states of Eastern Europe, Asia and Africa fail from overcontrol, the World of Islam will emerge to regain its former pre-eminence if and only if it can re-introduce the element of free competition into its societies. This requires a revision of custom very difficult to achieve for the Muslim world. It means that people must be given job opportunities on the basis of abilities rather than family affiliations. It means that national policies must be formulated on the basis of Islamic unity and common Muslim advantage rather than upon one of familial advantage. It means that free competition of ideas free of coercion by special interest groups must be restored to Muslim universities and that professors of different opinions and views must be allowed to express them in the same university. It means that students must be free of coercion by professors to follow paths dictated by them. In spite of excellent performance by individual Muslim scientists and engineers in foreign countries, the research output of Muslim universities is today negligible. This can only change by allowing more free competition and rewarding innovation rather than resisting it through fear that one will be required to learn more things to teach. The strange notion that a professor already knows all he must learn upon entry into the academic profession is far too widespread in Islamic universities. We must find new ways of teaching Muslim students. Innovation is not to be achieved by simply copying the West.

The crushing weight of blind adherence to Islamic orthodoxy which emphasize rigid observances of ritualistic ceremonies as a mechanistic formula for salvation was a major factor in the decline of Islamic science and this should be excluded from the Islamic universities. This does not mean that Islamic philosophy should be excluded. The fear that something might be discussed which would subvert the ideals and ethics of Islam can only be entertained by those whose faith is too weak to recognize the intrinsic power of Islam. The Prophet advocated unhampered acquisition of knowledge and warned against the inefficacy of mechanistic observances. Understanding and sincere belief were what he most emphasized and any attempt of certain groups among the Muslims to function as a clergy was strictly forbidden. "There is no compulsion in faith" is in the second surah of the Qur'ān. Even forcing people to pray subscribes to the infantile notion that Allah cannot distinguish genuine sincerity and hypocrisy. Although the call of the Islamic fundamentalists for a return to Islamic law is clearly motivated by a desire to overcome the corruption and deviousness of certain Middle East

governments, it has the great danger to Islam that it may attract the masses to a conception of salvation achieved by mechanical observances of ceremonies rather than by a sincere reflection (*dhikr*) on the inner meaning of Muhammad's (SAAS) message. Any attempt to restrict this meditative aspect of Islam to a "Muslim clergy" while leaving "mechanical observances" to the lay public would be a clear contradiction of the Prophet's admonitions.

Finally, let us turn to the reasons why Islamic beliefs are consistent with modern Science. Muhammad emphasized "striving mightily" to acquire wisdom. In Islam the concept of Allah is an abstraction free of inconsistent descriptions in terms of human or other forms. Thus Islam is the only religion which could survive encounters with alien lifeforms from other regions of the universe without major revision. It does not submit pictures of one race's conception of a deity for worship by another race. It offers universal salvation on the basis of ethical behavior to all intelligent beings. There are no hypocritical racial prejudices in Islam.

The contention of atheists that there is no deity is equivalent to the contention that there is no universal ordering principle in the universe. Aside from the fact that there exists no proof of their contention even if it were true, it would contradict the most fundamental conception of science that events are to some extent predictable on the basis of scientifically observed order in the universe.

Faith in the predictability (statistical or deterministic) of events is at the root of science, ancient and modern. Logic is a very powerful tool of the human mind, but it can only ideally extract conclusions from premises. It cannot validate the relevance of the premises to human beliefs. To function in this life with a feeling of security, man must have beliefs. Even the transition between steps in a logical argument is based upon faith.

The Islamic *Tawḥīd*, the single unifying all-embracing principle of natural law at once the logical union of all natural laws which the most enlightened of the ancient Egyptians called *neter* (the origin of the Latin world natura) leaves man free but also obligated to study all correlations of natural phenomena within the scope of his mental abilities. Polytheism does not demand a single source and in this way inhibits deeper investigations by terminating questioning along multiple paths ending in multiple deities. In this sense the *Tawḥīd* doctrine is a powerful impetus for the development of modern science.

The Islamic principle of *Zakat* goes far beyond the dispensation of one fortieth of a Muslim's income to his needy brothers in Islam. It means to Islamic scientists and engineers that their efforts must never cease to raise the standard of living and improve the understanding of Muslim communities everywhere. Only when each Muslim community can be a shining example of progress to other communities of the world will the cause of Islam be fur-

thered. As long as a single Muslim family exists in a state of economic abasement, social degradation or political oppression, every Muslim is disgraced. It is this interpretation of *Zakat* which will lead Islam to the forefront of world progress again.

