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ORIGINAL ARTICLE

Muslim and Non-Muslim Collaboration: Catalyst to the Scientific and Technological Excellence of the Abbasid Era

¹Roziah Sidik @ Mat Sidek and ²Wan Kamal Mujani

¹*Department of Arabic Studies and Islamic Civilization, Faculty of Islamic Studies, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.*

²*Institute of West Asian Studies (IKRAB), Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.*

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ABSTRACT

This article analyses the collaboration between Muslim and non-Muslim scholars in the Islamic civilization, specifically during the Abbasid era. Its purpose is to give due acknowledgement to non-Muslim scholars who worked closely with Muslim scholars to spur science and technology excellence in the Islamic civilization during the Abbasid era. In addition, it also aims to discover the reasons conducive to Muslim and non-Muslim collaboration in developing science and technology in the Islamic civilization. This study finds that Muslim and non-Muslim scholars could work closely together to develop scientific and technological progress during the Abbasid era.

Key words: *Muslim, non-Muslim, collaboration, scholars, catalyst, science, technology, Islamic civilization.*

Introduction

The development of science and technology during the Abbasid era occurred in stages. The early stage of development witnessed transfer of knowledge from cultures which previously existed such as the Greek, Persian as well as the Indian civilizations. This stage witnessed intensive translation activity. The subsequent stage involved rectification of ideas of previous civilizations, followed by original works or creations. It has been determined that the collaboration between Muslims and non-Muslims in developing science and technology during the Abbasid era had occurred since the early stage, that is, the stage of knowledge transfer from the other civilizations into the Islamic civilization. The role of Muslims can no longer be denied. But the reality of the fact of the non-Muslims' role needs to be acknowledged. In fact, the contribution of the non-Muslims, specifically the Christians, has been described by Sarton (1975) as immense.

Another expression by him also affirms the existence of this immense contribution to translation by the non-Muslims as follows: "... out of 8 physicians whom I have selected as the most important, 6 were Christians...of the 2 remaining, 1 was a true Arab, the other a Persian. A great part of the activity of these men was devoted to translating Greek medical texts, especially those of Hippocrates and Galen, into Syriac and into Arabic. All of these translators were Christians, the most prominent being Yahya ibn Batriq, Ibn Sahda, Salmawayh ibn Bunan, Ibn Masawayh and Ayyub al-Ruhawi." This article does not intend to uplift the status of non-Muslim scholars to a level at par with Muslim scholars from the view of their contribution to the development of the Islamic civilization during the Abbasid era. However, denying their contribution which did actually exist would be inappropriate. What is stated herein rests on historical sources as basis for support.

Materials and Methods

This study uses the qualitative methodology through instrument analysis by way of textual and contextual study of primary sources. The importance of this study is relevant because all parties regardless of religion should play a role in developing science and technology to a level of excellence.

Results and Discussion

The Collaboration Forged Between Muslims and Non-Muslims:

Collaboration between Muslims and non-Muslims was significantly forged in matters relating to the transfer of scientific knowledge from previous civilizations, mainly Greek, Persian and Indian, into the Islamic civilization. The transfer of this knowledge encompasses various fields such as philosophy, medicine, chemistry, astronomy and mathematics which were written in various languages, whether Greek, Syria, Persian, Sanskrit or even Pahlavi. Transfer of knowledge was done through translation of works in various fields and foreign languages into Arabic language. Translation into Arabic language was a necessity in view of it being the sole language used by society in the Islamic world then. It was the language used in daily life. And, it was also the language used in all fields, including science as well as literature. Moreover, transfer of knowledge would be of immense benefit if it could be appreciated by all walks of life in society. And, the matter could only be done through a language which blended with the soul of the said society, that is, Arabic language. Hence, the transfer of knowledge from other civilizations and other languages into Arabic language became very essential.

Transfer of Knowledge through Translation:

According to Young (1990), this era of translation movement lasted about 300 years and ended in the middle of the 11th Century. Young's statement seems in line with Iqbal's (2007) view which also states that the said movement lasted for about 3 centuries. However, Nasr's (1976) view seems different when he states his idea that the translation movement of the Abbasid era lasted for only 150 years. He claims that it started in the 8th Century and ended in the 10th Century.

