AN ASSESMENT OF SCIENTIFIC AND TECHNOLOGICAL EXCHANGES BETWEEN CHINA AND INDIA DURING THE ANCIENT TIMES

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Abstract

China-India interface is not a story of recent few years, but the interaction has been continuous for over two millennia now. China and India did not only co-operate and learn from each other in the field of art, literature, and religion but also in the sphere of science and technology. China learnt from India and so did India from China. In this article, the author explores in which aspect of science and technology, China and India learnt from each other during the ancient times and what were the major inventions by the two countries during the ancient times? The author also tries to investigate into the famous Needham Question 'why had China and India been overtaken by the West in science and technology, despite their earlier successes?'

Key Words: China, India, Science & Technology.

Introduction

Among the four ancient civilizations in the world, China and India are the only two countries, whose civilizations have been uninterrupted and continuous.The

two countries flourished and burgeoned side by side without having any stigma of fissure and hiatus influencing each other and extending all kinds of co-operation and collaboration with each other. The two countries have a very long history of mutual co-operation and consultation in almost every field; including literature, arts, religion, philosophy, science and technology. From the ancient times itself, aself-independent tradition of researching on science and technology developed in the two countries and several monarchs and kings also encouraged and patronized scientists and researchers in the hope that these research and innovative works would profoundly inspire and enhance their scope of influence and military supremacy. Scientists are researchers including translators were patronized by the royal family which is not the case in the modern times. The share of budget currently on research and development in both the countries is very less compared to the other developed nations in the world and these are some of the reasons to answer the famous Needham question that why the West has leapfrogged both the countries in the field of scientific and technological advancements. India's spending on Research and Development has remain stagnant at 0.8% of the total budget in more than 2 decades which is a matter of great apathy and consternation for an ambitious nation like ours, which had such a glorious past (*Economic Times*:2018*)*. Spending on R&D in China has recently considerably increased since Xi Jinping has ascended to the power and it is around 2.1% of the total GDP now (*Reuters News*:2018*)*. This is also the reason that China is increasingly becoming stronger in Science, technology, research, and development now.

As, the two countries started their civilizational progress earlier than most of the other countries of the world, the scientific and technological development in both the countries, also started earlier than the other nations on the earth. Result was pretty obvious. Prior to the Industrial revolution in the west, both China and India were not only the leading centres of innovations, but also the two largest economies of the world (Madison: 2007). However, because of western colonialism and semi-colonialism as well as feudalism, external invasion, and internal strife, these two countries lost their pinnacle positions of being the top two economies in the world. Nonetheless, trends are very positive, and we already know that China has already become the largest economy (On Purchasing Power Parity basis) in the world today (*Bloomberg News*: 2016). Road

for India is still very long;however, we are probably also progressing in the right direction. Needless to mention though, that it is not the R & D that is making China and India grow prosperous today but that was not the case during the ancient times or even till the medieval times. In the following pages, we shall try to explore in which field of science and technology, the two countries were major power in the world and how they interacted with each other through the annals of history during the ancient times.

India

Eminent Indian scholar Prof.Debiprasad Chattopadhyay quoted an European Muslim scholar who said in the 11th century that,

> "Among the nations, during the course of centuries and throughout the passage of time, India was known as mine of wisdom and fountainhead of justice, and good government and the Indians were credited with excellent intellects, exalted ideas, universal maxims, rare invention and wonderful talents. They have studied arithmetic and geometry. They have also acquired copious and abundant knowledge of the movement of stars, the secrets of the celestial spheres and all other kinds of mathematical sciences. Moreover, of all the peoples, they are most learned in the science of medicine and thoroughly informed about the properties of drugs, the nature of composite elements and peculiarities of existing things." (Chattopadhyay: 1986)

We all also know that scientific and technological development in a country is a force for the progress of its economy and to a large extent its military development is also based on this.[i] Scientific and technological developments are also based on the tradition and orientation of the culture of the society. Many social scientists and anthropologists have declared that the main driving force of the social and economic progress of a country is scientific and technological development.[ii]

Dr. Murli Manohar Joshi, the Minister for Science and Technology of India in 2002 said, "Science is the basis for superior knowledge and enables us more analytical and logical reasoning. Science is also the stepping stone to advance and modern technology that can form the basis for strong industrial growth in the country and for global competitiveness."[iii]

