April 19, 1996 - revised October 20, 2005

# Islam, Science and Values

by

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## 1. The Context of Global Knowledge:

Consider the paradoxes of our times. We live in a world of plenty, of dazzling scientific advances and technological breakthroughs. Adventures in cyberspace are at hand. The Cold War is over, and with that we were offered the hope of global stability. Yet, our times are marred by conflict, violence, debilitating economic uncertainties and tragic poverty. Globalization and the assertion of local group specificity seem to be everywhere[1]. Worse, we live in a world where the rising inequities between the rich and the poor are everywhere, nationally and internationally. But these inequities are probably even more acute in the domain of knowledge, at the time when the world is hurtling towards the information-based society.

Let us for a moment look at the global reality in which the Muslim intellectuals function, the reality of an enormous and frightening knowledge gap and the risks inherent in it.

There is a vast and growing gap in the production and availability of scientists and engineers between the North and the South by a factor of ten to twenty times[2]. This is purely on the quantitative side, and does not speak of the quality of the training or the resources at the disposal of the scientists[3]. In addition, scientists in the developing countries suffer from problems of access,

[1]For a discussion of some of these trends, see Ismail Serageldin, Nurturing Development: Aid and Cooperation in Today's Changing World, Washington, D.C.: World Bank, 1995.

[2]According to UNESCO statistics, As of 1990, the number of scientists per million population was running from 4,700 in Japan to 3,800 in the USA to 2,300 in Europe, Canada and Australia to 1,000 in the "tigers" of East Asia, to well less than 200 in India, Africa and much of the Far East. See Remi Barre and Pierre Papon, "Global Overview" in UNESCO, Science Yearbook 1993, UNESCO, Paris, 1993, p. 140.

[3]In the United States alone, there are 200,000 academic researchers funded to the tune of some $60 billion annually. (See David L. Goodstein, "After the Big Crunch", in the Wilson Quarterly, , vol. 19, No. 3, Summer 1995, p.54).

visibility and recognition[4]. The Muslim world does not escape this remarkable inequality of numbers and resources, nor is it immune to this inequity in treatment. Furthermore, many of our institutions of science and technology are deprived of equipment and supplies, and voided of their standards of excellence in the service of political expediency and cronyism. We are still struggling with the needs of basic laboratory equipment at a time when the north is mainstreaming computers for the average person to use as simply as telephones.

In addition, an amazing information explosion is taking place, and as we enter into the new century, information will be everywhere around us. Furthermore, with simple and inexpensive tools the most remote locations will not be excluded from tapping into it. We can leapfrog some of the slavish location-specific patterns of development of science and knowledge accumulation that earlier generations had to adhere to. PCs and network hookups will be as cheap and available as transistor radios.

Against this background, it becomes clear that never before has the need for the scientific enterprise of the developing countries -- our scientific enterprise -- been greater, and never before has the potential for its success been as present as it is today.

And yet, as the world explores the marvels of the genes and breaks down the secrets of the atom and reaches to the stars and calculates the age of the oldest rocks ... we in the Muslim world debate "the hadith of the fly"... we debate whether a woman's nail polish prevents her from having full ablutions, we look with suspicion on the new and try to erect barriers to limit where our minds may range[5]...

## 2. Islamic attitudes to science:

It is always amazes me to find this pernicious debate on "Islam and Science" being put forward as if they are contradictory. Sadly, many of those who advance such arguments are supposedly scholars of Islamic thought or Muslim scholars. In both cases they do not merit the mantle of scholarship. They are either mistaken or intentionally misrepresenting the facts.

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[4]The discrepancy between North and South is further magnified by the many obstacles that impede the science of the South from being adequately recognized in the North. Southern journals, even when they try to adhere to impeccable standards find it very difficult to be listed in the authoritative Science Citation Index (SCI). The SCI is run by the Institute for Scientific Information, a private firm in Philadelphia. The SCI lists about 3,300 journals from about 70,000 worldwide. Inclusion in the SCI and a few other databases is very important to be seen by scientists everywhere. See W. Wayt Gibbs, "Lost Science in the Third World", in Scientific American, August, 1995, pp. 92 - 99.

[5]The great reformer, Muhammad Abduh, was committed to this idea that there is no limit to where the mind may roam in the search for understanding the world and the search for truth. See Muhammad 'Imara (ed), Al-A'mal Al-Kamila lil Imam Muhammad Abduh (the complete works of the Imam Muhammad Abduh), (in six volumes), Al-Mu'assasa Al-Arabiya Lil Dirasat Wal Nashr, Beirut, 1972, vol. 1: p. 183.

Let us first start with the "Usuli[6]" argument from the sources. This means to rely on primary sources as much as possible, but it differs from the "rejectionist" mode of thinking[7] that so many of the contemporary Muslim "Usuli" writers seem to take[8]. Let us not start by postulating the need to underline the "otherness" of the Muslim experience. Rather, let us return to the original sources of Islamic doctrine, the Quran[9] and the Sunna of the Prophet[10], and relate these to the historical context of past experience and present realities.

The search for Knowledge ('Ilm) and Truth (Haq) are an integral and undeniable part of the Muslim tradition. The pursuit of knowledge is the single most striking feature in a system of great revelation such as Islam. The word 'Ilm (knowledge) and its derivatives occur 880 times in the Quran. But knowledge is not perceived as neutral. It is the basis for better appreciating truth (Haq), which is revealed but which can be "seen" by the knowledgeable in the world around them. Indeed, believers are enjoined to look around and to learn the truth. The Prophet exhorted his followers to seek knowledge as far as China, then considered to be the end of the earth. Scientists are held in high esteem: the Prophet said that the ink of scientists is equal to the blood of martyrs. The very first word of the Quranic revelation was an order to read[11] and to learn, and to seek knowledge.

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[6]The reference is to the "Usul" or foundations, or bases. It is also a whole domain of Muslim Jurisprudence, refered to as "Usul Al-Fiqh" or foundations of jurisprudence. See, inter alia, Mohammed Abu Zahra, Usul Al-Fiqh (the Foundations of Jurisprudence), Dar Al- Fikr Al-Arabi, Cairo, 1958, and Abdel Wahab Khallaf, 'Ilm Usul Al-Fiqh (The Science of Foundations of Jurisprudence), Dar AlQalam, Kuwait, (1942,1947) ninth edition, 1970

[7]An extreme statement of this rejectionist viewpoint is given by Maududi as quoted by Leites: "Thus, no elements of Western culture may be incorporated into a truly Islamic society. Maududi warns that in choosing the path of Islam people will [. . .] `have to give up all desire for material gains and sensual pleasures that has been created by the fascinations of the Western civilization; they will have to cleanse their mind of all those concepts and ideas that they have borrowed from Europe; and they will have to cast off all those principles and ideals that they have imbibed from the Western culture and way of life.'" Justin Leites, "Modernist Jurisprudence as a Vehicle for Gender Role Reform in the Islamic World," Columbia Human Rights Law Review 22 (2) (Spring 1991): 323, quoting A. Maududi, Purdah and the Status of Women in Islam (Lahore: Islamic Publications, 1972), 17.