The variance in the duration of the translation movement of the Abbasid era ought not to cause any confusion. Moreover, Nasr's view meant, rather, the time period during which the translation of majority of important works of earlier civilizations were completed. These works included works by prominent figures such as Hippocrates, Aristotle, Theophrastus, Euclid, Ptolemy, Dioscorides and Galen.

Historical and Islamic civilizational reference sources such as *Harakat al-Tarjamah wa al-Naql fi al-'Asr al-'Abbasi* (Murad, 1973) and *Duha al-Islam* (Amin, 1933) reveal in detail the phases of the translation movement during the Abbasid era. The first phase began during the rule of Khalifah Abu Ja'far al-Mansur until the end of Khalifah Harun al-Rashid's rule, that is, from the year 754AD until the year 809AD. This period of 57 years witnessed the translation of several works into Arabic language, such as the Persian work, that is, *Kalilag u Dimnag*, the work from India, that is, *Brahmasputasiddhanta* as well as works from Greece, that is, *Megale Syntaxis Mathematike* and *De Interpretatione*. And the translators involved during this period were Ibn al-Muqaffa', Jurjis ibn Jibra'il as well as Yuhanna ibn Masawayh.

The second phase of the translation movement of the Abbasid era began when Khalifah al-Ma'mun took over the reign of the caliphate, that is, from the year 814AD until the year 913AD. The translators involved included names such as Yahya ibn al-Batriq, al-Hajjaj ibn Yusuf ibn Matar al-Warraaq al-Kufi, Qusta ibn Luqa al-Ba'labakki, 'Abd al-Masih ibn Na'imah al-Himsi, Hunayn ibn Ishaq, Ishaq ibn Hunayn, Thabit ibn Qurrah and Hubaysh ibn al-Hasan al-A'sam. Most of the works translated during this period covered the great Greek civilization works such as by Pythagoras, Hippocrates, Galen, Plato and Aristotle. As for the third phase, it began early in the 10th Century up to the middle of the 11th Century. This period involved several active translators such as Mata ibn Yunus, Sinan ibn Thabit ibn Qurrah, Yahya ibn 'Adi as well as Abu 'Ali 'Isa ibn Ishaq ibn Zur'ah.

These translation efforts were very important and cannot be viewed as trivial at all. This is especially so when involving great scientific works by several prominent and renowned figures such as Hippocrates, Aristotle, Theophrastus, Euclid, Ptolemy, Dioscorides and Galen. Above all, this phase involved the use of the target language, that is, Arabic language, which is clear and precise.

The Abbasid era witnessed the translation of a vast number of Hellenistic-Greek scientific works into Arabic language. Amongst these were works on astronomy by Ptolemy or, his real name, Claudios Ptolemaeos and mentioned in Arabic sources as *Batlimiyus* (d.170AD). His work entitled *Megale Syntaxis Mathematike* had been translated into Arabic. Marhaban (1988) asserts that the first person to translate it was a Jew, that is, Sahl ibn Raban al-Tabari (lived in early 9th Century). He had embraced Islam during the rule of Khalifah Harun al-Rashid. The Arabic version of this work was entitled *Kitab al-Majisti* (Sarton, 1975). Other than Sahl ibn Raban al-Tabari, there was also another translator who jointly translated the same work. A scholar by the name of Hajjaj ibn Yusuf (d.833AD) also translated it from Syriac to Arabic. Translated works were not merely accepted, but were subject to an examination process by several renowned scholars. O'Leary (1964) revealed that the translation of this work was in fact examined by Hunayn ibn Ishaq, Thabit ibn Qurrah as well as Muhammad ibn Jabir ibn Sinan al-Battani (d.929AD).

Other than *Megale Syntaxis Mathematike*, Ptolemy's work entitled *Tetrabiblos* was also translated into Arabic. Its translation was done by Abu Yahya (Yuhanna) al-Batriq (d.815AD) during the rule of Khalifah Abu Ja'far al-Mansur, that is, the second Abbasid caliph. The Arabic version was entitled *Kitab al-Arba' Maqalat fi*

Sina'ah Ahkam al-Nujum (Farrukh, 1970). Another of Ptolemy's work which was also translated into Arabic is Geographike Syntaxis. Its translation involved a prominent translator, that is, Thabit ibn Qurrah. The Arabic version of this was entitled *Kitab Jughrafiyya fi al-Ma'mur wa Sifat al-Ard* (Marhaban, 1988).