The Muslim principle of *Ṣawm* goes beyond the abstinence from eating during daylight hours of Ramadan for those whose health permits. It requires a genuine concern, sympathy and social consciousness for the hungry and the unfortunate. As long as any Muslim feels hunger no Muslim scientist or engineer should relax his efforts to solve the root problems leading to this condition. The Sahel drought problem partially caused by Western ecological mismanagement is a case in point. There is no reason why a consortium of Muslim Banks could not finance a Qattara inland freshwater lake project with immense benefits in agriculture, electric power generation, etc. Nuclear explosions could be used to construct a canal from the Mediterranean and a desalination plant could be hydroelectrically powered by the elevation difference. Muslim technologists must think beyond the giving of food to the provision of a technical base for a bountiful agriculture.

The Muslim obligation of Hajj must go beyond the requirement of travelling to Makkah and participating in the ceremonies. There must be constructed a great central Islamic information center complete with museums and libraries and taped tutorial courses so that every Hajji may have the opportunity whatever his level of understanding to improve his mastery of his profession, trade or craft and thus carry back with him the latest knowledge in his field to enrich his home community. Thus Islamic technology can return to the forefront of human endeavour.

The principle of Muslim Ṣalāh must go beyond the important recognition and praise of the *Raḥmat Allah* and embody a persistent plea for improvement of understanding and guidance for intellectural growth and for the avoidance of intellectural arrogance which only cripples the capacity for creative thinking. The greatest intellectural accomplishments of mankind and its geniuses represent only a kind of stumbling progress compared with the clear path of the enlightenment from Allah without whose guidance the clever sophistry is without avail. Still it is the duty of Muslims to strive mightily and ceaselessly to improve their understanding of the world of nature and submission to the Will of Allah implies this lifelong struggle not the sleep of individuals nor the sleep of centuries by societies. He who fails to try to improve his mind to its optimal capacity treads the path to progress backwards to the status of the unthinking beast. Without exception all will be judged on the basis of what they chose to do compared with what they could have done.

These are the five pillars of Islam as they should be seen by every Muslim scientist and engineer. They are not to be seen as a maximal set of obligations

but rather as a minimal set to be expanded into a complete philosophy of Islamic technology in service of man's traversal of *al Sīrāṭ al Mustaqīm* . In Islam, science is not isolated from the system of belief but is an integral part of the Muslim Ummah.

The Making of a Scientist: The Islamizing of a Muslim Scientist

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The Making of a Scientist: The Islamizing of a Muslim Scientist

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Abstract:

Some essential characteristics of a scholarly scientist or what it takes to make a research worker in the real sense are discussed. Contemporary research is described as it is being done in this modern society. Some recommendations of Islamizing of attitude and practice of Muslim scientists are made. Personal contacts are strongly urged which can be achieved only by establishing a center of excellence.

I. Introduction

Today Muslims constitute more than 20% of the world population. Their contribution, however, is much less than this ratio to the field of science and technology. At this stage any step taken in increasing the role of Muslims in the scientific endeavour is enthusiastically welcome in all quarters regardless of the process which is adopted and regardless of the price that is paid. It is exceedingly important – the importance could not be emphasized more – what attitude is taken in stepping up the effort in science and technology.

There has been a great deal of upsurge in research and development in science and technology almost all over the Muslim World in the recent past. New ministries, centers, foundations, etc., have been created in many Muslim countries for the advancement research and development in science and technology. A number of bi-national agreements for the promotion of research in science and technology have been signed between individual Muslim countries and some developed countries, mostly with the USA or USSR and their allies. Most of the efforts for the promotion of research and development are directed toward universities.

The intent and effort for promoting research and development not only in science and technology but in all disciplines are both most welcome in all quarters, more so the emphasis on research and development in universities. One would say that it is in perfect harmony with the spirit of Islamic philosophy as far as seeking of knowledge, evolving of new knowledge, sharing it with others, and applying it to the betterment of mankind is concerned. However, the question is: what is the spirit of Islam and how can it be permeated into the entire process of establishing knowledge and research activities? We attempt to contemplate on this question and offer a model for the research activity for the Muslim world.

II. Model of New Knowledge

Most of the Muslim countries adopt or have adopted the research model followed by one of the developed countries which are, without exception, all secular in their approach to their life. This model may be suitable for a given developed nation from which it is borrowed. It may not be necessarily as effective for the country which borrows it if it is implemented without any modification suitable to its ideological and governmental objectives and to the needs of the society. In this context we must first understand what research is, how it is carried out in some developed countries, how, and at what stages the Islamization can be instilled.

In general, in words of Albert Szent Gyorgyi: "Research is to see what everybody else has seen, and to think what nobody else has thought."

The primary aim of research must not just be more facts and more facts, but more facts of strategic value. The strategic value should 1) lead to the clarification of a problem or 2) provide deeper insight into a phenomenon, or 3) link previously unrelated facts and ideas and finally perhaps most importantly, 4) present a clear understanding of the ultimate impact on mankind.