The social, cultural and religious traditions of India augmented the process of scientific and technological developments and discoveries. Bal Gangadhar Tilak (1856-1920) said, "There are several sacrificial hymns in the Rigveda, which shows that the sacrificial ceremonies must have been considerably developed. Without the knowledge of months, season and year, it will be not too much to presume that during the Vedic times in India, there must have been existed a calendar to regulate the sacrificial ceremonies. We also know that during the Vedic period, Indians had good understanding of the 24 hours in a day, 30 days in a month and 12 months in a year. Because of the spread of trade and Buddhism between India and China, it will be not naïve to estimate that Chinese calendar and scholars of astronomy would have drawn substantially from the Indian understanding on Astronomy and Calendrical science" (Kumar: 2004).

Indian calendar did make its presence felt in China and we can read the names of a number of Indian astronomers and calendar experts who lived in Changan (长安-presently known as Xi'an), the capital of Tang China (618-908). In fact there were three clans of Indian calendar makers living in Changan, namely the Sidartha clan, the Kumara clan and the Kashyapa clan among which the Sidartha clan was the most respected and active. The most distinguished person of this clan was Gautama Sidartha who translated the *Navagraha* calendar in 718 and complied the *Da-Tang KaiyuanZhanjing*《大唐开元占经》 (Treaties on Astrology of Kai Yuan era during the greater Tang Times) (Selin: 1997). The great Chinese scholar of Tang times, Yixing 一行(683-727) heavily collaborated and learnt with several Indian scholars and monks who lived in Tang Capital, Changanabout the art of calendar making (Selin: 1997).

Both the Chinese and Indian ancient scriptures show that people in India and China knew about the 28 positions occupied by the moon in one sidereal rotation in around 700 BC, known as Nashatras in Sanskrit and Xiu (宿) in Chinese (Kumar: 2004). However, the story of rabbit in the moon and many other mythical stories about the moon seem to have its origin in India, which might have influenced the ancient Chinese literature. In the Buddhist story, Śaśajâtaka" (Jataka Tales: no.316, written around 300 BC), we find the story of the rabbit in the moon. The same story of 'Rabbit in the moon' is found a number of times in the Chinese literature but we find its' first occurrence in *The Verses of Chu* or 'Chuci (楚辭)'[iv] written during the warring state period which ended at around

221 BC. However, this story of a 'Jade rabbit in the moon' can be also found in later Chinese literature including in the compendium *Taiping Yulan*《太平御览》 which is translated as*Imperial Readings of the Taiping Era Encyclopaedia* of the Song Dynasty (AD 960-1279)[v].

Indian Science mainly developed in three fields: Mathematics, Astronomy and Medicine (Bryan &Hellemans: 2004). Indus Valley Civilization of India was one of the most scientifically developed civilizations in the world and people knew about irrigation (Rodda &Ubertini: 2004), sanitation (Teresi: 2003), hydrographs, blast-furnace and many other advanced technologies. The making of dyes, distillation of perfumes, the extraction of sugar, the weaving of cotton cloth (Burton: 1998), the concept of zero, and even the techniques of algebra and algorithm, the concepts of atom and relativity, the technique of surgery, the herbal system of medicine, the technique of alchemy, the smelting of metals, the game of Chess, the martial art of Karate, etc., have been found with evidence that they might have originated in India.

The Harappans[vi] (Indus Valley civilization) had analytical minds. The great accuracy that they achieved in measuring the physical units of length, mass and time indicates the advanced level of scientific and technological development reached by them. It shows the scientific and technological advancement of the ancient India was much ahead of other countries including China.

Steel started to be used in India at around 500 BC, however Chinese knew about the use of iron and steel much earlier than Indians and we will discuss about it in later pages.

In the field of Astronomy, people cannot forget the huge contribution made by Aryabhatta (476-550) and Brahmagupta (598-665). Aryabhatta's fame rests mainly on his *Aryabhatia,* which he composed at a tender age of 23. However, from the writings of famous other ancient Indian astrologers like Varhamira (505-587)[vii], Bhaskara I (600-680)[viii] and Brahmagupta; it is clear that priorto *Aryabhatia,*he also composed *AryabhattaSidhanta*(Selin: 1997).*Aryabhatia*which has survived to the modern times, was written in Sanskrit and is a compendium on mathematics and astronomy. It covers various aspects of mathematics including arithmetic, algebra, and trigonometry. It also talkes about tables of *Sines*.*AryabhattaSidhanta,* is however a lost work which mainly dealt with astronomy.Brahmagupta was the first to give rules to compute with zero.He is

also the author of two early works on mathematics and astronomy: the *Brāhmasphuṭasiddhānta*—a theoretical treatise, and the *Khaṇḍakhādyaka*—a more practical text.