[8]Some members of the Islamic movement are themselves revisiting some of these aspects of contemporary thinking in the "movement". For an interesting and thoughtful insider's critique, see Abdallah Al-Nafisi, ed., Al-Haraka Al-Islamiyya: Ru'ya Mustaqbaliya: Awraq fil Naqd Al-Dhati (The Islamic Movement: A View to the Future: Papers in Self-Criticism) (Kuwait, 1989); and Muhammad 'Imara, Al-Sahwa Al-Islamiyya wal Tahadi Al-Hadari (Islamic Revival and the Cultural Challenge) (Beirut: Dar Al-Mustaqbal Al-Arabi, 1985).

[9]The *Quran*, which is held by all Muslims to be the word of God, is in Arabic. There are many translations of the meanings of the *Holy Quran*, but for this essay I have used the authoritative translation of Yusuf Ali (The Meaning of) The Glorious Quran, Dar al Kitab Al-Arabi/Dar Al-Kitab Al-lubnani, Cairo/Beirut, N.D. This is the work which (in its two-volume edition) is distributed by the Rabitat Al-'Alam al-Islami of Saudi Arabia.

[10] The "Sunna", meaning "the way" in Arabic, technically refers to the way the Prophet showed for all Muslims to practice to live as Muslims. More generally, it refers to the words and deeds of the Prophet, his "tradition." The *Sunna* is the record and analysis of the words and deeds of the Prophet Muhammad. It is distinct from the *Quran* and is considered by all Muslim scholars as complementary to the *Quran* and second only to the *Quran* as source of authority for legal and religious rulings. For a discussion of the subject see Ahmad Umar Hashim, Al-Sunna Al-Nabawiyya wa 'Ulumiha (The Prophetic Tradition and Its Sciences), Gharib Library, Cairo, 1989.

[11]The verses are rendered by Yusuf Ali as:

> Read! In the name of thy Lord and Cherisher who created-
> Created man, out of A (mere)clot of of congealed blood:

The earliest Muslims were not averse to using the best science and technology that they could find. There is no case of the Prophet refusing to use the best technology either for war or peace. The early Muslims, when confronting the philosophy of Plato and Aristotle, did not call for banning or burning their books. Indeed, they translated them into Arabic, they wrote excellent studies about them and selected those part of Greek philosophy that suited their needs and interests and rejected the other parts. Al-Farabi's brilliant contributions to the foundations of Muslim philosophy, never denied his reading of Plato and Aristotle[12], nor is his personal contribution diminished by that, any more than Einstein's contributions would be diminished because he read and studied Newton and Maxwell.

Furthermore, evidence from recent scholarship[13] shows that even in the so-called periods of decline, the great scientific disciplines of the astronomers in Damascus and the Maragha School[14] continued to be at the cutting edge of world science well into the 16th century. They preceded Copernicus in their critique of the Ptolemaic system, and in fact, their critique was more profound[15]. The later Muslim scientists also remained open to the study of the Copernican theories at a time when the Church in the West was condemning them as heretical, not surprising considering how much of Copenicus' work had already been developed by the Muslim astronomers one or two centuries before[16].

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Proclaim! And thy Lord is most Bountiful, -
He who taught (the use of) the pen, -
Taught Man that which he knew not. (Quran, 96:1-5)

[12]Al-Farabi (870-950 AD), is widely considered to be the founder of Islamic philosophy, and his work on Greek philosophy is of particular relevance to this discussion. See Alfarabi's Philosophy of Plato and Aristotle, translated with an introduction by Muhsin Mahdi, Agora Editions, The Free Press of Glencoe, New York, 1962.

[13] See George Saliba, A History of Arabic Astronomy: Planetary Theories During the Golden Age of Islam, NYU Press, New york, 1994

[14]The reference is to the activities of scientists at the Maragha Observatory in Northwest Iran and others who undertook similar or related work. It is an unfortunate choice because it has been employed by scholars to refer to works preceding the Maragha observatory and to works done elsewhere. Nevertheless it has acquired currency in circles dealing with the history of science and Islamic science. See note 11 in Saliba, op.cit., p. 41

[15]The critique linked observation, philosophy and geometry in model building. It was a profoundly sophisticated critique, that advanced the status of astronomy and the available data sets of observations. The importance of Saliba's contributions in establishing this new view should not be underestimated. Basing himself on the original manuscripts, he has convincingly refuted the conventional view that these scientific activities were not related to observation, and that the critiques of the Ptolemaic system were of a philosophical nature. Saliba's work has thus superseded such works as Owen Gingerich's "Islamic Astronomy" (in Scientific American, 254, 1986, pp.74-83) or A.I. Sabra's "The Scientific Enterprise" (in Bernard lewis (ed) Islam and the Arab World, Thames and Hudson, London, 1976, pp. 181-200). Regretfully, these older works still have much currency in the West today.

[16]A number of recent scholars have underlined this fact, and the weight of evidence has been accumulating in the last twenty years or so. See, inter alia, E. S. Kenedy, et al, Studies in the Islamic Exact Sciences, ed. by D. King and M.H. Kennedy Beirut, 1983, pp. 50-107, and N. M. Swerdlow, "The Derivation of the First Draft of Copernicus's Planetary Theory: A Translation of the commentariolus with Commentary" in Proceedings of the American Philosophical Society, 117: 1973, pp. 423-512. Indeed, Swerdlow and Neugebauer go as far as to state: "The question therefore, is not whether, but when where and in what form he {i.e. Copernicus} learned of

So, let us not waste time on artificial and misleading dichotomies that are neither supported by the primary sources nor by the historical record of the Muslim societies.

Before proceeding further, however, it is necessary to settle one more false dichotomy which is being put forward by many today, namely that the nature of knowledge and truth is such that it precludes a true Muslim from being a practicing scientist, or accepting scientific evidence. This line of argument was well dissected by Akbar S. Ahmed among others[17]. Indeed, Ahmed points out that Umberto Eco, along with many influential thinkers, believes that there is an irreconcilable difference between the study of philosophy and being a believer[18]. That view is pernicious, since the religious dimension of the truth being asked of the believer in the Quran is of a different kind than that of the search for knowledge and truth being pursued by science.