There are many worthy activities that may not be considered research. For example, research is not instruction; it is not practice; it is not consultation. Research is seeking new solutions to problems or new ways of identifying problems. The product of an activity is a research output only if it is novel or original or a replication of previous research under different conditions or in different settings. The researchers' activity creates new knowledge or products (outcomes) which become part of a problem-solving repertoire. This means producing novel tangible consumer products of processes. The product or outcome may take the form of intellectual property—new ways of structuring or solving problems.

University research may be understood to mean a broad spectrum of original problem-solving activities which have the purpose of creating new knowledge, prototypes, patents, products, innovation transfers and disseminating these to those who accept. The contemporary research activities can be broken down into these categories:

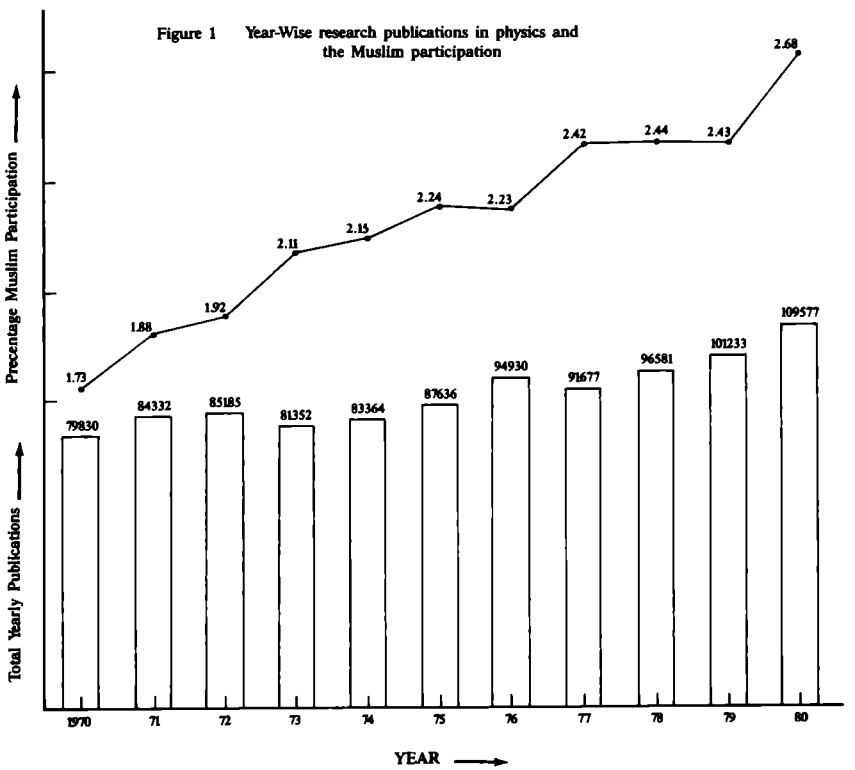
1. Basic Research: It addresses questions such as why a phenomenon occurs as it does. It creates new knowledge.
2. Applied Research: It promotes rendering an idea into practice.
3. Development: Its role is stepping up or modifying a model situation.
4. Product Research: It offers designing for a sponsor of a new product or improving production processes.
5. Technology Transfer: It extends man's capabilities by adoption of innovations.

In United States universities, these activities are respectively 64%, 23%, 8%, 2%, and 3% by the amount of research funded in each category with a total of university research share of \$9 x 10^9 out of a total research funds of \$63 x $10^9$9. Out of 2300 United States universities (institutions offering at least baccalaureate) the top 200 do about 80% and the top 100 do about 99% of the total university research. Approximately \$40 x 10^9 out of \$63 x 10^9 go into applied and developmental research. While this breakdown may not be ideal even for the US universities, it may not be suitable moreover for universities of the Muslim World. The Islamization requires first to take an inventory of resources of the Muslim World before adopting any research model. Perhaps in this process the emphasis on various categories and aspects of research would vary from place to place and time to time. The research category ratio for one Muslim nation at one time could be (in the same order as above) 10%, 20%, 60%, 5%, and 5%; whereas it may be quite different for the same nation at some later time or for a different nation at the same time. The steps for Islamization have been underscored wherever its infusion is most desired. Further breakdown of these research categories into a) Input, b) Process and c) Output would call for Islamization. As a first step in reviewing the methodology of research and indoctrinating it with Islamic thought, a thorough study of resources of the Muslim World with respect to mission-oriented research, be done in different disciplines. Such proposals should be invited from experts in their field, followed through and kept up to date periodically by some central body like the International Institute of Islamic Thought. This inventory could be used for further development in collaboration with others. As an example current practicing physicists and their output

for the last fifteen to twenty years would provide a realistic situation for any research model or methodology to be developed for physics and allied sciences in the Muslim World.

