

Engineering Legacy of Ancient Indians: A Historical Review

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Abstract - The 21st century is a revival of the natural philosophical style of thinking. However, current trends offer meaningful new thinking about culturally embedded technology which in turn refers to cultural understandings of technological development. Technology is always adapting to changing conditions and therefore alternative technologies are possible. Natural sciences and technology are embedded in the web of tradition. Innovation is subsequently linked to the transformation of tradition. Technological development can be understood as a cultural-historical process. In modern day India it is believe that trend of knowledge, research and mass education comes from the west and made our society decent. Here we will review some facts which will show that the legacy of engineering and the flow of knowledge, tradition and research is not new for us by analysing some facts from ancient and modern texts as well as from the traditions that were followed in parts of country.

KEY WORDS :- Ancient, Engineering, Shilpashastras, Vedas, etc.

I. INTRODUCTION

India is the land of living civilisation with continuity from time immemorial. Its knowledge and tradition has given its status of being immortal from centuries. As Mark twain quoted "India is, the cradle of the human race, the birthplace of human speech, the mother of history, the grandmother of legend, and the great grandmother of tradition. Our most valuable and most instructive materials in the history of man are treasured up in India only." Which leaves no doubt that India is always in the leading position and provides directions to the world in various field like mathematics, astronomy, navigation, medical science and many more. If I correctly say it is "Bharat" rather than India as India is the geographical identity but Bharat is the name given to its tradition and the people who are always keen to attain knowledge. Hu Shih Chinese philosopher and diplomat said "India conquered and dominated china culturally for 20 centuries without sending a single soldier across her border".

India has remained the quintessential epitome of knowledge, right from the dawn of human civilization. Indians had left no stone unturned as their intellect forayed into almost all disciplines of knowledge, particularly, Sciences like Physics, Meteorology, Chemistry, Mathematics, Astronomy, Metallurgy, Nuclear Science, Spiritual Science, etc., where they made an indelible impression by way of their landmark and ground-breaking contributions. Their scientific temper is unquestionable. But, the only thing to be borne while attempting a study of the ancient Sciences is the encryption of scientific facts behind the narration.

Engineering is basically a process of doing a particular product/process by application of scientific knowledge and materials. Ancient Indian text divides engineering in various branches like Biological sciences, Water resource engineering, metallurgy, water and surface transportation engineering, air and space engineering, engineering for habitations, warfare, town planning, machine and mechanisms, and more. And obviously every engineering and technology has a philosophical idea behind that. Ancient indian word used for field of engineering and technology is the word "Shilpa". Shilpa is a Sanskrit word which in modern day translates into industry. When we talk about industry, then it basically will be involving technology and engineering. When we think about engineering and technology, science always will be there. So let us see what our scripture says about that:

"नानाविधानं वस्तुनां यन्त्राणां कल्पसम्पदम् । धातुनां साधनं च वास्तुनां शिल्पसंगीतम् ॥"

The 'nanavidhanam', means various kinds of techniques, machines etc. The 'vastunam' means basically materials and 'Yantranam' means machines. Of course you can make a product from the materials using certain the process. When we talk about material, you need to know how to extract and process materials from raw material. The dhataunam (metal) is aloys used for making a product. The word 'sadhanancha' means transportation, one need to move from one place to another and also the motion of the components in a machine. And 'vaastunam' means habitats, like Vaastu Shastra, that is basically how to make a building or a hut or a room or a place or a fort. So Shilpa is like a song composed of various materials which undergo several processes in more systematic manner. That means it is the combination of engineering and technology, that we call it as a Shilpa.

Indian texts provide us with considerable layered evidence related to the development of engineering and technology. The civilisations that took over the classical heritage of science had a hard task to prevent

themselves from being stifled by it. There was still, however, the vast store of knowledge to be found in books available to any with the desire or skill to read them. Spanish Muslim scholar wrote in A. D. 1068 : "Among the nations, during the course of centuries and throughout the passage of time, India was known as the mine of wisdom and the fountainhead of justice and good government and the Indians were credited with excellent intellects, exalted ideas, universal maxims, rare inventions and wonderful talents. They have studied arithmetic and geometry. They have also acquired copious and abundant knowledge of the movements of the stars, the secrets of the celestial sphere and all other kinds of mathematical sciences. Moreover, of all the peoples they are the most learned in the science of medicine and thoroughly informed about the properties of drugs, the nature of composite elements and peculiarities of the existing things." It is true that compared to the tons of books written on Indian philosophy, there has been a sad neglect of the work of constructing scientific concepts and methods in the investigation of physical phenomena". But this does not mean that we have to start today from mere scratch. Though in a minority, some of the scholars went against the stream and took an absorbing interest in the scientific activities in India. Bharat knowledge tradition has a long list of sages (modern day scholars/researchers) from Baudhyana (Sulbasutra) to Panini (Ashtadhyayi) to Charaka (Charaka Samhita) to Pingala (Chandahshastra) to Bharadwaja (Vimanika Shastra) to Aryabhatta (Aryabhattyam) to Varahmihir (Brhat Samhita) to Sripati (Sidhaanta Shekhar) to Bhaskara (Lilavati) to Mahendra suri (Yantraraja) to Kamalkara (Siddhanta-tatva-vivek) to more and more. Sages set the basis of knowledge in culture, tradition and spirituality which focuses on overall growth of person.

Indian Veda and other ancient Indian Literature have contributed a lot for the development in Engineering, Technology and Science. Enough evidences are present in the text to show that there were innovative scientific methods and engineering concepts that showcase a charisma of our Rishis, who we believe are true Engineers. On the occasion of Engineer's day, birth anniversary of Bharat Ratna Sir Mokshagundam Visvesvaraya, a legend who served as one of the chief Engineers in the country, we will discuss some important aspects of Engineering in Ancient India.