Besides works by Ptolemy, history also witnessed the translation of other works into Arabic language. For example, the work of Dioscorides (who lived in the middle of the 1st Century) entitled *De Materia Medica* had been translated by Istafan ibn Basil (who lived in the 9th Century) during the rule of Khalifah al-Mutawakkil. The Arabic version was entitled *Kitab al-Hasha'ish fi Hayula al-Tib* (Al-Hunaydi, 2001). Its translation was then examined by Hunayn ibn Ishaq. This Arabic version is considered by Nasr (1976) as a very well-known work on pharmacology. Thus, it later became the main reference for medical and pharmacological writings. For example, 'Ali ibn Raban al-Tabari made it his guide to produce his work entitled *Kitab Firdaws al-Hikmah*. Likewise, Muhammad ibn Zakariyya al-Razi used it as his main reference to produce his work entitled *Kitab al-Hawi*.

In the meantime, Galen's works were also not exempted from translation into Arabic language. Their translation involved the renowned translator, Hunayn ibn Ishaq. He had translated almost all of Galen's (d.216AD) medical curriculum known as *Summaria Alexandrinorum*. In Arabic, it is known as *Jawami' al-Iskandaraniyyin*. Amongst the said works were *De Sectis Ad Eos Qui Introducuntur*, *Ars Medica*, *Ad Glauconem de Methodo Medendi*, *De Temperamentis*, *Naturalibus Facultatibus*, *De Morborum Causis et Symptomatibus Libri Sex*, *De Diebus Decretoriis*, *De Alimentorum Facultatibus* and *De Victu Attenuante*. The Arabic versions for these works are *Kitab al-Firaq*, *Kitab al-Sina'ah*, *Kitab ila Aghluqan fi al-Ta'ti li Shifa' al-Amrad*, *Kitab al-Mizaj*, *Kitab al-Quwa al-Tabi'iyah*, *Kitab al-'Ilal wa al-A'rad*, *Kitab Ayyam al-Buhran*, *Kitab Quwa al-Aghdhiyyah* and *Kitab al-Tadbir al-Mulattif* (Ibn al-Nadim, 1997; Iskandar, 1976). Besides translating Galen's medical works, Hunayn ibn Ishaq also translated the medical work of Hippocrates (d.257BC) that is, *Aphorismos*. The Arabic version is entitled *Kitab al-Fusul* (O'leary, 1964).

Galen's works were also translated by Hubaysh ibn al-A'sam and 'Isa ibn Yahya. Sarton (1975) reveals that Hubaysh had translated as many as 35 works by Galen, whilst 'Isa had translated as many as 24 works. Details of the titles of Galen's works which were translated together with the titles of their Arabic versions can be found in the works of Iskandar (1976) and Ibn al-Nadim (1997). The work translated by Hubaysh were *De Locis Affectis* and entitled *Kitab Ta'arruf 'Ilal al-A'da' al-Batinah*, *De Sanitate Tuenda* by the title *Kitab Tadbir al-Asihha'*, *De Anatomicis Administrationibus* by the title *Kitab al-Tashrih al-Kabir*, *De Semine* given the title *Kitab al-Mani*, *De Usu Partium Corporis Humani* by the title *Kitab Manafi' al-A'da'*, *De Bono Habitu* with the title *Kitab Khasb al-Badan* and *De Compositione Medicamentorum Per Genera* entitled *Kitab Tarkib al-Adwiyyah*. Whilst Galen's medical works translated by 'Isa were *De Antidotis* entitled *Kitab al-Adwiyyah al-Muqabalah li al-Adwa'*, *Prognosticum* by the title *Kitab Taqdimah al-Ma'rifah* and *De Parvae Pilae Exercitio* with the title *Kitab al-Riyadah bi al-Kurrah al-Saghirah*.

Other than the three translators abovementioned, there were other individuals identified who were translators of calibre and had also translated Galen's work into Arabic language. For example, *De Motu Thoracis Et Pulmonis* was translated by Istafan ibn Basil and entitled *Kitab Harakat al-Sadr wa al-Ri'ah*, *De Probis Pravisque Alimentorum Succis* was translated by Thabit ibn Qurrah with the title *Kitab al-Kimus* and *De Simplicium Medicamentorum Temperamentis Et Facultatibus* was translated by Yusuf al-Khuri (lived during the rule of Khalifah al-Muktafi) by the title *Kitab al-Adwiyah al-Mufradah* (Sarton, 1975).