Fazlur Rahman, the great Muslim thinker, challenges Eco's assumptions that there are "two truths", one from the Quran and one from philosophy, and that they are to be left undisturbed. Rahman considers that knowledge (ilm), the creation of ideas is "an activity of the highest order". Rahman then challenges not just Eco and other westerners, but also the so-called Muslim scholars who would pursue such a dichotomy: "Otherwise why did it [The Quran] ask the Prophet to continue to pray for 'increase in knowledge'? Why did it untiringly emphasize delving into the universe, into history, and into man's own inner life? Is the banning or discouragement of pure thought compatible with this kind of demand? What does Islam have to fear from human thought and why? These are questions that must be answered by those 'friends of religion' who want to keep their religion in a hot-house, secluded from the open air"[19].

Having thus disposed of these false dichotomies, we can proceed to ask a few questions about the current state of the universities in the Muslim world, for it is in the universities that one would expect the practice of science in the Muslim world to take place, and more importantly, it is in the universities that the inter-generational transfer of knowledge and attitudes takes place.

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Maraghatheory." And further "In a very real sense, Copernicus can be looked upon as, if not the last, surely the most noted follower of the 'Maragha School'" , N.M. Swerdlow and O. Neugebauer, Mathematical Astronomy in Copernicus's De Revolutionibus, Springer, New York, 1984; (also cited in Saliba, op.cit., pp.254-255).

[17]Akbar S. Ahmed, Postmodernism and Islam: Predicament and Promise, Routledge, London, UK, 1992.

[18]Eco has stated "If the Koran says something different, the philosopher must philosophically believe what his science shows him and then, without creating too many problems for himself, believe the opposite, which is the command of faith. There are two truths and one must not disturb the other." (See Umberto Eco, "Function and Sign: An introduction to Urban Semiotics", in M. Gottdiener and A. Lagopoulos, (eds.) The City and the Sign: An Introduction to Urban Semiotics, New York, 1986, p.264. cited in Akbar S. Ahmed, Postmodernism and Islam: Predicament and Promise, Routledge, London, UK, 1992, pp. 84-85.)

[19]Fazlur Rahman, Islam and Modernity: Transformation of an intellectual tradition, University of Chicago Press, Chicago, Ill., 1984, pp. 158-9; also cited in Akbar S. Ahmed, Postmodernism and Islam: Predicament and Promise, Routledge, London, UK, 1992, pp. 84-85.

## 3. The Challenge to the Universities:

It is clear that the arenas where ideas are developed and communicated to the next generation are the universities, even if the mass media play a formidable role in mobilizing society as a whole. Yet, it is equally clear that universities in the Muslim world are facing far more than a financial challenge, although many are indeed pitifully short of funds. Indeed, the biggest challenges facing our universities today are the absence of freedom of inquiry, the virtual disappearance of quality standards, a loss of public prestige due to political interference, and a more general and profound questioning of the traditional functions of institutions of higher learning in most societies.

This is not to say that western universities are problem free. Indeed, many parts of the Western academic establishments have now acquired a bureaucratic and ideological dimension that make the practice of science difficult. It is all the more so in the areas of the social sciences, where it is easier to attack the motivations of the authors than to address the substance of their arguments. The difficulties of addressing a dominant paradigm is also tainted by the politics that pervade the various academic departments and associations[20] But this is still a matter of degree, and no objective author would deny that the state of the universities in the Muslim world today leaves much to be desired, and that is the topic of this essay, not the critique of the universities of the West, about which a wholly different critique can be made[21].

Let us now turn to the more general critique based on the traditional functions of institutions of higher learning. There were three traditional functions that universities were expected to perform[22]:

i. A certification function. After a certain amount of skill imparting instruction, a test was conducted and the student was certified as competent in the subject matter. A degree was granted. Increasingly, however, this was supplanted with continuing education and re-certification and other forms of professional peer-reviewed certification and professional licensing arrangements. This was only partly due to the parochialism of the professional societies. It has a lot more to do with the recognition of the speed at which knowledge, especially in scientific and technical fields, is exploding, making obsolescence of technical knowledge one of the great problems of our time.

Furthermore, the structural unemployment that dogs today's societies, even industrial societies, makes the implicit promise of a job at the end of the university degree increasingly uncertain. The doubt about the relevance and the rigor of the training is therefore exacerbated.

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[20]See for example the difficulties of the socio-biologists to engage in a formal intellectual debate in the anthropological and sociological schools, described at some length by Lionel Tiger, in "My life in the Human nature Wars", in The Wilson Quarterly, vol. xx, No. 1, winter 1996, pp. 14-25.

[21]See for example, the excellent "What's wrong with the American University?" a special section in The Wilson Quarterly , vol. xx, No. 1, winter 1996, pp. 43-66, which includes a discussion of the economics of higher education in the U.S.: Chester E. Finn and Bruno V. Anno, "Behind the curtain", (pp. 44-53) and the conditions of the faculty: Alan Wolfe, "The Feudal Culture of the Postmodern University" (pp. 54-66).

[22]See inter alia Robert Paul Wolff, The Ideal of the University, Beacon Press, Boston, 1970.

ii. The advancement of knowledge and the search for truth[23]. This, too, is being eroded, as the validity of "truth" is increasingly called into question by a rising tide of relativism and the conflicting claims of competing dogmas[24]. The university is, as it has frequently been, the battleground for the ideological culture wars around the world. The faculty and students are the key and most consistent agents of change in any society. Yet the ideological dogmas cannot be allowed to define what is true, much less to define what may actually be researched[25]. Therein lies the trap that we face today, from the attacks of dogmatists to the efforts of deconstructivists to relativize everything and thereby void it of meaning[26]. Returning to the search for truth as a major commitment of intellectuals is a way to build the common ground between religious and secular thought[27].

iii. A socializing function. All youths get to learn a set of behavioral and social skills that their society values, and puts store on. In addition, the grounding of the national cultural identity through an emphasis on teaching courses about the people's culture, history and current societal institutions was a key part of educating the future generation. University education was the place to explore the boundaries of pluralism without jeopardizing the cohesiveness of the national identity. It was the possibility of learning the value of rejoicing in the richness of diversity, while learning to appreciate the common threads between different parts of this enriching diversity.

Yet today, in the wake of the global multi-cultural pluri-ethnic environment, all societies are confronted with a lot more questioning of the prevalent social values, and profound doubt about the validity of any single unifying cultural construct. In the United States, as well as in many parts of

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[23]In 1969, when Harvard University, along with most of the Universities of the world, was forced to confront its fundamental values in the wake of widespread student unrest, the University Committee stated: "...the pursuit of truth and learning is the central value of the university." See the "University on Governance" series of monographs, especially: Harvard University, The Nature and purposes of the University: A Discussion Memorandum (Interim Report), Harvard University, Cambridge mass., January 1971, p. 3

[24]Distinguished philosophers such as Mortimer Adler, consider the idea of "Truth" as one of the three key ideas we judge by. See Mortimer Adler, Six Great Ideas, MacMillan, New York, 1981, pp. 56-63.

