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Editor's desk

JSDIVSR has come up with the third issue of Ved Vigyan Vaibhav - a tri-monthly magazine. After the completion of two successful issues, here is the third one we are publishing in the month of November. This one would be the last in the year 2019.

This issue contains quality of information in the domain of Vedic Science. Two special articles are included in this issue. Late Dr. G. G. Joshi has done the tremendous work in the field of Shilpashastra. His work always gives an inspiration to the youths to work in the field of Vedic Science. Our Board member, Dr. A. S Nene has beautifully described the journey of Dr. G. G. Joshi. Another article tells us the importance of how saints of Bharat are playing an important role in the field of technology for developing our nation. Last article in this Magazine tells us about the vital role of Puri Seer Shankaracharya in the launch of Chandrayan 2.

Let's try to acquire the knowledge from our Ancient Indian Literature and make us feel proud of what ocean of knowledge our nation contains!

Environmental Geo-technology As depicted in ancient Indian literature

Dr.A.S.Nene

(Board Member, JSDIVSR)

First International Conference on Environmental Geo-technology , Allentown, New york USA-1986
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Ancient Indian literature includes texts on engineering sciences also. Some of these texts deal in details with environmental and geotechnical engineering.

The information in these texts has scientific background and can be very useful to modern scientists and engineers. This paper presents, in brief, information on environmental Geo-technology as depicted in ancient Indian Literature.

INTRODUCTION:

Engineering sciences were very advanced in India in ancient period (as early as 5000 BC). More than thousand texts (Shilpasamhita) can be mentioned on the various engineering sciences. Out of these some five hundred or more texts are preserved, in the form of manuscript on palm leaves, tree barks etc, in some of the libraries of Oriental research institutes and museums. The vast technical literature still exists as it was concealed in religious and mythological scriptures. Modern engineers and scientists, unfortunately, have not paid proper attention to this ancient literature mainly due to lack of knowledge of the language i.e. Sanskrit or due to improper Translation and interpretation of this information by non-technical academicians.

The various aspects of environmental Geo-technology, as depicted through

ancient Indian Literature, are presented in brief in this paper.

ENVIRONMENTAL GEOTECHNOLOGY

1. Environment Factors

As per ancient practice of planning of structures neighborhood of following six factors was taken into account.

A) People, B) Animals, C) Birds, D) Trees, E) Water, F) Site (Ref.25).

Only the last three factors are discussed herein.

A) Trees : Trees form a part of Indian cultural Heritage. Ancient texts clearly specify the trees which are suitable or unsuitable near the structures. Tree roots cause considerable volume change within the foundation stratum and thus results in damage to foundation as well as to superstructure. The trees which are declared unsuitable are (Ref. 5.53, 15.38, 25.5, 22.2, 8.1, 20.1)

- i) Plaksha (Ficus Infectoria)
- ii) Nyagradha (Ficus Bengalensis)
- iii) Ashwath (Peepal)
- iv) Audumber (Country Fig)
- v) Thorny Trees
- vi) Milky Trees

According to some texts (Ref 20.1) the trees should be at such a distance such that they do not cast shadows in the second or third quarter of daytime.

Alternatively the clear spacing between the tree and building should not be less than twice the height of the tree.

Some texts (Ref. 5.252) recommend that the unsuitable trees should be confined by a ring of masonry wall around it and the tree roots crossing this boundary should be cut as when necessary.

Some suitable trees such as Ashoka (*Polyathia Longifolia*), Bakul (*Mimusops*

Elenji), Panas (Jack Fruit) etc are recommended to be planted midway between unsuitable trees and buildings as per some texts. (Ref. 5. 252).

Some trees which are recommended to be grown near the buildings are Banana tree, coconut tree, Neem, Pomegranate etc, for the obvious reason of their germicidal and medicinal properties (Ref 21, 22, 5.52, 20.1).

Modern geotechnical engineers too have realized the importance of the problem and have identified certain parameters (Ref Geotechnique June 83) influencing the damage due to the tree roots. The parameters were a) Type of tree specie, b) spacing between tree and foundation, c) climatic conditions, d) type of foundation stratum etc. In this context one can admire the utility of information depicted in the ancient literature.