Traditionally there is not much difference between astronomy and astrology in China. Tianwen（天文），is the character whichis used for both these names. Having said so, Chinese dynastic histories and works of Si Maqian (司马迁; 146BC-86BC) includes information on astronomical objects. However, long ago in the third century; Indian astrology had made entry into Chinese when the *Sardulakarnavadana*[ix] was translated, introducing the names of seven luminaries (Sun, Moon and five other planets) and the *Nashatras*(Moon stations). In 718, Sidartha translated the *Navgraha* calendar and introduced the names of two heavenly bodies; *Rahu* and *Ketu*. Tantrik monks from India played an important role in translating these forms of astrology to China. Amoghavajra (705-774) produced a book under its title *Xiuyaojing* (Books on Nakshatras and luminaries), in which the twelve signs of zodiac appeared for the first time in China. Thus, by the 8th century, important systems of astrology with Hindu roots had become very popular in China. A number of original horoscopes cast during the Tang times are recorded in *Qindinggujintushujicheng*《古今图书集成》 *(Complete Collection of Ancient and Modern Writings and Charts)* edited by Chen Menglei et al. in 1726 (Selin: 1997). Chinese astrology was no doubt highly influenced by Indian astrology. For example, the Ziping system employs a cycle of twelve phases, reminiscent of the twelve Nidanas of Buddhism.[x]

Moreover, as far as Chinese astronomy is concerned many scholars believe that it originated from India, some think from Arab but the famous scholar Josheph Needham (1900-1995)[xi] thought that it originated from Mesopotamia.

Indian Medicine

Indian medicine was so developed in the ancient days that, I think it will be prudent to write about it under a separate head-line. Indian believed that every plant and herbs have some power to heal the human body and all the plants have some medicinal value. *Ayurveda* is known to be one of the most fascinating books on medicine written in India about 4,000 years ago. Later on, Charaka(3rd century BC?) who is known as father of the Indian medicine and Sushruta, who is known as the father of Indian surgery contributed a lot for the development of Indian

medicine. Charaka was the proponent of 'Prevention is better than cure' theory in medical healing and is considered as the first person on the earth to present the concept of digestion, metabolism, and immunity. He authored *Charaka Samhita* which was a pioneer work on medicine and human anatomy and it has been translated into several languages including Arabic and Latin. Sushruta is considered as one of the main authors of The Compendium of Suśruta (*Suśruta-saṃhitā*). The book talks about techniques of surgery of hernia and cataract among several others.

Several others dealing with such subjects as, Anatomy, Surgery, Gynaecology and Obstetrics made their appearance in *Ayurveda*. Surgery and operations like cataract started in India in around 800 BC as we have mentioned above. Indian medicine was based on preventing diseases as much as on hygiene and curing it. Hospitals and herbal gardens existed from 3rd century and mention of herbal medicines and herbal gardens are found a lot in the ancient Indian epics and literature. Health was viewed to be the result of three elements: Air, fire and water. In relation with the body, these elements became wind, bile and phlegm, which is almost the same concept in the ancient Chinese medicine. In fact, Joseph Needham went on saying that only in the Chinese civilization there was focus on care of life in the ancient past.[xii] However, there are literary evidences, which show influence of ancient Indian medicines on Chinese medicines. For example, two Chinese works on ophthalmology, which were composed during medieval period (8th to 12th century AD) were attributed to Nagarjuna, the Indian scholar. Even great Tang poets like Bai Juyi (772-846) and Liu Yuxi (772-842) write in their famous poems about works of Nagrajuna, cataract surgery, and how a Brahmin physician priest cured eyes of Chinese people. The influence of Indian medical theory and practice, especially related to ophthalmology, became apparent in the well-known Chinese work, *Prescriptions Worth Thousand Pieces of Gold* which was written by Sun Simiao (AD 582-681)—the famous medical writer of the Tang period (Deshpande: 2001). There are also several stories in China which reflect that Chinese emperors learnt that in India there was a medicine which will make them immortal for ever and they sent several embassies to India to look for these kinds of medicines and doctors. Pursuit of immortality and elixir of life was common among the Chinese emperors and a very recent research in China shows

that even the first Emperor of China, Qin Shihuang (秦始皇; 259-210 BC) was looking for the medicine of immortality (Xinhua: 2017).