III. Surveying the Contemporary Science

A survey of the research in science done and published for the last fifteen to twenty years in the world ought to be done systematically according to nations and subjects. The data should be analyzed with special reference to a particular field of science and a particular geographical region. For example, physics in Pakistan, in the Muslim World, and in the world in general is surveyed for the last decade in a cursory manner as a case study. An overall growth of research publications in physics has been obviously noted as depicted by Fig. 1. It is also observed that the rate of research publication of Muslim



physicists has grown much faster than the overall growth rate of published research in physics for the last decade. Nevertheless, this tremendous growth of Muslim contribution to research in physics when compared with the overall physics research, is much lower than the ratio of the Muslim population to the world population. Ironically, almost all the Muslim scientists in this category, with the exception of those in the USSR and in some very few other cases, invariably have been living and/or doing research in places other than their own homelands. The migration of these scientists has increased consistently, and in some cases it has already reached past its critical point. This is actually the situation of Physics in Pakistan. In other cases the critical situation may reach soon should the existing trend be allowed to continue. The trends noted in this field and in this country may well be projected to other disciplines and regions with an appropriate scaling factor. However, a thorough survey and recommendation based on hard facts should urgently be undertaken.

The desire of getting into the main stream of science and technology, if there is any, is achievable within the resources and assets of the Muslim World. What is needed to achieve this goal can philosophically be described in the following brief narration: It requires only longsightedness, perseverance, and the order of priority. This matter (of getting into science) is of such great significance to the future of the Muslim Ummah that it should be regarded as vital as its security and stability itself. This issue is of no less importance if not more, or so it seems to me.

Such study should aim at describing briefly the methodology of collecting data out of which the relevant numbers and statistics may be derived. Based on those data, a number of modest to ambitious recommendations should be made which encompass the science and technology and the entire Muslim World including the two cases (Physics and Pakistan) in particular. As much as possible, a comprehensive analysis and interpretation of those observations should be presented. The following efforts should be made:

i) Efforts should particularly be made in looking for causes for the dissipation of Muslim science, if any such trend is observed.
ii) A systematic plan should be discussed for The Muslim World to invest in the "knowledge business," the most prospering of all businesses.
iii) Efforts should be made to look for ways and means to improve and to harness the growth of science and to channel it for the continuous advancement in improving the condition of the people.

iv) Caution should be made not to dissipate efforts and dole out resources.

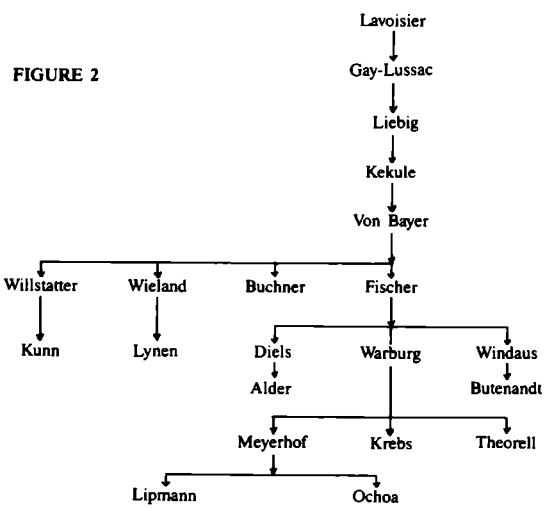
4. Close Contact

The inventory is just preliminary work. The main task of Islamization of attitude and practice of a Muslim scientist still lies ahead. An environment is thus to be created in which an attitude catering Islamic values be developed and Islamization can be practiced. From the results of the survey discussed in preceding paragraphs, an institution is to be established which maintains this environment established by some noted scholars of the time with whom highly promised young scholars are engaged in seeking and promoting science.

4 Humility

The most important event in the career of a young scientist is the personal contact with great scientists of his time. When the personal contact and close association between great scientists and their pupils (rather disciples) is intimate and prolonged, extending to the mature stage of their pupils, they in turn become great scientists or even some excel their masters. This has been the tradition of transfer of knowledge of science historically. In support of this statement, I will present an example of nineteenth and twentieth century chemists illustrated in Fig. 2. This contact has been now institutionalized

FIGURE 2



Islamization of Attitude and Practice in Embryology

Ibrahim B. Syed

Abstract

At the rise of the Islamic Empire, the Muslims were at the forefront in all sciences, technology, medicine, etc. and contributed immensely to the advancement of knowledge without which the Western Civilization would have still existed in the dark ages. Unfortunately, the Muslims deviated from the Islamic path and fell down from that exalted position to what we are now today– with colonial minds possessing brain washed non-Islamic attitudes and practices in science. The Muslim scientists, ignorant of Islamic knowledge, blindly follow Western teachings and read textbooks written by non-Muslims who consider themselves as secularists and who separate church from state. This is a contradiction for Muslims because Islam is a complete way of life with no separation between state and religion.