[25]The clerical attacks on free inquiry come in many different garbs. We tend to think of the battles between the Christian church and the key figures of western science from Galileo to Darwin, but we must also include the clerics of secular ideology as well: Lysenko in Soviet biology, and a wide array of "political correctness" from the right (e.g. McCarthyism in the 1950s) and the left, dominant in France for a long time and on the ascendant on many western campuses today, especially in the United states.

[26]See inter alia, the works of Michel Foucault such as, L'Archeologie du Savoir, Editions Gallimard, Paris, 1969 and L'Art du Discours, Editions Gallimard, Paris, 1971. Both of these works have also appeared in English: Michel Foucault, The Archeology of Knowledge and The Discourse on Language, translated from the French by A. M. Sheridan Smith, Pantheon Books, New York, 1972. Among the French intellectuals, contrast Foucault's work with the more thoughtful work of Edgar Morin, especially the third volume of his trilogy on "La Methode", entitled La Connaissance de la Connaisance, Seuil, Paris, 1986. For a general critique of the deconstuctionists, see, inter alia, John M. Ellis, (ed.) Against Deconstruction, Princeton University Press, Princeton, NJ 1989.

[27]Thomas Merton, the distinguished Catholic philosopher wrote: "At root one searches for God by only one way, i.e. in following the truth with all the sincerity of one's conscience." From a letter by Thomas Merton to Feminist Argentinian Literary figure Victoria Ocampo dated January 13, 1963; see: Thomas Merton, The Courage for Truth: Letters to Writers, Selected and edited by Christine M. Bochen, Farrar-Strauss-Giroux, New York, 1993, p. 209.

the western world, there is a rising babble of pseudo-science and astrology that muddy the waters of rational discourse. These are times when the reassertion of the commitment to serious science is needed to reinforce the societal values that undergird the scientific enterprise. The fight against quackery is a never ending one, and many of the scientists who used to consider it beneath them to engage in debunking these currents of superstition and obscurantism are now getting engaged because they see the corrosive damage that they inflict on society[28]. The Muslim societies of today are the crucible of many of these same currents, and they are experiencing many of the same problems.

These problems, however, have exploded with particular vehemence in the wake of the intolerant fanaticism of Muslim so-called fundamentalists[29] and the ideological politicized positions of many others, including radical leftists, on the campuses. It is the duty of intellectuals to oppose and question dogma, not to create or perpetuate it[30]. But today, fear of the hegemonic West looms ever larger for an insecure faculty, ill-equipped to handle the challenges of the day, and the domain of inquiry is ever more circumscribed by the bigotry and intolerance that pervade our societies.

Thus, it is not just a matter of pouring money in the universities of the Muslim world to enable them to be "centers of excellence" in science and technology that is required. Far from it. It is a rethinking of the University as a vector of social change in our modernizing societies, in the rapidly changing world environment of today, that is called for.

This will require liberating the Muslim mind from fear of the different, the new and the foreign, and the promotion of the respect of diversity in a shared collectivity. These are values inherent in the scientific outlook, that promotes bonds that transcend race and culture to reshape culture in the broader, more tolerant framework that the true scientific enterprise requires and engenders. These are also profoundly Islamic values.

It is a profound challenge. Paradoxically, this challenge can only be answered by promoting the scientific outlook throughout society. For the scientific outlook helps in the modernization (as distinct from "westernization") of society, and that kind of modernization will strengthen the possibility of universities to play their full role, in arts and philosophy as well as science. And as universities play their full societal role, they will further help to promote the scientific outlook.

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[28]See Carl Sagan, The Demon-Haunted World: Science as a Candle in the Dark, Random House, NY, 1996.

[29]The phenomenon of militant Islamic fundamentalism is well analyzed in Daryush Shayegan, Qu'est-ce qu'une Revolution Religieuse?, Albin Michel, Paris, second edition, 1991. Shayegan has clearly woven together the philosophical, sociological and religious strands of thought to analyze the double failure of modernity and tradition to meet the needs of an anxious population. This, he argued, gave rise to the new obscurantism, which he prefers to refer to as "the ideologization of tradition".

[30]Edward Said, defined the intellectual as an "individual endowed with a faculty for representing, embodying, articulating a message, a view, an attitude, philosophy or opinion to, as well as for, a public. ... someone whose place it is publicly to raise embarrassing questions, to confront orthodoxy and dogma (rather than to produce them), to be someone who cannot easily be co-opted by governments or corporations, and whose raison d'être is to represent all those people and issues that are routinely forgotten or swept under the rug."[30] See Edward Said, Representations of the intellectual, Pantheon Books, New York, 1994, p. 11

## 4. The Scientific Method and the Values of Science:

These issues go to the very heart of the meaning of development. The promotion of science per se is an integral part of the modernization process. Without it, the social transformation that is implicit in modernization will not take place.

I hasten to add that modernization here is not synonymous with westernization[31], although there is a central core of universal values that any truly modern society must possess, and these are very much the values that science promotes: rationality, creativity, the search for truth, adherence to codes of behavior and a certain constructive subversiveness.

### 4.1 The meaning of science:

Let me start by asserting, along with Bronowski, that I define science as "the organization of our knowledge in such a way that it commands more of the hidden potential in nature".[32] In that definition, it is clear that it goes far beyond the utilitarian application of knowledge. It impacts on an entire world outlook from cosmology to being. It is an enterprise that forces upon its practitioners values and outlooks peculiar to science and that in its essence are the keys to modernization. These approaches to thinking are very different from the cheap embrace of technology as the savior of society and the world, and the disengagement from moral issues that is prevalent among many today[33].

Values are not rules. They are in Bronowski's beautiful phrase: "... those deeper illuminations in whose light justice and injustice, good and evil, means and ends are seen in fearful sharpness of outline.[34]" This is a critical thought, and an important reminder of the core Muslim values of openess, honor and tolerance, in the context of the intolerant debate that permeates so much of the public discourse in the Muslim World today, where a person is judged by the color of their skin or the god they choose to worship or the ethnic group they were born into or their gender.

This thought -- that the openness and rigor of science, and its dedication to the search for truth, can give a context for our judgments -- is a powerful reason to rethink the need to promote science as an essential element in the development process. Let me hasten to acknowledge that not all scientists

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[31]This is an issue that touches all developing societies. See among others Alvin Y. So, Social Change and Development: Modernization, Dependency, and World-System Theories, Newbury Park, Cal., Sage, 1990.