China

Helain Selin has written in the chapter, "Science and Religion in China" in his tome that "When the great scholar Josheph Needham started to publish the results through the extant resources about the history of scientific and technological advancement of China, it shocked the world to note that Chinese themselves did not remember what they had achieved, certainly the ancient Confucius would not have valued these 'achievements' as much as we the western do" (Selin: 1997).

Chinese civilization was by no mean less advanced than the Indian civilization. From the antiquity and ancient past, China made significant advances in science, technology, mathematics, and astronomy. The first recorded observations of comets, solar eclipses, and supernovae were made in this country. The four Great Inventions of ancient China: papermaking, the compass, gunpowder, and printing, were among the most important technological advances and world will remain indebted to China for these inventions. We all know that the first Emperor of China, Qin Shihuangdi (秦始皇帝) built up probably the first canals in the world which was about 32 KM long. Whether the Emperor had any knowledge about small Harappan canals of India, is not confirmed yet but the Emperor did make huge contribution in this field at such an early stage.

Paper was invented in China by an eunuch named, Cai Lun (蔡伦;48- 121) but some people think that paper was already invented in the country in around 250 BC for packing and other purposes but not for writing. In AD 618, China started publication of a court newspaper with several dozen copies printed which continued for several hundred years. The first printed book which was a Buddhist scripture, *VajracchedikāPrajñāpāramitāSūtra,* (Diamond Sutra) was printed in China in around 9th century (May 11, 868) and movable types were invented in China less than 200 years later. In fact, Bi Sheng (毕升;990-1051) is credited to invent the movable printing system in the world in between 1041 and 1048 (Needham: 1985). The *Diamond Sutra* was found by Aurel Stein in Gansu province (甘肃省) at (Dunhuang grottoes 敦煌石窟) in 1900 and the credit of its

translation goes to Kumarajiva. Prof. Ji Xianlin (季羡林; 1911-2009) explains that before 11th century, Indians did not know how tomake paper and he corroborates this fact through various primary Chinese resources and literature on India. He thinks that Chinese paper and silk was introduced to India through the silk route.

Karl Marx (1818-1883) has said, India has no respect for history. I think it is because of two facts. Although Indians used tree leaves (*Bhojpatra*), bamboo and some other materials for documentation, they did not know the art of paper making. Chinese knew the art of paper-making much earlier and hence we have very detailed dynastic history books in China. Second reason was that Indian teaching was mainly based on "oral teaching" from the Guru to his disciple and not a serious effort was made to record everything what the Guru prophesied.

China was also the first country to print a map. In 1155, it printed a map of western parts of the country. Chinese also gave us the correct value of Pie which is 3.1415927. In ancient time, people used "woods" as medium of fire but Chinese started the use of "Coal" as the main choice of fuel.

In AD 620, a Chinese engineer named, Li Qubi(李瞿碧) built a stone bridge over the QiaShuiRiver which survives even today. It was the first example of a segmented arch bridge.

We are currently short of energy, but people in China knew about the use of natural gas several thousand years ago and natural gas was transported through bamboo pipes in 1000 BC. I am not sure if the western learnt has learnt about 'fracking' from Chinese bamboo pipes transportation though. Some sources suggest that gas was started to be used from wells in around 900 BC (Mehrotra: 2003). By 400 BC, Chinese in Sichuan province (四川省)，started use of natural gas and petroleum for cooking and lighting. Use of poisonous gas also started in China, as we know through the Mohist writings[xiii].

According to some researchers, women in China in around 5th century started the use of matches for cooking and heating, which was almost unknown to other civilizations. A few crucial inventions such as harnessing of horses in China and concept of Zero in India had profound influence on their historical development (Bhavava: 2003).

The flowering of China under the Song resulted from agricultural changes, notably because of the upsurge of rice cultivation in South China and in

gunpowder, porcelain, umbrella, fishing reel and suspension bridge (McClellan & Don: 2006).

Song rulers started using paper money in AD 1024, which made China become the first country to use the paper money and also advance its civilizational progress (McClellan & Don: 2006). The ability to reproduce pictures put China well ahead of west and several countries (McClellan & Don: 2006).