Apart from Galen's work, the work of Aristotle (384-322BC) was also not spared from being translated into Arabic language. For example, *Historia Animalium/De Animalibus* was translated by Yahya ibn al-Batriq (born in early 9th Century) by the title *Kitab al-Hayawan*. The same individual also translated Aristotle's work *Secretum secretorum* entitled *Sir al-Asrar* and the work *Meteorologia* (Aristotle's work on meteorology) by the title *Kitab al-Athar al-'Ulwiyyah* (Young *et al.*, 1990).

The works of Apollonios Pergaeus, Nichomachus, Menelaos, Archimedes, Diophantos, Theodosius, Theophrastus, Heron and Kassianos Bassos were also translated into Arabic by scholars of the Islamic civilization. Apollonios Pergaeus (who was born about the year 262BC) had his work *Conica* translated by Hilal al-Himsi for Ahmad ibn Musa ibn Shakir. The Arabic version is entitled *Kitab al-Makhrutat*. The work of Nichomachus (born in the year 100AD), that is, *Introductionis of Arithmeticae* was translated by Thabit ibn Qurrah by the title *Kitab al-Madkhal ila 'Ilm al-'Adad* (Haq, 1994). The work of Menelaos (born in the year 100AD), that is, *Sphaerica* (sphere trigonometry) was translated by Ishaq ibn Hunayn by the title *Kitab al-Ashkal al-Kurriyyah*. The work of Archimedes (d. 212AD), that is, *De Sphaera Et Cylindro* was translated by Thabit ibn Qurrah with the title *Sharh Arshimidias fi al-Kurrah wa al-Ustuwana* (Meri and Bacharach, 2006). Yusuf al-Khuri translated the work of Archimedes concerning triangles, that is, *Quadratura parabolae* with the title *Kitab al-Muthallathat* (Bell, 2001).

Qusta ibn Luqa (died at the end of 9th Century) was a translator who had played the role of translating the works of many Hellenistic-Greek scholars. Amongst these were the work of Diophantos (born about the year 250AD), that is, *Arithmetica* with its Arabic title *Kitab Diyufantas fi al-Masa'il al-'Adadiyya* (Ibn al-Nadim, 1997); The work of Theodosius of Bythynia (born in the first century BC or at the end of the last century BC),

that is, *Sphaerica* was translated with the title *al-Akr*; the work of Theophrastus (born about the year 372BC) entitled *Meteora* with the Arabic title *al-Sama'* and the work of Heron (born about the year 50AD), that is, *Mechanica* with the title *Kitab al-Hiyal*. Qusta also translated the work of Kassianos Bassos on agriculture, that is, *Georgika* in the year 827AD with the title *Kitab al-Filahah al-Rumiyyah* (Mc Cabe, 2007).

Yahya ibn 'Adi translated the commentary book of Aphrodisias on the meteorological work of Aristotle, that is, *Commentaria in Meteorologica* with the title *Tafsir Kitab al-Athar al-'Ulwiyyah li Aristutalis* (Ibn Abi Usaybi'ah, 1965). Aristotle's work entitled *Topica* was translated by Yahya ibn 'Adi, Abu 'Uthman al-Dimashqi and Ibrahim ibn 'Abd Allah al-Katib by the title *Kitab al-Tubiqa* (Daiber, 1999).

Abu Bishr Mata Ibn Yunus (d. 940AD) translated the commentary work of Themistios on *De Coelo*, that is, *Commentaria in De Coeloby* with the title *Kitab Tafsir al-Thalath Maqalat al-Awakhir min Tafsir Thamistiyus*. According to Sarton (1975), the translation was then examined by Yahya ibn 'Adi. The latter also translated Aristotle's work *Poetica* with the title *Kitab Aristutalis fi al-Sh'ir*. 'Abd Allah Ibn al-Muqaffa' translated Porphyrys work *Eisagoge* with the title *Kutub Isaghuji fi al-Madkhal ila al-Kutub al-Mantiqiyyah*.