To regain our heritage and the glorious past, we must start Islamization of attitude and practice in science. A scientist who has a good grasp of Islamic knowledge will find that the Qur'an is a textbook of sciences. the Qur'ān imparts knowledge about anatomy, astronomy, quantum physics, zoology, etc., in very clear and succinct words. For example, references to the Big-Bang Theory, evolution, human embryology, space travel, and many truths not earlier known to scientists are found in the Qur'ān.

When books and textbooks of science are written by Muslim Scientists, each chapter should start with one or more pertinent verses from the Qur'ān or quotations from eminent Muslim Scientists. Where appropriate the Qur'ânic verses should be amplified with modern scientific knowledge in the text of each chapter. After all, the Qur'ān itself is a book of truths. Hence there is no conflict between Islam and science. There is, however, a definite conflict between science and other religions. The author will present material to prove that modern scientific knowledge confirms the revelations in the

Qur'ān and how these revelations should be incorporated in textbooks for Muslims students from primary school to the University level.

Introduction

George Sarton, a professor of Science History at Harvard University, stated in his book *The Life of Science* that the foundations of science were laid for us by the Mesopotamian civilizations whose scholars and scientists were their priests; and to them we owe the foundations of medicine, navigation, astronomy and some mathematics. The second development came through the Greeks, as taught in the traditional way in Western schools and colleges. The third stage of development, however, is to be credited to the meteoric rise of Islam, whose Abbassid caliphs drank avidly at the fountain of the ancient Persian and Hindu, as well as Greek sources of knowledge. For nearly four hundred years Islam led the scientific. From Spain to India, the great body of past knowledge was exchanged between her scholars and *the torch carried forward with new discoveries.* Scholars of Christendom from about the eleventh through the thirteenth century, were mainly occupied with translating books from Arabic into Latin. *Thus Islam paved the way for the Renaissance,* which in turn led to science's fourth great development in the modern Western world.

Down from that exalted position, the Muslims stand presently at the lowest rung of the ladder of nations, possessing colonial minds with brain washed non-Islamic attitudes and practices in science. The causes for such decline and the reasons for the present day standing of the world *Ummah* of Islam are eloquently described by the late Ismā'il R. Fārūqī.[1] To regain our glorious past and heritage, we must start Islamization of attitude and practice in Science. The attitude of al Qur'ān is very scientific. It encourages mankind to think, to reflect and to investigate all natural phenomena. The Qur'ānic revelations *do not negate* the modern scientific truths, which have come to light in many areas of human knowledge. Maurice Bucaille, in his book, *The Bible, The Qur'ān and Science*[2] shows how Qur'ānic revelations are in agreement with modern science in the areas of cosmology, geology, astronomy, animal and vegetable kingdoms, and human reproduction. The Islamic spirit which prevailed during the meteoric rise of Islam should be instilled in all the Muslim children of the Muslim world from primary school to the university level. This islamization of science should inspire the young Muslim minds to become the torch bearers who can push forward the frontiers of science to regain the Islamic tradition of excellence and mastery in all sciences.

One of the practical methods of achieving this is that when books and textbooks of science are written by Muslim scientists and scholars (who are presumed to possess sound Islamic knowledge and Islamic spirit), each chapter should start with one or more pertinent verses from the Qur'ān, *Ṣaḥīḥ* Hadith or quotations from eminent Muslim scientists or scholars. Where appropriate, the Qur'ānic verses should be amplified with modern scientific knowledge in the text of each chapter. In this paper the author presents material on Human Embryology to prove that modern scientific knowledge confirms the revelations in the Holy Qur'ān and how these revelations should be incorporated in the textbooks for Muslim students. The following presentation is only a work plan and each chapter is not complete.

I. Embryology Before Qur'anic Revelations

The first recorded embryological studies are in the books of Hippocrates (460–377 B.C.). He wrote on the nature of chicken embryos. Galen (2nd century A.C.) wrote a book called *On the Formation of the Fetus* in which he described the placenta and fetal membranes. It appears that the fact that human beings are developed in the uterus (womb) was not known until the fifteenth century. The first known illustration of a fetus in the uterus was drawn by Leonard da Vinci. The Physicians in the seventh century A.C. did not know that the human embryo developed in stages. However in the fourth century B.C., Aristotle had described the stages of development of the chick embryo. The fact that the human embryo develops in stages was not discussed and illustrated until the fifteenth century.

In 1673 Leeuwenhoek who discovered a simple microscope, described the early stages of the chick embryo. The staging of human embryos was not described until 1941.