B. Water: In ancient time construction of wells reservoirs, canal works etc was considered highly pious work and formed a part of duties of kings and wealthy people. Water divining was a well developed science. Varahmihir (5000 B.C.) in his book Brihatsamhita (Ref. 5, chapter 53) described in detail about water divining. The depth, quality and quantity of water was predicted on the basis of surface features such as rock outcrop, type of trees and their foliage, presence of anthill, etc. Venkatraman (23) and Pognon (11) have given details about this and about the texts on this science. Fluctuation of water table effects properties of foundation stratum especially in case of expansive soils. Hence Kashyapa Shilpa (7.4) and other texts (Ref. 17.1, 20.1, 2.2 etc) recommend that the foundation should rest on rock or a stratum near to water table.

C. Site: The site near to hills was considered as good. The site sloping towards center, cracking ground (expansive soils) saline ground etc. was considered unsuitable.

2. SITE INVESTIGATIONS

Importance of site investigation was well known to ancient Indian engineers or scientists. Most of the texts discuss in detail about site, selection and site investigations in their preliminary chapters. . First explore the site, then plan

for structure. as quoted in Matsya Purana (Ref 9.253) and other texts (Ref 22.2, 8.1, 20.11, 6. etc.) given the description of unsuitable sites. Sites containing defects such as ash, coal deposits, burial grounds porous or expansive soils, saline soils etc. were considered unsuitable as building sites Many texts describe the field tests for ascertaining the suitability of sites. The simple field tests were,

- Compactness test,
- Permeability,
- Resistance to penetration of a sounding tool,
- Germination test,
- Flower test,
- Lamp test.

Only the last three pertaining to the theme of this paper are discussed below.

FIELD TESTS FOR SOIL INVESTGATION

1. Germination Test: In this test certain types of seeds are sown at the proposed site. If germination takes place within three, five days average or bad respectively. (Ref. 12- 24.3).

2. Flower Test : In this test flowers of four colors namely white, red, yellow and blue are placed in leaf cones at the four corners of a pit in the evening and the condition of the flowers is observed at the next day morning. The freshness of flowers indicates the suitability of site. If white flowers are fresh

the site is best, if red flowers are fresh then the site is good and so on. (Ref. 5.53, 15.10, 8.1, 22.2)

3. Lamp Test: In this test four oil lamps are lit in the four directions (east, north, west and south) in the foundation pit. Out of these , the lamp which lasts for longest period indicates the suitability of site. If the lamp in the east direction lasts for longest period then the site is considered best and so on

(Ref. 5.53, 24.1, 9.253, 15.10).

All the above tests are based on geotechnical environmental factors namely humidity, water content, temperature, oxygen content, thermal conductivity etc.

INDEX TESTS ON SOILS

The quality of any building material was decided on basis of index tests such

as color, smell, taste, shape, sound and touch (Ref. 6.4 and 25.5). These index tests were also applicable to foundation soil also. Based on these index tests the foundation soils are classified into four categories. Such classification is shown in the table 1.

TABLE - 1: CLASSIFICATION OF FOUNDATION SOILS				
Index Test	Classification			
	Good	Average	Poor	Bad
Color	White	Red	Yellow	Black/ Blue
Smell	Pleasant	Like Food	blood	Bad/Foul /Fishy/
Taste	Sweet	Pungent	Bitter	Sour/Salty
Slope	East	North	West	South

Sound *	Drum or Flute		Broken Pot
Touch	Oily	Pleasant	Unpleasant hot/ cold
* on impact by rammer			

STABILIZATION AND COMPACTION

Earliest reference on soil stabilization can be found in Shatapatha Brahman (Ref. 16). "Then the ground was stabilized (by Gods) using gravels and boulders, as a cobbler stretches the leather by driving nails.. Many texts describe in detail the method of compaction of foundation pits using rammers of the size of elephant's foot. Use of brick-bats, boulders, sand and clay in proper proportion in combination with water has been described in many texts (Ref. 25.5, 12.1, 17.1). Preparation of soil by mixing various ingredients and the process of mud plastering for walls etc. is described in details in Sakaladhikar (Ref 24, chapter 25). The water content of the soil for plastering it recommends, should be such that when a clay ball rolled on the palm, the lines of palm are printed on the clay ball. (This water content, as per authors experience, corresponds to liquidity index of 0.35 to 0.45).

Various processes of preparation of soil for idols, by mixing different ingredients, gums, resins etc to make the soil water repellent and hard, were known in ancient period. (Ref. 14.25, 19.11, 4.232).