Other than the Hellenistic-Greek civilization, other world civilizations such as the Indian civilization had also transferred various fields of knowledge through translation. Amongst the fields of knowledge which were translated into Arabic were astronomy, mathematics and also medicine. The work of the Indian civilization relating to astronomy and mathematics entitled *Brahmasphutasiddhanta*, for example, was translated into Arabic by the title *al-Sind Hind* (Nallinu, 1911). Its translation was by Abu 'Abd Allah Muhammad ibn Ibrahim al-Fazari at the command of Khalifah Abu Ja'far al-Mansur, the second Abbasid caliph. In Sarton's view (1975), this work had become the main gateway in the direction for the transfer of Hindu numerals into the Islamic civilization. Besides this, the work on Hindu astronomy, that is, *Khandakhadyaka* was also translated into Arabic by the title *al-Arkand* (Sharma, 2004). It was translated by Muhammad ibn Ibrahim al-Fazari and Ya'qub ibn Tariq.

An Indian work on medicine translated into Arabic was the writing of a doctor by the name of Chanakya (Shanaq in Arabic). According to Needham (1980), Chanakya's writing was based on a work entitled *Arthashastra*. This work was translated by Abu Hatim al-Balkhi from Persian language into Arabic for Yahya ibn Khalid. The Arabic version goes by the title *Kitab al-Sumum wa al-Tiryayq* (Levey, 1973). The work by Charaka, that is, *Caraka Samhita* was later translated by 'Abd Allah ibn 'Ali in the 9th Century from Persian into Arabic by the title of *Sharik al-Hindi*. And the work of Susruta (former Hindu surgeon of 6th Century BC), that is, *Susruta Samhita* was translated into Arabic by Mankah with the title *Kitab Susrud*. In the Indian civilization, *Susruta Samhita* was considered as the best work in Sanskrit literary arts, specifically, concerning surgical operations. The surgical operations contained in the said work encompassed cataract, hernia, caesarean operation, etc. In addition, it also discusses aspects of anatomy, physiology, obstetrics and paediatrics (Sarton, 1975).

Works of the Persian civilization were also not exempted from being transferred into the Islamic civilization through translation into Arabic. *Kalilag u Dimnag* (written in Pahlavi language) which contained a collection of Persian mythical stories, for example, had been translated by 'Abd Allah ibn al-Muqaffa' and 'Abd Allah Ahwazi. The Arabic version is entitled *Kalilah wa Dimnah* (Letvinsky *et al.*, 1996). According to Brown (2006), this work was a collection of Indian mythical stories contained in the work titled *Panchatantra/Pancatantra*. It was written by an Indian intellectual named Pandit Vishnu Sharma about the year 200BC. During the rule of Khusraw/Kisra I, a famous minister Burzoe/Barzawayh had translated this work from Sanskrit into Pahlavi by the title *Kalilag u Dimnag*. The Arabic version is considered by Nasr as a model of classical Arabic literary arts.

In addition to the above work, Ibn al-Muqaffa' also translated other works, such as *Khudhay Namag* (work on the biographies of Persian kings) by the title of *Siyar Muluk al-'Ajam* (Ashtiany *et al.*, 1990). He also translated *Ayin Namag* with the title of *Kitab Ayin Namah*, *Mazdak Namag* entitled *Kitab Mazdak* etc. *Kitab Ayin Namah* discusses ethics, customs and the laws of Persians. *Kitab Mazdak* relates stories of Persian religious leaders. Another work from the Persian civilization which was translated into Arabic was a compilation of *zij* known as *Zij-i Shatroayar*. It was translated by 'Ali ibn Ziyad al-Tamimi. The Arabic version was given the title *Zij-i Shahriyar*.

Muslim and Non-Muslim Scholars:

The Muslim scholars involved in the aspect of knowledge transfer through translation as above mentioned were represented by Abu 'Abd Allah Muhammad ibn Ibrahim al-Fazari, Abu Sahl al-Fadl ibn Nawbakht and Abu 'Uthman Sa'id ibn Ya'qub al-Dimishqi. Whereas the non-Muslim scholars were represented by Hunayn ibn Ishaq, Salmawayh ibn Bunan, 'Abd al-Masih Na'ima and also Jurjis ibn Jibril ibn Bakhtiashu' (Nasr, 1984).