The foregoing could be included in the introduction or Chapter 1 of the textbook on *Human Embryology for Muslim students* (see Table 1 for the contents of the textbook).

Chapter 2: Fertilization

> "Then He made his seed (sperm) from a draught of despised fluid"
> (Qur'an 32:8)

> "Hath not man seen that We have created him from a drop of seed (sperm)?
> (Qur'an 36:77)

He it is Who fashioned you in the wombs as pleaseth Him.
(Qur'an 3:6; 18:37; 22:5)

Allah created you from dust, then from a little fluid, then He made you pairs (the male and female)
(Qur'an 35:11)

He it is Who created you from dust, then from a drop (of seed), then from a leech-like clot.
(Qur'an 40:67; 75:37-38)

Lo ! We create man from a drop of thickened fluid to test him; so We make him hearing and seeing.
(Qur'an 76:2)

From a sperm-drop, He hath created him, and then mouldeth him in due proportions.
(Qur'an 80:19; 82:7-8)

So let man think from what he is created. He is created from a gushing fluid that is issued from between the loins and ribs.
(Qur'an 86:5-7)

Verily, We fashioned man from a small quantity of mingled liquids (gametes i.e., ovum and sperm)
(Qur'an 76:2)

Fertilization is the sequence of events that begins with contact between a sperm and an ovum. Fertilization usually occurs in the outer third of the uterine tube. The fertilized ovum goes into successive divisions. The embryo's sex is determined at fertilization by the kind of sperm (X or Y) that fertilizes the ovum.

And that He createth the two spouses, the male and the female. From a drop of sperm when it is poured forth
(Qur'an 53:45-46)

He bestows (children) male or female according to His will.
(Qur'an 42:49-50)

in postgraduate and postdoctoral levels of education and personalized training. The making of a scientist is not merely a matter of attending a course of lectures and reading books but of researching together over an extended period of a few years. In this process excellence and distinction develops if nurtured by excellence. Merely constructing a building for a so-called center of excellence does not build excellence—it has never been done in history. In the absence of someone with outstanding ability there is always a good chance that we easily come to believe that we are excellent and much better than others. Mediocre people may appear big to themselves and to others if they are surrounded by small circumstances. By the same token, big people feel dwarfed in the company of giants. From the giants of science what we learn is "to see ourselves modestly and not to overrate ourselves with vast broadmindedness, free but disciplined imagination, great enthusiasm and deep devotion." The most important element out of these qualities is the attitude of humility; from it flows a self-critical mind and the continuous effort to learn and to improve. This is reflected in the following Qur'ānic verses:

وَهُمْ لَا يَسْتَكْبِرُونَ ﴿١٥﴾

And they do not boast.

(Qur'an 32:15)

وَٱسْتَكْبَرْتُمْ ۖ إِنَّ ٱللَّهَ لَا يَهْدِى ٱلْقَوْمَ ٱلظَّٰلِمِينَ ﴿١٠﴾

And you boasted, indeed God does not guide such transgressing people.

(Qur'an 46:10)

فَٱسْتَكْبَرُوا۟ وَكَانُوا۟ قَوْمًا مُّجْرِمِينَ ﴿٧٥﴾

And they boasted to be big and they were criminal people.

(Qur'an 10:75)

إِلَٰهُكُمْ إِلَٰهٌ وَٰحِدٌ ۚ فَٱلَّذِينَ لَا يُؤْمِنُونَ بِٱلْءَاخِرَةِ قُلُوبُهُم مُّنكِرَةٌ وَهُم مُّسْتَكْبِرُونَ ﴿٢٢﴾
لَا جَرَمَ أَنَّ ٱللَّهَ يَعْلَمُ مَا يُسِرُّونَ وَمَا يُعْلِنُونَ ۚ إِنَّهُۥ لَا يُحِبُّ ٱلْمُسْتَكْبِرِينَ ﴿٢٣﴾

Your God is just one and those who do not believe in the hereafter, their hearts are full of rejection (of truth) and they are proud. Truly

God knows what they hide and what they manifest; surely He does not love (or like) the proud.

(Qur'an 16:22-23)

رُحَمَآءُ بَيْنَهُمْ

They are compassionate among themselves.

(Qur'an 48:29)

B. Courage, hard work and patience

Humility is one element that teachers of special distinction hand down to their pupils on one hand. Simultaneously, courage is another quality on the other hand that their pupils learn from them. A scientist, however humble he may be, may have the courage to attack the great unsolved problems of his time and that solutions should be forced by carrying out innumerable experiments without any hesitation, forging new tools and methods for tackling the chosen problems, taking pains in verifying facts, expressing results and ideas clearly and concisely and altogether focusing his entire lifestyle on true values. The scientists of great distinction achieve their distinction not by going after the distinction, but by being engaged in creative activity all the time—day and night—with a few hours of sleep, three or four only. The creative activity begins with bold speculations basing on or violating previous findings, sharing them in constant exchange of ideas among their fellow scientists in their group. In that scientists learn at all levels as much from their own fellow scientists as from their seniors and mentors. The distinction follows, by itself without being pursued, the long hours of untiring work and hard trying with patience and courage.