Invention of gun-powder in mid ninth century changed the course of Chinese and world history (McClellan & Don: 2006). Invention of gun-powder in the beginning was not for any military motive but for warding off evils and demons but was used as fire-works. However, the veteran traveller, Marco Polo has written that Chinese were using firearms in AD 1237. The first small gun is known to be invented by the Chinese in 1288.

By the 13th century, Chinese had become the greatest and most accomplished algebraist in the entire world. Having said so, during the eight century AD, Indian advancement in mathematics and its' influence on Chinese thought and mathematics was evident.

Vibration and growth in early Chinese society and civilization was also because of the quite early usage of iron in the country. Chinese metallurgists started researching and use of iron very early. By 117 BC, iron production in China had become a state enterprise, employing thousands of labourers. Chinese started the use of cast iron much before any other civilization. However, it seems that the technology of pure iron was also known to Indian by 5th century AD. About 24 feet long iron pillar was erected in Delhi during Gupta Period (5th century) which is still extant because of its extreme purity. The iron pillar is not rusted at all and visitors can still see it in inside the premises of '*Qutub Minar*' in Delhi[xiv].

We all know about Ajanta and Ellora paintings, however very few people know the influence of these paintings on China. Several scholars have worked on this subject and Dunhuang research academy （敦煌研究院） in Gansu province （甘肃省）of China has contributed a lot in exploring the ancient interaction and influence of Indian paintings on China. With the huge influence from Indian archaeology, painting, carvingand stone chiselling, several hundred thousand figures of Buddha were chiselled and carved at Yungang (云冈石窟, Shanxi Province), Dunhunag (敦煌石窟, Gansu Province) and Luoyang (洛阳石窟,

Henan Province) in China (Tan: 1994). Giant statues of Buddha were erected and this was a clear cut influence from Indian archaeology. Empress Wu Zetian (武则天; 624-705) made several Buddhist statues and one major statue of Buddha seems to resemble her face in Luoyang. Resemblance of her face with that of Lord Buddha might be because of the effort of the Empress to influence and wedge more power and respect on the society (Rothschild: 2008).

Culture of silkworm was started in China. According to a legend, wife of an Emperor, who is famously known as the Yellow Emperor of China (2697-2597 BC?) first unrolled the cocoon and extracted silk from it. However, I will agree with many scholars including Dr. Shelagh Vainker who is Curator of the famous Oxford Ashmolean University that production of the silkworm would have not started initially with such an easy process (Vainker: 2004). In fact, before the legend of the Empress started producing silk in around 2600 BC, archaeological evidence suggests that silk cocoon were found in Yangshao culture (仰韶文化) of Shanxi province (山西) almost 1000 years ago, in around 4000 BC. We all know that in the Indian epics, *Ramayana* and *Mahabharata*, Chinese silk is mentioned. Even in ancient Indian literature like,*Arthsashtra* and *Manusmriti*, Chinese silk is mentioned many times which shows that Indians learnt about Chinese silk very early. However, apart from silk, there were many commodities which were introduced from China to India which includes, iron, tea, sugar making technique, groundnut, porcelain, porcelain, jujube, pear, peach and chestnut. According to Chinese resources, several commodities from India were also introduced to China which includes, various kinds of jewelleries, precious stones, ginger, asparagus, pepper, cardamom, tulip, jasmine, and rhinoceros horn (Gang: 1999)

Sugar making technique is an important issue in the Sino-Indian scientific and technological co-operation. Some scholars including Professor L. Smith believe that people in both India and China, knew about sugar-cane very early but it was India which knew the technique of Sugar making and then from India, Chinese learnt (Smith: 1984). However, Prof. Ji Xianlin refutes this concept and thinks as the name of Sugar in Hindi itself suggests (*Chini*), white sugar making technique was discovered in China and it was during Ming times (16th-17th century) that this technique was introduced to eastern India (In modern Bangladesh region). Prof. Ji Xianlin substantiates his argument on the basis of several Chinese

primary literary resources. He further says that the white granulated sugar called "*Misri*" in Hindi was introduced to India from Egypt and all the three countries learnt from each other in sugar extracting techniques (Wang: 2006). Prof. Ji further reckons that steel was also introduced to India from China. One synonym of steel in Sanskrit is "*Cinaja*"-from China, and Professor Ji substantiates his view on the basis of these linguistic concepts.