[32]J. Bronowski, Science and Human Values, (revised edition with a new dialogue, the Abacus and the rose, 1965), Perennial library edition, Harper and Row, New York, 1972, p. 7

[33]See inter alia, Theodore Roszak, The Cult of Information: A neo-Luddite Treatise on High Tech, Artificial Intelligence, and the True Art of Thinking, University of California Press, second Edition, 1994; and Neil Postman, Technopoly: The Surrender of Culture to Technology, Knopf, NY, 1992

[34]J. Bronowski, op.cit., p. xiii

have been pursuing the truth with that same level of commitment to the values of science[35]. Wittingly or unwittingly, we are all partially captives of our milieu, but Science certainly does more to help us overcome the limits and prejudices of this milieu than almost any other activity involving knowledge. Interestingly enough, there is a profound critique of the values of science by the more extreme of the artistic and liberated minds for the reductionist, quantifying rigor they associate with science[36]. This is a different critique, which really has more to do with appreciating the limits of scientific investigation[37], not a challenge to the values that undergird the scientific enterprise or to the need to recognize other forms of endeavor beyond the scope of science.

### 4.2 The humanist perspective :

I think that all would agree that the essence of development is a deep humanism. Humanism is itself defined by a set of profound values that, in my mind require the scientific outlook and the values of science. Sadly, there are many who fear this view in the Muslim countries today. The rise of intolerant fundamentalism is a manifestation of this fear.

This fear starts from a view that concepts of value - justice and honor, dignity and tolerance - have an inwardness which is not accessible to experience. Accordingly, "because they believe that there is no rational foundation for values, they fear that an appeal to logic can lead only first to irreverence and then to hedonism."[38]

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[35]Scientists, of course also have their prejudices, and frequently politics and ideology intrude into the scientific realm, as was dramatically the case with Lysenko and biology in the Soviet Union. But more subtle and pernicious intrusions or researcher prejudices can intrude into the scientific assessments of the researchers, even when they think that they are indeed being as rigorous as they can be. See Stephen Jay Gould, The Mismeasure of Man, Norton, New York, 1981 for an impressive expose of this phenomenon

[36]When Vaclav Havel, playwright and President of the Czech Republic, writes about modern rationalism and modern science: "This era [of science and rationalism] has reached the end of its potential, the point beyond which the abyss begins." (Cited in J. Michael Bishop, "Enemies of Promise" in the Wilson Quarterly, , vol. 19, No. 3, Summer 1995, p. 62); he is asserting that other realities of the human condition are beyond the scientific method to explore and decipher. That is, of course the realm of religion, art and philosophy. This existential lament, however, is no justification of obscurantist, authoritarian societies that want to lock up the minds of their citizens. Havel himself, sprang to political prominence precisely for defending the freedom to think. The critique of the "limits to rationality" type are well represented in the work by John Ralston Saul, Voltaire's Bastards: The Dictatorship of Reason in the West, Vintage Books, New York, 1992. Antonio R. Damasio has looked at the question in a different light, linking the neural underpinnings of reason and the emotional aspects of human behavior to gain better insights into the phenomenon of rationality. See: Antonio R. Damasio, Descartes' Error: Emotion, Reason, and the Human Brain, Grosset/Putnam, New York, 1994. Such efforts at deepening our understanding are themselves the fruits of the values of science as I have been discussing them, and will enrich our understanding as all good science is intended to do.

[37]This notion of a hierarchy of theories or constructs is ably presented by one of the leading scientists in the world. See Stephen Jay Gould, An Urchin in the Storm: Essays about Books and Ideas (New York: W.W. Norton & Co., 1988), 68-69.

[38]Bronowski, Science and Human Values , op.cit., p. 53

How mistaken they can be.

Science values originality as a mark of great achievement. But originality is a corollary of independence, of dissent against the received wisdom. It requires the challenge of the established order, the right to be heard however outlandish the assertion, subject only to the test of rigorous method[39].

Independence, originality, and therefore dissent -- these are the hallmarks of the progress of contemporary civilization. ... (For)..."Dissent is the mark of freedom as originality is the mark of independence of mind."[40]

**4.3 The value of modernization and the modernization of values**:

We all know that effective pursuit of science requires the protection of independence. Without independence of inquiry, there can be no true scientific research. The safeguards which independence requires are obvious: free inquiry, free thought, free speech, tolerance, and the willingness to arbitrate disputes on the basis of evidence. These are societal values worth defending, not just to promote the pursuit of science, but to have a better and more humane society. A society that is capable of adapting to change and embracing the new. A tolerant society[41].

Tolerance based on the adoption of the values of science is different from the tolerance begotten by indifference to the behavior of others, dismissing them without engaging them. Tolerance among scientists " must be based on respect. Respect as a personal value implies, in any society, the public acknowledgments of justice and due honor. ... If these values did not exist the society of scientists would have had to invent them to make the practice of science possible. In societies where these values did not exist, science has had to create them."[42]

[39]The resistance by the scientific community to changes in the dominant paradigm of a particular branch of science, however, can be severe. It tends to be partly due to vested interest and partly to inertia and partly to cliquishness in scientific circles. These are in addition to the reasonable "burden of proof" on the innovators. The process, however is well known and has been brilliantly described by Thomas Kuhn in his The Structure of Scientific Revolutions, University of Chicago Press, Chicago, 1962 (Phoenix books edition, 1970).

[40]Bronowski, op.cit., pp.61-62

[41]See Barrington Moore, Jr., "Tolerance and the scientific Outlook" in Robert P. Wolff, B. Moore, Jr. And Herbert Marcuse, A critique of Pure Tolerance, Beacon Paperbacks, Boston, 1969, pp. 53-79. Regretfully, in the concluding paragraph, this excellent essay uses some unfortunate references to Muslims and the Koran, attributing to them the willingness to see .."other books...may be cast on the flames." This typically ignorant comment is a use of a Western stereotype that is unworthy of the rest of the essay, which deals with Science and tolerance and reason in the Western context.

[42]Bronowski, Ibid., p.63

**4.4 Promoting the scientific outlook:**

So, if we accept that science promotes certain values that we hold as essential for the true modernization of a developing society, how does one promote this broad concept of science? How does one involve the leaders and decision-makers in the promotion of scientific outlook? Can such ideas resonate in a society wracked by poverty and hunger, riven by civil strife and worried about fiscal crisis? I can already hear the nay-sayers, and their emphasis on pragmatism, realism, and the urgent. But they are wrong.

Science does have the capacity to capture the imagination and to move the emotions. As Steven Weinberg noted: "Today's basic scientific research is part of the culture of our times."[43]

Weinberg is right. We must see science as an integral part of our culture, that informs our world view and affects our behavior. It promotes fundamental ethical values. Indeed, "Those who think that science is ethically neutral confuse the findings of science, which are, with the activity of science which is not."[44]

Even more, science is itself a culture of global dimensions. To the extent that culture can be defined as comprising both an activity, and a vision - a way of doing things, and a way of thinking and feeling about them - then science is a culture, or at least a cultural current that affects strongly the society where it flourishes.