Muslim Scholars:

Abu 'Abd Allah Muhammad ibn Ibrahim al-Fazari was the son of the astronomer Abu Ishaq Ibrahim ibn Habib ibn Sulayman ibn Samurah ibn Jundab. The translation of Siddhanta by him was by order of the second 'Abbasid ruler, Khalifah al-Mansur (754-775AD). This translation effort was done in the year 773AD. Besides being a translator, he was also an astronomer (Sarton, 1975). In fact, Nasr (1984) described him as the first official astronomer of the 'Abbasids. He was also the first person to invent the astrolab, which became an important device in Muslim astronomy.

Another translator was Abu Sahl al-Fadl ibn Nawbakht, son of al-Nawbakht. He was a Persian translator as well as an astronomer. During the 'Abbasid rule of Khalifah Harun al-Rashid, he was given the responsibility of being chief librarian. And during the rule of Khalifah al-Ma'mun, the first observatory, Shamasiyah, was built and placed under the care and responsibility of Abu Sahl al-Fadl b. Nawbakht jointly with another astronomer, Muhammad ibn Musa al-Khawarizmi. This observatory was built in Baghdad in approximately 828AD (Nasr, 1984).

Meanwhile, Abu 'Uthman Sa'id ibn Ya'qub al-Dimishqi, was the translator of many works on medicine into Arabic language. Besides medicine, he was also actively involved in the field of mathematics. He served under Khalifah al-Muqtadir (908-932AD) (Sarton, 1975).

Non-Muslim Scholars:

Heading the list of non-Muslim scholars was a great figure, that is, Abu Zayd Hunayn ibn Ishaq al-'Abadi. He was born in Hira between the years 809-810AD and died in the year 877AD. He studied in Jundishapur, and later in Baghdad under Ibn Masawayh. Then he travelled to Anatolia to complete his study of the Greek language. Thus, it is not surprising that he is reported as the most proficient in Greek language, apart from three other languages, that is, Arabic, Syrian as well as Persian. He had also served under the rule of Khalifah al-Mutawakkil as supervisor of a translation project. He was also hired by the Banu Musa ibn Shakir family to gather Greek manuscripts and translate them into Arabic language. He was the foremost translator of works on medicine (Ibn al-Nadim, 1997).

Salmawayh ibn Bunan was actively serving under the rule of Khalifah al-Ma'mun and Khalifah al-Mu'tasim (795-842AD). In fact, Khalifah al-Mu'tasim had appointed him as his personal physician as soon as he became caliph (Ibn Abi Usaybi'ah, 1965). Salmawayh ibn Bunan died, either at the end of the year 839AD or at the beginning of the year 840AD (Sarton, 1975). Meanwhile, 'Abd al-Masih Na'ima, who was also involved with translating Aristotle's works, had done so under the command of Khalifah al-Mu'tasim (833-842AD).

In addition, Jurjis ibn Jibril ibn Bakhtiasu' held the responsibility of running a hospital in Jundishapur until the year 766AD. He then was invited to Baghdad by Khalifah al-Mansur. According to the records of Ibn Abi Usaybi'yah (1965) and Nasr (1984), Khalifah al-Mansur who was suffering from dyspepsia (gastrointestinal pains due to poor digestion) had fallen sick and sought a remedy for his malady. However, his condition worsened when he was treated by other physicians then available. Khalifah al-Mansur was later informed of the skills of a physician by the name of Jurjis, whom he promptly invited to Baghdad. Jurjis and his Persian family thus had served under several 'Abbasid caliphs such as Khalifah Harun al-Rashid, al-Amin, al-Ma'mun, al-Wathiq and al-Mutawakkil (Ibn al-Nadim, 1997).

Why Collaboration could prevail ?:

The explanation aforesaid clearly shows that the group of persons who were not less great in their contribution to spur the excellence of science and technology during the 'Abbasid era were also not confined to only one religion. In fact, the efforts and roles played by the Muslim scholars who did not decline working together closely with non-Muslim scholars prove that a person's faith did not at all become an issue in the development of science and technology during that era.