Rice Cultivation started in China in around 7,000-10,000 BC. Water buffalos were started to be domesticated in around 6,000 BC. Use of wheel seems to be started in both India and China at around same time in 2,500 BC. Cats were domesticated in India at around this time (Bunch &Hellemans: 2004). The first Zoo, called as the park of intelligence was established in China in around 2,000 BC (Bunch &Hellemans: 2004).

Around 100 BC, the Chinese discovered that a magnet orients itself in southern and (northern pole) but they did not use magnet for navigation at sea till 10th century. It is widely accepted that Shen Kuo (沈括; 1031–1095)was the first to describe the magnetic needle compass, which would be used for navigation (Bowman: 2000).

The ancient Silk Road was not necessarily a continuous road but a commingling of various cultures and China's trade with several countries including India flourished through this road.

During first millennium AD, hundreds of translation schools translated slew of Indian Sanskrit texts into Chinese and this way, secular science of India including medicine, astronomy, astrology, mathematics etc made etc way to China.

One can safely thus deduce to the conclusion that through trade and Buddhism, India China connection was quite robust and both the sides interacted not only in the field of business and commerce but also in science and technology.

Travellers

There are some travellers who visited both India and China in medieval times and their travelogue has been the one of the best source for learning about the scientific advancements and interactions in these countries. One of the prominent travellers among them was Marco Polo (1254-1324) who visited China first and while returning back also visited several parts of southern India and has recorded about this in his travelogue "*The Travels of Marco Polo*". The other

famous traveller was Niccolo De Conti (1385-1469), who first went to India and then to Southeast Asian countries. He then also travelled to China and wrote his travelogue which is known as *Le voyage aux Indes de Nicolò de.* His accounts are fairly consistent with those who travelled with great Zheng He (郑和; 1371-1433). Ma Huan (马欢; 1380-1460) accompanied Admiral Zheng He three times out of the seven voyages Zheng He made and he wrote a fantastic book called *YingyaShenglan*[xv] (瀛涯胜览, The Overall Survey of the Ocean's Shores). Aside Ma Huan, there were two other famous travellers who accompanied Zheng He, and they were Fei Xin (费信; 1385-1471) and Gong Zhen (巩珍). Fei xin wrote *XingchaShenglan* (星槎勝覽) during the four voyages he together made with Zheng He, while Gong Zhen wrote XiyangFanguoZhi (西洋番国志 or The Annals of Foreign Nations in the Western Ocean) published in 1434. All these famous books talk about co-operation between China and India in various fields including in the area of science and technology.

Few prominent Chinese scholars who travelled to India and wrote about development of Indian science were Faxian (法显; 337-422), Xuangzang (玄奘; 602-664), Yijing (义净; 635-713), and Wang Dayuan(汪大元;1311-1350). Wang Dayuan wrote *Dao Yi Zhi Lue* 《岛夷志略》 which is also a fantastic source for knowing about the progress and development made in India in those days.

One of the most famous travellers who visited both India and China was Moroccan, Ibn Battuta (1304-1368) who visited the empire of Delhi Sultanat(1206-1526) in India and also travelled from Shanghai and Hangzhou to Beijing via the Grand Canal (Yao: 1998).[xvi]

The famous traveller and navigator, Christopher Columbus (31 October 1451 – 20 May 1506) has also written in detail about capsicum in his dairies (Phillips & Phillips: 1992).He said that Capsicum is used widely in both the Indian and Chinese traditional culinary and it is not clear which country developed the cultivation of capsicum, however it is certain that it was grown first in either of these two countries and then introduced to the other parts of the world.

Although the great polymath Al Biruni (773-1048) never visited China but he has written in details about the Chinese advancements in defence engineering and mechanical engineering in his pioneer book *"Ta'rikh al-Hind" (Dani: 1973).*

From the twelfth to fourteenth century, Chinese fleet were at the pick of their prowess, at the least on the routes linking China with South Indian ports and this way the interaction between the two sides became more frequent (Selin: 1997).

Conclusion

Contrary to the view of some scholars, Sino-Indian Interaction has all along been a two way path and both the civilizations learnt from each other. Trade and Buddhism facilitated this process and the process of learning from each other's experience is the need of time as well. There is no gainsaying of the fact that both China and India were quite advance and much ahead than other civilizations as far as scientific and technological progress is concerned in the ancient past. These two countries were also very friendly and the bond of Buddhism further fostered the ties. There were several direct and indirect trade routes between these two nations and because of the dual channel of "Buddhism and Trade", both the countries learnt from each other to a great length which we do not see in the civilizational dialogue of China with any other country.