It brings imagination and vision to bear on concrete problems and theoretical speculation. After all, in Blake's immortal phrase: "What is now proved was once only imagin'd." Imagination and vision are at the very heart of the scientific enterprise. Again, Bronowski put it beautifully when he said "..we are the visionaries of action; we are inspired with change. We think the past preserves itself in the future of itself, the way Isaac Newton is changed and still preserved in Albert Einstein. We are the culture of living change."[45]

How different is this vision of continuity with its respect for past achievements reborn in contemporary ones, from that of those militant Muslim fundamentalists who would freeze us forever in their own interpretation of the past.

In fact, the values promoted by that scientific outlook: honesty, honor, truth, and the use of reason, are profoundly Islamic values. These were the values in the period when Islamic science was defined as the contributions that Muslims made to the collective scientific enterprise, rather than an effort to dissociate ourselves from the rigor of scientific debate by claiming a separateness to our scientific enterprise. So let us not allow the essence of these arguments to be sidelined by

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[43]Steven Weinberg, "Life in the Universe", Scientific American, vol.271 : No. 4, October, 1994, p. 49

[44]Bronowski, Op.cit., pp. 63-64.

[45]Bronowski, The Abacus and the Rose, op.cit., p. 118

arguments about Islam and the west[46]. Let us reclaim, as intellectuals, our right to reason[47], let us liberate the Muslim mind.

Let us hold up mirrors for our societies to see themselves, and windows through which they can see the world[48]. Let us accept that the promotion of the scientific outlook is necessary and unavoidable for the pursuit of science, and is in itself a major part of promoting the societal values that are at the core of modernization and development. These are not two separate tasks, promoting two separate endeavors, they are a single, more effective way of doing either or both.

The role of government at this intersection of the university and the practice of science needs to be discussed. Governments are, without question, the key institutions that help create an overall climate of openness or fear, of tolerance or of prejudice. They can create a nurturing climate, or one in which the persecuted and alienated intellectuals have to struggle. I believe that the attitudes of the leaders to science and its values will doubtless be very significant in the kind of climate they seek to nurture[49]. This does not mean that they themselves have to be scientists or even that they specifically want to have a close relationship between government and science, a position that many scientists would be concerned about in terms of their freedom of inquiry. Indeed, the arguments I have been presenting here are very different from the issues of the relationship between Science and Government. The promotion of a scientific outlook that permeates public discourse is different from the issues related to government and military funding of Science in the universities and the implications of that for free inquiry and the purposes of the scientific enterprise[50].

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[46]Fundamentalists tend to define themselves as much by "anti-Western" as by "pro-Muslim" views. The adversarial character of this dichotomy leads to the pursuit of "Islamic science" and "Islamic medicine" without regard to the vast areas of inevitable overlap between such constructs and "Western science" and "Western medicine." Such attempts miss the fact that science and culture operate at different levels. Discussion of these types of issues are addressed in many writings, see, for example, Robert Walgate, "Science in Islam and the West: Synthesis by Dialogue," in The Touch of Midas: Science, Values, and Environment in Islam and the West, ed. Ziauddin Sardar (Manchester, United Kingdom: Manchester University Press, 1984), 240-53.

[47]Muhammad Abduh, the Mufti of Egypt in the late 19th century and one of the towering figures of the Muslim intellectual tradition, always made a compelling case for the place of reason in anything dealing with Islam. He gave a very strong argument against those who would ban pictures or statues because of the Islamic injunction against graven images. He pointed out that the prohibition was related to the fear of idolatry, not the images per se, and based his defense of allowing the use of images largely on the benefit that it would have for the teaching of science. See Muhammad 'Imara (ed), Al-A'mal Al-Kamila lil Imam Muhammad Abduh (the complete works of the Imam Muhammad Abduh), in six volumes, Al-mu'assasa Al-Arabiya Lil Dirasat Wal Nashr, Beirut, 1972, vol. 2, pp.204-208, especially p.206.

[48]See Ismail Serageldin, "Mirrors and Windows: Redefining the Boundaries of the Mind." In The American Journal of Islamic Social Studies vol. II (1) (Spring 1994): 79-107. "Mirrors and Windows" was also published in two parts in Litterae (The Review of the European Academy of Sciences and Arts), Part I in 3(2-3)(Oct./11/93): 4-15 and Part II in 4(1)(1994): 8-26.

[49]In fact, the scientific outlook, if not outright scientific achievement was closely allied to the world view of the founders of the American Republic. See, inter alia, J. Bernard Cohen, Science and the Founding Fathers: Science in the Political Thought of Jefferson, Franklin, Adams, and Madison, Norton, New York, 1995.

[50]These issues are coming to the fore in the post-cold war United States, see for example, Daniel J. Vles, "The Crisis of Contemporary Science: The Changed Partnership", in The Wilson Quarterly, vol. 19, No. 3, Summer 1995, pp. 40 - 52.

I submit that the scientific outlook, as I have described it here, will make it possible to empower philosophers, writers, artists and critics to pour forth their myriad contributions that fashion culture, identity and the very fabric of society[51].

Thus are all intellectuals, not just scientists, the artisans of this new Muslim renaissance. Thus will they rise up to the tide of challenges that confronts the Muslim world today.

## 5. Science and the future of Muslim Societies:

The key questions in the preceding discussion is the extent to which the scientific enterprise can indeed be exercised in the Muslim societies of today in the manner that I have described it here. In other words that the scientists in the Muslim world can indeed flourish and make their contributions to the world of global knowledge while interacting with their own societies. This was after all the case at the time of the medieval and renaissance eras. A willful commitment by the intellectuals of today should be able to overcome the effects of the historic rupture[52] that the Muslim societies have encountered from the 18th century through the time of colonialism. National independence and post-colonial reassertion of their social identities should have laid the ground for that renewal. But it did not[53]. We, Muslim intellectuals, must overcome these obstacles from the past to pave the way for a better future.

There is a widespread view in many Muslim societies today, being promoted by obscurantist currents that contemporary science is a western import, and that it is alien to the Islamic tradition, or others who speak of "Islamic science" as being derived from verses of the Quran rather than through empirical study.

How mistaken they can be. To me, these people are turning their backs on the great tradition of Muslim and Arab science that did so much for humanity for a thousand years, when we were the bearers of the torch of knowledge and rationality. When we advanced knowledge like no other. Names like El Khawarezmi, El Razi, Ibn Al-Nafis, Ibn Al-Haytham, Ibn Sina, Ibn Rushd, are forever engraved in the honor roll of humanity's benefactors through their efforts at advancing knowledge and rejecting superstition. Listen to their powerful, modern voices as it speaks to us through the centuries.