To a Muslim or a Muslim scientist this is inherent in his culture or at least should be inherent in his culture as we find many conjunctions for his guidance in the Quran. For example:

لَقَدْ خَلَقْنَا ٱلْإِنسَٰنَ فِى كَبَدٍ ۝٤

Certainly We have created man to be in struggle. That implies for man working hard constantly.

(Qur'an 90:4)

ثُمَّ كَانَ مِنَ ٱلَّذِينَ ءَامَنُوا۟ وَتَوَاصَوْا۟ بِٱلصَّبْرِ وَتَوَاصَوْا۟ بِٱلْمَرْحَمَةِ ﴿١٧﴾ أُو۟لَٰٓئِكَ أَصْحَٰبُ ٱلْمَيْمَنَةِ ﴿١٨﴾

Then he is of those who believe and charge one another to show *patience*, and charge one another to show *compassion*. These are the people right of hand (success).

(Qur'an 90:17-18)

وَٱلْعَصْرِ ﴿١﴾ إِنَّ ٱلْإِنسَٰنَ لَفِى خُسْرٍ ﴿٢﴾ إِلَّا ٱلَّذِينَ ءَامَنُوا۟
وَعَمِلُوا۟ ٱلصَّٰلِحَٰتِ وَتَوَاصَوْا۟ بِٱلْحَقِّ وَتَوَاصَوْا۟ بِٱلصَّبْرِ ﴿٣﴾

I swear by the time (declining day) most surely man is in a state of loss, except for those who *believe* and do *good deeds*, and exhort one another to *truth* and enjoin on each other *endurance* (patience). C111

(Qur'an 103:1-3)

C. Attitude Overall

From the giants of science their pupils learn by intimate contact with them the ways of thinking required by science. More precisely they learn how to select the object to be explored, how to interpret and evaluate the results obtained, and how to integrate into the whole body of knowledge. In this way their pupils not only are made familiar with methods and facts but are imbued with general scientific spirit which shapes the pattern of the true scholar and researcher. Knowledge *per se* can be learned from books or from any teacher, but scholarly *attitude* is conveyed by great teachers only. What should be the attitude of a Muslim scholar is no secret today. The great master, Muhammad, has conveyed to his disciples in totality. What his disciples have acquired is very subtle and critical. What is critical is the use of skill, how to assess their potentialities and their limitations, how to improve, to rejuvenate. A pupil inherits enthusiasm from the great teacher. It is the essence of a large capacity for work. It makes the research worker look on research not as mere work but as a commitment.

Concluding Remark

O believers, enter into Islam in totality and do not follow the footsteps of Satan for he is your avowed enemy. That is, "Come into the fold of Islam completely without any reservation." Your thoughts, your theories, your culture, your science, your manners, your dealings, your efforts, etc., should in every aspect of life be subordinated to Islam or to the dictates of Islam. You should not divide your life into different compartments so as to follow Islamic creed in one and discard it in the other where you follow something else. That something else is clearly a Satanic creed which is your clear enemy.

Fortunately, the process of Islamization has been effective in various forms since the time of the Prophet Mohammad[s]. Islamic Jurisprudence is perhaps by far the most developed subject area both in theory and practice which is perhaps solely responsible for the evolution of the principles of Islamization. It is widely known that: 1) Divine Revelation—Qur'ān, 2) Model Conduct of the Prophet— Tradition or Sunnah, 3) Consensus of Righteous and Competent Scholars of the Community—*Ijmā'* and 4) Method of reasoning by Analogy—*Qiyās*, are the principles of Islamization. There are five other auxiliary principles, viz. 1) Necessity (*Ḍarūrah*), 2) Need of the Time(*Muṣlaḥah*), or public interest (*Istiṣlāḥ*), 3) Continuance (*Istiṣḥāb*), 4) Preference over analogical reasoning (*Istiḥsān*) and 5) Juristic Speculation*Ra'y*. No Islamization however, is possible without a good comprehension of Islam and its spirit. More so, this is important in Islamizing the research model of a modern university where the method of analogy is the only tool available.