Ancient Indians knew about quick sand condition. Amarkosha (Ref 3.2), an ancient dictionary type text gives thirty eight names of different types of land.

The quicksand is termed as " Bandhokak" or water which holds a person or animal. Such soils were stabilized by draining excess water through sand drains connected to river etc. (Ref. 6.8). Other aspects or stabilization such as brick making, pottery etc are beyond the scope of this paper.

CONCLUSIONS

The various aspects of environmental Geo-technology are discussed in the foregoing paragraphs. This information leads to following conclusions.

1. Some of the basic principles of modern geotechnical and environmental engineering were known to Indian people in ancient period (5000 B.C.).
2. Many of the ancient practices of soil investigations, planning and construction methods have scientific basis and can be useful, with due modification, in present period.
3. There is a need to review the vast ancient Indian Literature with a modern perspective.

ACKNOWLEDGEMENT

The author wishes to express his gratitude to Mr. G.G. Joshi, 176, Ram Nagar, Nagpur., who has a rare collection of texts on Ancient Indian Engineering Sciences, inspired the author to pursue this topic.

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Introduction to Shilpashastra

The word *Shilpa* is an enigmatic term. Different persons assume different meanings for same word, till the correct meaning is understood. "*Shilpa*" is such enigmatic word. To most of the people, Shilpa means a carving in wood stone or metal.

The word "*Shilpa*" is derived from a Sanskrit root – *Sheel samadhau* and literally means anything that pleases your mind. Sage Bhrugu has defined Shilpa as creation of different materials with the help of machines, techniques and arts.

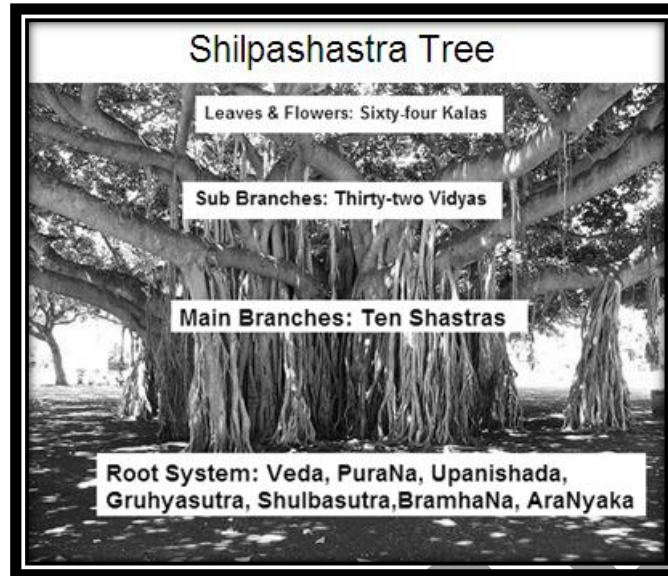
Shilpashastra is commonly interpreted as ancient Indian sciences. But laws and principles of science change from time to time. Hence better interpretation would be Engineering Philosophy of ancient India because the knowledge contained in Shilpashastra is an eternal truth.

For proper understand of Shilpashastra some technical terms must be under stood first. Such terms are explained below;

- Shilpashastra - The engineering Philosophy related to a particular subject comprising different techniques skills or arts.
- Shilpasamhita –A compilation of rules and procedure related to a particular science.
- Vidya –A techniques related to creation or execution of a Shilpa.
- Kala - An art or skill acquired by practice and experience. Even a blind of deaf person can master any particular skill.

As per sage Bhrugu, Shilpashastra covers 51 inter-related subjects, 10 Shastras or branches of engineering, 32 engineering techniques and 64 skills related to engineering.

Information related to Shilpashastra can be traced in Indian scriptures such as Veda, PuraNa, Upanishada, Gruhya-sutra, Shulba-sutra, BramhaNa and Niti. There were more than 10,000 texts exclusively devoted to Shilpashastra. But hardly 1000 texts are available now. The extent of Shilpashastra can be better understood by following figure.