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[51]Muhammad Abduh, was committed to the idea that the rational mind ('Aql) was the best instrument to deal with problems, and even for the understanding of the Quran. see Muhammad 'Imara (ed), Al-A'mal Al-Kamila lil Imam Muhammad Abduh (the complete works of the Imam Muhammad Abduh), in six volumes, Al-Mu'assasa Al-Arabiya Lil Dirasat Wal Nashr, Beirut, 1972, vol. 1: pp. 182-186

[52]For a discussion of this issue of rupture, see Mohammed Arkoun in the proceedings of Architectural Education in the Islamic World, Seminar Ten in the series "Architectural Transformations in the Islamic World", (Seminar series held in Granada, Spain, April 21-25, 1986) (Singapore: Concept Media for The Aga Khan Award for Architecture, 1986), 15-21, and subsequent discussion, 22-25

[53]See inter alia Edward Said, Culture and Imperialism, Knopf, New York, 1993.

Listen to Ibn El Nafis[54], - on the importance of listening to the contrarian view:

> "When hearing something unusual, do not preemptively reject it, for that would be folly. Indeed, horrible things may be true, and familiar and praised things may prove to be lies. Truth is truth unto itself, not because [many] people say it is."
>
> --- Ibn Al-Nafis, (1213-1288 A.D.) *Sharh' Ma'na Al Qanun*.

Listen to Ibn Al-Haytham[55], known in the west as Alhazen, who revolutionized optics and made major contributions in several fields of inquiry. Listen to him speak of and how he prefers the experimental method to the authority of the ancients, which should always be approached with caution:

> "He who searches for truth is not he who reviews the works of the ancients…[it is] he who follows argument and evidence, not the statement by an individual, who is inevitably affected by context and imperfection. It is the duty of he who reads science books, if he wants to learn truths, that he should set himself up as an opponent to all he looks at.. [accepting only what is supported by evidence and argument]."

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[54] Ibn Al-Nafis (1213-1288 A.D.) was born in 607 A.H./1213 AD in Damascus. Ibn al-Nafis became a renowned expert on Shafi'i School of Jurisprudence as well as a reputed physician. After acquiring his expertise in medicine and jurisprudence, he moved to Cairo where he was appointed as the Principal at the famous Nasri Hospital. Here he imparted training to a large number of medical specialists. He also served at the Mansuriya School at Cairo. When he died in 678 A.H./1288 AD he donated his house, library and clinic to the Mansuriya Hospital.

His major contribution lies in medicine. His approach comprised writing detailed commentaries on early works, critically evaluating them and adding his own original contribution. His major original contribution of great significance was his discovery of the blood's circulatory system, which was re-discovered by modern science after a lapse of three centuries. He was the first to correctly describe the constitution of the lungs and gave a description of the bronchi and the interaction between the human body's vessels for air and blood. Also, he elaborated the function of the coronary arteries as feeding the cardiac muscle.

The most voluminous of his books is *Al-Shamil fi al-Tibb*, which was designed to be an encyclopedia comprising 300 volumes, but it could not be completed due to his death. Ibn Al-Nafis' works integrated the then existing medical knowledge and enriched it, thus exerting great influence on the development of medical science, both in the East and the West. However, only one of his books was translated into Latin at early stages and, therefore, a part of his work remained unknown to Europe for a long time.

[55] Ibn al-Haytham (965–c.1040), sometimes referred to in the western classical sources as Alhazen [ălhuzen']. A distinguished Arab mathematician. Ibn al-Haytham was born in Basra, but made his career in Cairo, where he supported himself copying scientific manuscripts. Among his original works, only those on optics, astronomy, and mathematics survive. His Optics, which relied on experiment rather than on past authority, introduced the idea that light rays emanate in straight lines in all directions from every point on a luminous surface. Latin editions of the Optics, available from the 13th century on, influenced Kepler and Descartes. As a cosmologist, Ibn al-Haytham tried to find mechanisms by which the heavenly bodies might be shown to follow the paths determined by Ptolemaic mathematics. In mathematics, al-Haytham elucidated and extended Euclid's Elements and suggested a proof of the parallel postulate. (from The Columbia Electronic Encyclopedia, 6th ed. Copyright © 2005, Columbia University Press.)

--- Ibn Al Haytham, (965–c.1040) *Al Shukuk Fi Batlaymous*

Even more impressive, is this description of how the scientific method should operate, through observation, measurement, experiment and conclusion:

> "We start by observing reality … we try to select solid (unchanging) observations that are not affected by how we perceive (measure) them. We then proceed by increasing our research and measurement, subjecting premises to criticism, and being cautious in drawing conclusions… In all we do, our purpose should be balanced not arbitrary, the search for truth, not support of opinions.
>
> Hopefully, by following this method, this road to the truth that we can be confident in, we shall arrive to our objective, where we feel certain that we have, by criticism and caution, removed discord and suspicion.
>
> Yet we are but human, subject to human frailties, against which we must fight with all our human might. God help us in all our endeavors".
>
> -- Ibn Al-Haytham, (965–c.1040) *Kitab Al-Manadhir*.

Centuries before Bacon and Descartes, before the emergence of modern science in the west, our forefathers were calling for the experimental method, relying on the power of observation and the application of rationality and logic. They promoted openness to the contrarian view, balanced by a healthy skepticism. They advocated prudence in running ahead of the available facts, and finally to beware of our innate prejudices and weaknesses that may bias our work without our noticing it. This is a truly amazing description of the modern scientific method, which was way ahead of its time! The last section is stunning, considering the hubris of Paul Broca and his supposedly accurate work on brain measurements centuries later[56]!

These are stellar lights in the history of science and in the advance of knowledge. They are our forbearers and we should be their proud disciples. We need to recapture that great tradition. It is our tradition, our history, our legacy.

This to me is the tradition that Muslims and Arabs should be proud of. They took the torch and carried it for centuries, and if today the torch has passed to the west, we should be proud that we have done our share and more in earlier times, and should strive to take our place, by dint of hard work and innovation, alongside our western colleagues at the forefront of global scientific endeavor.

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[56] Paul Broca was incredibly accurate in his measurements of human brains, but was driven by an innate racism to bend his work towards "proving scientifically" the superiority of the white race. Excellent discussions of the problems exemplified by Broca, but by no means limited to him or to is time, cf.Stephen Jay Gould, The Mismeasure of Man, Norton,New York, 1981 (op.cit.), and also Carl Sagan's Broca's Brain, (c. 1974), Ballantine Books, New York, 1980.