The famous Chinese polymath Professor Ji Xianlin has empathetically said as quoted by Prof. Wang Shuying in his preface to the book that, "If there was no mutual learning and interaction between the two countries in the past, the development of culture in these two countries would have not taken the present shape".

I strongly agree with Prof. Helaine that 'the important thing in the study of history of science, technology and civilization is to learn about mutual exchange of ideas among different cultures rather than to engage in futile disputes, claiming priorities and making scores in meaningless contests, in which there is no prize for the winner other than a false pride and prejudice'.

End Notes

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[i] Serious study on History of Science and technology started after the establishment of the Asiatic Society of Bengal in Calcutta in 1784. In 1876, the

Association for the Cultivation of Science was set up in Calcutta which gave further fillip for the research of history of science in India.

[ii] American Scholars like Lewis H. Morgan (1818-1881), Leslie White (1900-1975), and Gerhard Lenski (1924-2015) have written in great length on this social theory.

[iii]Dr. Murli Manohar Joshi in his Message to the Indian Science Congress in 2002.

[iv]*Chu Ci*, which is generally translated as *Verses of Chu* is an anthology written by famous poet Qu Yuan (屈原; 340-278 BC) and Song Yu (宋玉; 298-263 BC).

[v]The *Taiping Yulan*, is a massive Chinese encyclopaedia compiled by a number of officers under Li Fang from 977 to 983. It is divided into 1,000 volumes and 55 sections, which consisted of about 4.7 million Chinese characters. It is also considered one of the Four Great Books of Song dynasty.

[vi] The Harappan or Indus Valley Civilization (3300-1300 BC) was one of the four early cradles of civilization of the world. It was also the largest in terms of area among all the civilizations.

[vii]Varahamira was one of the nine jewels (Navratnas) in the court of the king Vikramaditya (Chandragupta II). Gupta Dynasty (Ad 320-600) is known to be a golden period in the history of Indian science, literature and arts.

[viii] Bhaskara I was apparently the first to write numbers in the Hindu-Arabic decimal system with a circle for the zero, and who gave a unique and remarkable rational approximation of the sine function in his commentary on Aryabhata's work.

[ix] *Sardulakarnavadana* was annotated and edited by Prof. Sujit Kumar Mukhopadhyaya of Visva-BharatiUniversity (Where I taught for more than a decade), Santiniketan in 1954 and Dr.Sharmishtha Sharma wrote about the astrological lore in this book, publishing as *Astrological Lore in the Buddhist Sardulakarnavadana*in 1992 from Eastern Book Linkers, India.

[x] Twelve Nidanas are known as 十二因緣 (*shíèryīnyuán)* in Chinese as Prof. Wang Shian 王世安 writes in his book '*History of Indian Buddhism*'《印度佛教史》, Commercial Publication 商务印书馆，2000, p. 52

[xi] Noel Joseph Terence Montgomery Needham was a British scientist, whose work on 'Science and Civilization' is commendable and an indispensable reference book for those working and understanding the growth of science and technology in the country. The famous Needham question, 'why had China and India been overtaken by the West in science and technology, despite their earlier successes?' begs further serious answers from current researchers.

[xii] In a TV speech by Prof. Wang Xinlu (Honorary President of Shandong Chinese Medicine University) on June 24, 2010 available at http://tv.people.com.cn/GB/14644/11957359.html. He quoted Joseph, "只有中华民族有自己独特的养生文化"

[xiii] Mohism was an ancient Chinese philosophy of logic, rational thought, and science, which was considered as a major rival to Confucianism, and was initiated by Mo Zi (墨翟; 470 – 391 BC).

[xiv] The iron pillar currently standing at the Qutub Minar Complex was built by Chandraguputa II and it was certainly moved from other place to Qutub Minar complex at some time in the history. Nobody has been able to precisely ascertainthe exact date of relocation of this pillar.

[xv] The Original YingyaShenglan is extant but the copies of work has been preserved.

[xvi]Yao hanyuan 姚汉源 writes that Grand Canal of China is the longest and the oldest man made artificial river which connected northern China to Southern China and helped maintaining the unity of the country).

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