Religion is not an obstacle:

What had been done by Hunayn ibn Ishaq, Salmawayh ibn Bunan and 'Abd al-Masih Na'ima who represented the non-Muslim scholars showed that religion was not at all a factor which restricted them from being involved in the progress of the Islamic civilization. Although Islam was not their faith, and the Islamic civilization was not one to which they were obliged to put their energy and contribution into, these did not count ever. In fact, their role is acknowledged, recognised and never ignored in the folds of history. Their names are permanently on record in authoritative sources of reference. In fact, Sarton (1975) preferred to use the term Arabic with the word scholars, as compared to Muslim. This is because he was always aware of the joint roles

of the non-Muslims alongside the Muslim scholars, especially the Christian Arabs, who spoke and wrote in Arabic language.

The Characteristic of Universality:

There is a possibility of a question arising as to how easy it was for Muslim scholars to cooperate with non-Muslim scholars in developing science and technology during the 'Abbasid era. Why did they have such an attitude? This question can be answered if we go back to the universality of Islam. Kettani (1984) who analysed this issue pointed out universality as one of the characteristics of the golden age of the Islamic civilization. He further explained that the sole bond of unity amongst individuals accepted in Islam is the bond of faith and purpose in life. All Muslims are bonded by the word Ummah. Ummah as defined in al-Qur'an is a people who 'invite to good and prevent evil and believe in Allah'. The unity of Ummah does not oppose anyone outside of it. In fact, Muslims are constantly aware that the Ummah is part and parcel of the bigger Ummah, that is, humanity. Hence it is not strange that Muslim scholars are willing and ready to work together with non-Muslim scholars.

The Characteristic of Tolerance:

When the characteristics of universality and tolerance are combined, it makes possible two things (Kettani 1984). The first is an exchange of ideas. Historical records prove that the excellence of science and technology during the 'Abbasid era witnessed efforts in developing ideas pioneered by non-Muslims in previous civilizations, such as Greek, Persian, Indian as well as Chinese. The second is the acceptance of foreign or non-indigenous talent. The second is more important and is closely related with this article. The Muslim scholars did not have any problem with working closely alongside non-Muslim scholars. In fact, the acceptance of foreign talent also helped to form an Islamic scientific community which was cosmopolitan in nature.

Unity of Language:

The Islamic world during the era of scientific and technological excellence, was inhabited by societies who used Arabic language. It was the sole language used in the Islamic world then, whether they lived in Baghdad or Cordova. It was used not only in daily speech, but in all fields, including sciences as well as literature. In fact, Al-Hassan and Hill (1986) described the situation as a miracle for the Islamic civilization that everyone in its dominion spoke and wrote the same language.

The stage of translation, which lasted for a hundred and fifty years, was followed by the next stage, that is, the stage of correcting the observations of the previous eras and exploring new fields and frontiers in science. In the process of going through these stages, Muslim scholars attempted to avoid assimilating other cultures completely. Hence, they made sure to remain on the Islamic guidelines outlined by focussing on facts and ignoring assumptions, as well as by staying away from magic and mythology. Besides, Muslim scholars also desired that Arabic language be a universal language. Moreover, it was already the language understood by everyone from all walks of life then. This desire motivated them to translate all knowledge into Arabic language and to go further in making it a medium of instruction which was effective, efficient and potent for scientific communication amongst all peoples in the world. Scholars, Muslim and non-Muslim, were not excluded from using the same language. This unity of language has contributed to make possible the forging of cooperation to develop science and technology during the 'Abbasid era.

Conclusion:

A human being, regardless of whether he or she is a Muslim or non-Muslim, inter-dependes with other human beings. The concept of Ummah itself explicates that Muslims within it do not oppose outsiders. Although this article touches on collaboration between Muslims and non-Muslims only from the aspect of knowledge transfer, it shows proof that these two groups could work closely together to develop scientific and technological progress during the 'Abbasid era. What is certain is that religion was not a barrier to forge cooperation. In fact, several characteristics in Islam itself, such as universality and tolerance, are conducive to continued cooperation. If ever there was a time when collaboration between Muslims and non-Muslims was realised, and had contributed in no small measure to the scientific and technological excellence then, there is now no reason why it would not be possible to re-enact such collaboration and restore the glory of the Islamic civilization today. However, this collaboration needs to be done with caution and Muslim scholars must always be vigilant in view of the different world situations of the 'Abbasid era and today.

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