We need to reinforce science and math education throughout the Arab and Moslem world, and create research institutions that will allow the Arabs and Moslems of today to make their contribution to the enormous collective human enterprise that science has become. These institutions must promote and defend the values of science which were crafted by these very names I have been quoting.

Two obstacles can affect that, beyond the ones that I have described above. These include the receptivity of the society at large to the work of the scientists and the attitudes of the scientists themselves.

On the receptivity of society, I believe that there is a widespread hunger in societies everywhere to know more about scientific change even if they cannot fully comprehend the full ramifications of that work. Thus, I believe that I am not being unduly romantic when I talk of the influence of science and scientific ideas on culture and outlook of entire societies. True, there is a special language of science, and the public at large cannot be expected to absorb the intricacies of scientific research. But, as Steven Weinberg observed: "Whatever the barriers that now exist to communication between scientist and the public, they are not impermeable. Isaac Newton's *Principia* could at first be understood only by a handful of Europeans. Then the news that we and our universe are governed by precise, knowable laws did eventually diffuse throughout the civilized world. The theory of evolution was strenuously opposed at first; now creationists are an increasingly isolated minority"[57]. The same can and must be true of any society. The Muslim societies of the past that encouraged science and respected scholarship did not fully understand the chemistry or algebra that the scientists were developing, but they were satisfied that these learned men deserved respect and that their studies contributed to a better understanding of the world. Today with universal education and omnipresent communications, there is no reason that the attitudinal direction that the practice of science can provoke in society will not be very strong indeed. The universities are the key arena where these values of honor, tolerance and the pursuit of truth have to be forged and strengthened by teacher example and student practice.

The other type of obstacle to the application of these ideas may well be the attitudes of the scientists themselves. It is not uncommon to find many scientists, especially in the poorer parts of the world, including the Muslim world, who not only do not see the value and benefit of that symbiotic link between science and society, but would prefer to keep the two worlds apart[58]. Some of them may well become “intellectual migrants” who identify only with their external colleagues with whom they are linked by internet or other form of communication. It is another form of brain drain, even if the scientists are physically still in the country, when they totally disengage from the difficult surroundings in which they find themselves.

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[57]Steven Weinberg, "Life in the Universe", Scientific American, vol.271 : No. 4, October, 1994, p. 49

[58]Muhammad Abduh, in one of his writings in the journal Al-Waqai’ Al-Misriyya, 28 March, 1881, observed that the real poverty of Egypt, that would keep it in backwardness was the disengagement of the elites from the conditions of the country, and the limited number of the learned and the able in the country. And in the same journal on May 11, 1881, he wrote about the problems of scientific books and the fight against obscurantism and quackery. See Muhammad ‘Imara (ed), Al-A’mal Al-Kamila lil Imam Muhammad Abduh (the complete works of the Imam Muhammad Abduh), in six volumes, Al-Mu’assasa AL-Arabiya Lil Dirasat Wal Nashr, Beirut, 1972, vol. 3 : pp. 42-48 and 49-52.

We must all fully support their full commitment to relations and dialogue with the international scientific community, without which there can be no effective practice of science. But it would be a great loss if their voice were not to be heard loudly and clearly in the national discourse of their own societies. This not only delinks science from its salutary effect on the modernization of societies, but also undermines the public support necessary for the pursuit of science. As Stephen Jay Gould observed: "It is important that we, as working scientists, combat these myths of our profession as something superior and apart. ... But science can only be harmed in the long run by its self proclaimed separation as a priesthood guarding the sacred rite called ***the*** scientific method.(emphasis in original) Science is accessible to all thinking people because it applies universal tools of intellect to its distinctive material"[59].

Overcoming these obstacles, as much as the preceding ones that I have described, is an essential task in reforming and reconstructing the educational institutions of the Muslim world to make them more receptive to and supportive of science and technology. Indeed, I am convinced that this is a two way street. The promotion of the scientific outlook is necessary and unavoidable for the pursuit of science, and is in itself a major part of promoting the societal values -- the profoundly Islamic values -- that are at the core of modernization and development. These are not two separate tasks, promoting two separate endeavors, they are a single, more effective way of doing either or both.

To the members of the scientific community in the developing world generally, and the Muslim world specifically, I say : we are at a crossroads: either we are going to reassert the importance of science and the scientific outlook, or we are going to witness our societies increasingly marginalized in the world of the information age. The scientific communities of the developing world will either become a mere appendage to the elite of the global (mostly western/northern) scientific establishment and more and more detached from their own societies, or they will reassert the links of the scientific outlook and its values in the mainstream of the modernization efforts and discourse of their changing societies. They must by their engagement help create the "space of freedom" necessary for civilized constructive social discourse and essential for the practice of science, even more than the availability of money[60]. This commitment is the only way to create centers of excellence in the Muslim world and to ensure that the benefits of progress accrue to all the poor and the marginalized. It is this rededication to the values of science, those intrinsically Muslim values that I have described, that will bring about a renewal of thought for a better future for the Muslim societies[61]. Those same Muslim societies who have so much to offer the world, if

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[59]S. J. Gould, Time's Arrow, Time's Cycle : Myth and Metaphor in the Discovery of Geological Time, Harvard University Press, Cambridge, Mass., 1987, p.7.

[60]The research laboratory dealing with animal diseases in the International Livestock Research Institute (ILRI), which is located in Nairobi, Kenya, and operates under the umbrella of the Consultative Group for International Agricultural Research (CGIAR), is currently not just at the cutting edge of world science in its field, it is undertaking about 20% of the world effort on mapping the bovine genome on an annual budget of around $7 million. It is not the location or the budget that is not easily replicable in the developing countries, it is the commitment to the values of science and the dedication to excellence and a space of freedom for the researchers that makes all the difference.

[61]There are a number of efforts at present, although still too few, to call for a progressive reading of Islam, that meets the needs of the believers for faith and respect the domain of the rational, and try to address the problems of today

only they would unleash the full measure of their talent and their genius. All of that however, requires liberating the Muslim mind from the tyranny of intolerance, bigotry and fear, and opening the doors to free inquiry, tolerance and imagination.

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and tomorrow. This balance between the rational and the faith for the more complete human being and the more justly balanced society is well articulated in Ahmad Kamal Aboulmagd, Hiwar la Muwajaha (Dialogue, not Confrontation), Kitab Al-Arabi, 15 april 1985, Kuwait, 1985. See also Ismail Serageldin, "The Justly Balanced Society: One Muslim's View." In Friday Morning Reflections at the World Bank: Essays on Values and Development by David Beckmann, Ramgopal Agarwala, Sven Burmester,and Ismail Serageldin, Washington: Seven Locks Press, 1991, 55-73.