APPENDIX

WORKSHOP PROGRAM

Friday	3:45	*Ṣalāt al 'Aṣr*
	4:00–6:00	**Session 1** (Opening) **Moderator:** Ṭāhā Jābir al 'Alwānī **Rapporteur:** Jamal Barzinji 'AbdulḤamīd AbūSulaymān *Theme Introduction*
	6:00–6:30	*Ṣalāt al Maghrib*, and *al 'Ishā'*; Snacks
	6:30–8:00	**Session II** **Moderator:** M. A. K. Lodhi **Rapporteur:** Wael Fahad Essam Ismail *Profiles of Muslim Students in USA: Population and Orientation* M. Yameen Zubairi *The Principle of Intrinsic Opportunity*
	8:00	Dinner at the Guest House
Saturday	6:00–6:30	*Ṣalāt al Fajr–Dars Qur'ān*
	7:30–8:00	Breakfast

8:30–10:00	**Session III** **Moderator:** Sayyid M. Syeed **Rapporteur:** Ahmad Totonji Syed M. Amir *Scientific Research in Muslim Countries* S.H. Durrani *Islamic Values*
10:00–10:30	Break
10:30–12:30	**Session IV** **Moderator:** Hisham Altalib **Rapporteur:** Mustafa Fahmi S. Imtiaz Ahmad *Perspectives on Knowledge Engineering* Muhammad Ishaq Zahid *Use of Islamic Beliefs in Mathematics and Computer Science Education*
12:30–2:00	*Ṣalāt al Ẓuhr* & Lunch
2:00–4:00	**Session V** **Moderator:** Ahmad Totonji **Rapporteur:** Muhammad Anwar Adel A. Bakr *A Blue Print for the Islamization of Attitudes and Practices in Earth Sciences with Special Emphasis on Groundwater Hydrology* Mazhar Hussaini *Islamic Attitudes and Practices in Food and Nutritional Sciences*
4:00–4:30	*Ṣalāt al ʿAṣr;* Snacks

	4:30–6:00	**Session VI** **Moderator:** Abdulrahman Alamoudi **Rapporteur:** Hisham Altalib M. A. Ki. Lodhi *The Making of a Scientist or the Islamization of a Muslim Scientist* Ali Kyrala *The Islamic Basis of the Coming Muslim Technological Renaissance*
	6:00–6:30	*Ṣalāt al Maghrib and Ṣalāt al 'Ishā'*
	6:30–8:00	**Session VII** **Moderator:** Ali Kyrala **Rapporteur:** Sayyid M Syeed Tariq S. Najm *Islamic Directives of Science and Technology* Ilham Altalib *Islamization of Medicine*
8:00	*Dinner at Guest House*	
Sunday	6:00–6:30	*Ṣalāt al Fajr–Dars Qur'ān*
	7:30–8:00	**Breakfast**
	8:30–10:00	**Session VIII** **Moderator:** Farouq Abdul-Haqq **Rapporteur:** Iqbal Unus Summary Reports by Rapportuers
	10:00–10:30	**Break**

10:30–12:30	**Session IX** (Conclusion) **Moderator:** Jamal Barzinji *Final Summary & Future Plan* 'AbdulḤamīd AbūSulaymān M. A. K. Lodhi
12:30–2:00	*Ṣalāt al Ẓuhr*; Lunch

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Journals

AJISS *American Journal of Islamic Social Sciences* (AJISS). A quarterly published jointly with the Association of Muslim Social Scientists (AMSS), U.S.A.

MWBR *Muslim World Book Review* and *Index of Islamic Literature.* A quarterly published jointly with the Islamic Foundation (U.K.).

ABOUT THIS BOOK

This book is a compilation of selected papers presented at the Workshop on the Islamization of Attitudes and Practices in Science and Technology. (1408-1987). Sponsored by the Association of Muslim Scientists and Engineers (AMSE) and the International Institute of Islamic Thought (IIIT), this pioneering workshop emphasized the Islamization of attitudes and practices in the natural sciences.

Until recently studies on "Islamization" have concentrated primarily on the social sciences and humanities. This book focused on the problems and challenges of attitudes and practices in science and technology with respect to ideology, personality, education and environment of the Muslim scientists in the contemporary world.

This work includes M.A.K. Lodhi's "The Making of a Scientist: The Islamizing of a Muslim Scientist"; Syed M. Amir's "Science Research in Muslim countries"; S. H. Durrani's "Incorporation of Islamic Values in the Administration of a Science Research Institute"; and M. Mazhar Hussaini's "Attitudes and Practices in Food Nutritional Sciences."

Other highlights include "The Islamic Basis of the Coming Muslim Technological Renaissance" by Ali Kyrala. "Use of Islamic Beliefs on Knowledge Engineering" by S. Imtiaz Ahmad; and "Islamization of Attitude and Practice in Embryology" by Ibrahim B. Syed.

In all, thirteen prominent scholars share their valuable insights on their respective disciplines in this book. We hope that both Muslim and non-Muslim scholars *will* find their work to be a valuable source of critical observations and profound germinal concepts for future development.