Manu Smruti gives a gentle touch mentioning that the Indian Vedas are full of knowledge and all the concepts of modern subjects were already present in Vedas.

स सर्वोऽभिहितो वेदे सर्वज्ञानमयो हि सः । (मनु स्मृती २.७)

It means 'Sutras of knowledge' about all Arts, Engineering and Sciences (Social life, Politics, Economics, and Medicines etc.) are present in Indian Vedas. In all Vedas, Energy has been declared as Universal and Omnipresent and has power of transmission [Yajurveda: 15.33-34].

Maharshi Bhardwaj is the first Scientist of the World. His three inventions are mentioned in Rigveda, Yajurveda and Atharvaveda as follows: (Ref: Contributions of Indian Vedas in Art, Science and Technology- Madan Lal Ghai, Shiv Dev Shahi, Satya Bir Singh)

(i) He produced fire by friction. [त्वामग्ने पुष्करादध्यथर्वा निरमन्थत । {Yajurveda:11.32}].

Fire was produced by friction of two stones [Rigveda: 2.12.3].

(ii) He produced Hydroelectric, Hydel from waters of a Pond through friction [Rigveda:6.16.13] [Yajurveda: 11.32][Samveda: 9].

(iii) He produced Oil (Petrol) and Natural Gas from the inner Earth and Ocean through excavation [Yajurveda: 11.32; 11.28; 11.29; 11.31]

There are many books in Sanskrit devoted to Engineering and technology such as Yantra Sarvaswa, Samarangana Sutradhara, Tantra Pradipika, Shilpatantra Rahasya, Yukti Kalpataru etc. Several other books pertaining to other sciences also contain technical sections such as Artha Shastra, Rasa Shastra, Ganita Shastra, Vastu Tantra, Sthapatya Shastra etc.

Aircrafts:

There is an article "Aircrafts in ancient India" written by P. H. Thatte and published in Vedic Magazine Gurukul Samachar, Lahore, Vol.21, No.7,Dec.1923, and reprinted in magazine Shilpa Sansar Vol.20,23 April 1955,Pages 246 to 250. The article mostly deals with information in Agastya Samhita. Maharshi Agasti has mentioned some interesting aspects about the aircrafts mentioned below:

व्योमयानं विमानं स्यादग्रियानं तदेवहि । {अगस्त संहिता}

There are many names given to Vimanas in Agastya Samhita. It therefore appears that the vehicles were common in Agastya period.

लघुयत्सुघटं काष्ठं कोमलं ब्रम्हजाति तद ।

विमानो सर्वदाग्राह्यं लघुत्वादुत्तमं स्मृतं ॥{अगस्त संहिता}

The wood used in the construction of these vehicles used to be top class with properties such as light in weight, flexible and easy to work (soft). The lighter it was better.

कृमीकोषसमुद्भूत कौषेयमिति गद्यते ।

सूक्ष्मासूक्ष्मौ मृदुस्थूलौ ओतप्रोतौ यथाक्रमं ।
वैतानत्व च लघुता च कौषेयस्य गुणसंग्रहः ॥

The cloth used for it was silken. It was broad and soft. It was called “Kousheya” (made from cells of silk worms).

यवधारमयो धानौ सुशुक्तकजलसन्निधौ ।
आच्छदयति तत्तम्रं स्रणेनरजते नवा ।
स्वर्णलिसं तत्ताम्रं शतकुंभमिति स्मृतं ।

Electro-plating: Gilding electricity covers copper with gold or silver when contact with acidulated water and solution of metal salts i.e. contains metal full of ‘Yavakshara’, copper covered with gold was called ‘Shat Kumbha’. This gilding by means of gold or silver is called electroplating.

II. AN IRON PILLAR OF DELHI

Another most interesting work in this field is an Iron Pillar of Delhi that does not rust at all. It is said that this pillar was constructed by a “King Chandra”, probably Chandragupta II (reigned c. 375-415 CE), and now stands in the Qutub complex at Mehrauli in Delhi.

The iron pillar in India was manufactured by the forge welding (Forge welding (FOW) is a solid-state welding process that joins two pieces of metal by heating them to a high temperature and then hammering them together) of pieces of wrought iron. In a report published in the journal Current Science, R. Balasubramaniam of the IIT Kanpur explains how the pillar’s resistance to corrosion is due to a passive protective film at the iron-rust interface.

III. ZINC BY DISTILLATION PROCESS

The next significant Engineering in Ancient India is that, India was the first to smelt Zinc by distillation process. Zinc is a metal which was responsible for the innovation of utensils of mock-silver and coins of mock gold. As the boiling point of Zinc is low i.e. around 907°C, it is difficult to smelt. Brass however is known from even 3rd Millennium BC in China, but that can be produced from naturally occurring minerals containing Zinc and Copper. Pure Zinc could be produced only after the mastery of distillation techniques which have been described in our ancient chemical treatise. The mines of Rajasthan have given definite evidence of Zinc production going back to 6th Century BC. Hence, it can be very well said that distillation process however was being used only from the 12th century AD, thus India is the first to produce zinc by distillation processes.

IV. CONCLUSION

There are lot of such evidences mentioned in our Ancient Indian Texts that could clearly depict the picture that how brilliant was our Technology before we entered into Macaulay Education System. The traditional Gurukul method of Education enhanced the status of learning to the extent that could produce high class Engineers and more than that a responsible citizen which would serve the nation in a better way. The ancient texts contain ample amount of knowledge treasures which are hidden and it is the responsibility of every citizen of India to decipher and bring it on the top so that the world realizes that Bharat was, and however is, always at the position of Vishwaguru.

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