The reasons for loss of this ancient technical literature of India may be due to;

1. Natural- decay of writing materials-Birch tree bark (Bhurjapatra), palm leafs (Talpatra) or paper etc.
2. Language- Most of literature is in Sanskrit. Modern the engineers do not understand Sanskrit and Sanskrit scholars cannot interpret engineering terms.
3. Secrecy- Most of books were preserved as part of worship material and remained un-noticed.
4. Foreign aggression- Most of the aggressors destroyed the heritage structures and libraries. Some aggressors took most of the original texts to their countries
5. Neglect by modern engineers – Teachers who teach engineering subjects are themselves ignorant about the heritage of engineering knowledge. Indian authors do not mention a single word about Shilpashastra in their books. Practicing engineers and architects, therefore, do not include ancient Indian techniques in their works.
6. Religion barriers- There is a misconception that Shilpashastra is for a particular religion or caste, and therefore it's study lacks government support.

7. Irrelevance- Applications of Shilpashastra may be irrelevant today due to advent of modern materials (cement, plastic, fossil fuel etc) and construction tools and techniques.
8. Improper interpretations- Translation of many Shilpashastra texts were done by western scholars, without adequate knowledge of Indian religions and culture.
9. Absence of technical data- Western books on engineering contains technical data, calculation tables and codes. But Indian Shilpashastra lacks such information.

The exact period of Shilpashastra related texts is difficult to ascertain. Few authors had mentioned the date of completion of their work directly or indirectly giving planetary positions on that particular date. A table below gives the chronology of references.

Chronology of References	
Text (B.C.)	Text (A.D.)
Vedas- 15000 to 10000 B.C.	Hayashirshapancharatra 301- 400
Puranas - 10000 to 5000 B.C.	Samarangana Sutradhara -1001- 100
Brihat-Samhita- 5000 B.C.	Aparajitprichha - 1101- 200
Mahabharata- 3000 B.C.	Manasollas- 1131
Shatapathbramhana- 1500 B.C.	Shusruta- 1101-1200
Krushiparashar- 1300 B.C.	Ratnasamuchchya- 1201- 300
Shilpashashtra-800 to 200	Manasara- 1201- 300
Arthshashtra-300 B.C.	Tantrasamuccaya-1428
Amarkosha-300 B.C.	Shilpadipak- 1401-1500
	Rajvallabha- 1433- 1468

From 17th to 19th century Shilpashastra was almost neglected. The beginning 20th century brought new hopes of revival of Shilpashastra. The time line given below shows the progress.

- 1833- A thesis entitled as "Essay on architecture of the Hindus" by Ramaraja, was submitted to Royal Asiatic Society of London.
- 1876 - Rev. J.E. Kornas translated a Sanskrit text "Mayamat Shilpashastra".

- 1920- Madras manuscript library was established. Shri Ramaraja, a civil judge, was requested to compile information related to Shilpashastra.
- 1900- A.V.Tyagraj Ayyar compiled a book entitled "Indian architecture of the Shilpashastra of India"
- 1927- Dr Prasanna kumar Acharya compiled 3000 pages encyclopedia named as "Manasara -an encyclopedia of Hindu architecture. Six more books were added by him to the Manasara series.
- 1930-1950-Many ancient texts were edited and published and new generation of research workers started working on this subject. T.Ganapati Sthapati, Dr. Dixitar, Dr.Raghawan, Dr.Madayya, Raosaheb K.V.Vaze and Shri G.G.Joshi are few prominent names.
- 1950-2000- Many publishing houses such as Chaukhaba Series, Motilal Banarasidas,Tanjore Saraswati Mahal library, Jagannath Jaguste etc published low cost books in regional languages.
- 2000 onwards- With the advent of computers, digital printers and scanners, digitization of ancient texts was possible. Government of India formed Digital libraries in different parts of the country. Billions of pages are available for free downloading. Many institutions hosted their own web sites for exchange of knowledge. Rest of the world is again attracted towards this subject.

The day is not far away when the subject of Shilpashastra would be included in engineering curriculum.

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Khanishastra-Mining and Metallurgy

By Late G.G.Joshi

(Source – Weekly Shilpasansar, Pune, April 1955, pp 379-382)

Introduction: A Greek metallurgist, made a statement that "*knowledge of Indians about mining and metallurgy was very little and their method of metal ore extraction was faulty*". Probably Greeks have never seen Indian mines.

After reading the above comment one becomes curious to know about mining and metallurgy in ancient India.

Arthashastra (Kautilya) describes elaborately the forms of metal ores such as gold, silver, iron and zinc during extraction. It clearly proves that Indian knowledge was not in infant stage.

Metal foundries in Vedic period: Vedic scholars mention that there were metal foundries in Vedic period. Pandit Satwalekar has published a Hindi book "Iron foundries in Vedic period" Ancient text "Rasaratnasamauchhyaya" mentions nine types of metals; Gold, silver, copper, iron, lead, zinc, brass and German silver. One example, mentioned below, will prove that Indians had highest knowledge about mining and metallurgy in the world.

"Needles were first made in England by a native of India in 1545 A.D. but the art was lost at his death. It was however recovered by Christopher Greening in 1560 A.D. who was settled ... in Bucks, where his manufactory has been carried from that time to the present day."- Encyclopedia Britanika, Vol 14, 5th edition, 1915.

Gold, silver or copper needles were commonly used in surgery in ancient India. Gemology is a part of Khanshashtra and there are many ancient texts on this subject.

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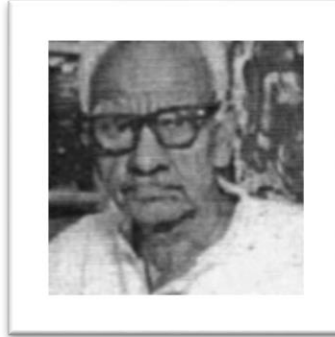
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Life sketch of G.G. Joshi

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Late Dr. G. G. Joshi

Shri Gopal Gajanan Joshi- A Researcher, Guide and Curator of literature on Shilpashastra (Engineering and Technology of ancient India).

Shri Joshi (referred hereafter as GG) was born on 15th January 1911, He obtained a diploma of Civil engineering (LCE) from Government Polytechnic Nagpur in 1933 and joined Public Works Department and worked in different capacity as tracer, estimator and overseer. In 1925 he came into contact of Shri Krishnaji Vinayak Vaze, a Civil engineer and Shilpashastra authority. Inspired by Vaze's monumental work, he decided to follow Shri Vaze and to finish his incomplete work of procurement of complete literature on Shilpashastra, scattered in manuscripts, books, journals, descriptive catalogues in all languages. Like Shri Vaze, he visited most of the oriental libraries. As photo coping (Xerox) facilities was not available he copied many books and articles on tracing paper so ammonia prints could be taken out for circulation amongst researchers. After 50 years of untiring efforts he collected more than 5000 references in his three room house at 276 Jeevan, Ramanagar, Nagpur 25. He made his collection open to all those interested in Shilpashastra. Many renowned scholars, book writers of Indology had visited his library for discussion and guidance from Joshiji. Distinguished guests who visited GG were, Alice Boner (Translator of Shilpaprakasha), Editors G.V.Ketkar, Social workers Shivaji Patwardhan

and Nanaji Deshmukh, RSS workers Moropant Pingle and M.G.Vaidya, Sanskrit scholars from India, England and Germany. GG wrote many technical articles on Shilpashastra and these were published mostly in a weekly journal "Shilpasansar" which was published from Pune, for a short span of two years (1955-56).

He arranged seven exhibitions of his rare collection during Annual meetings of Institution of Engineers (India) held at 5 cities.

He had a desire that his precious collection should be maintained by some institution only in Nagpur. He refused monetary offers for purchase of his collection. Unfortunately, during GG's lifetime, no renowned institute came forward for transfer and maintained this rare collection of references.

After the death of G.G. Joshi in 1992, his few followers formed a private trust named as "G.G. Joshi memorial Shilpa Sanshodhan trust". Adequate library space for storage and maintained could not be arranged till 2014 and the library had to shifted to seven different locations. Ultimately it located in a spacious independent house at 51 Ramakrishna Nagar, Nagpur.

It was felt that the published and unpublished work of GG should be compiled, translated and edited into a single book "Engineering and Technology of India- A compendium of G.G. Joshi's articles".

It is hoped that this book will inspire many engineers and architects of India. Many authors of engineering text books will tempted to quote ancient Indian reference books of their subjects.

Day is not far away when "History of Indian Engineering" would be included in the curriculum of university offering engineering or architecture degree course.

Contents of the proposed but un published book of Late G.G. Joshi

The proposed book would be based on the technical articles published in a Pune weekly "Shilpasansar", by various authors.

Serial No starting with **A, B or C** indicates the year of publication as **1955, 1956 and 1960** respectively.

Prachin Bharatiya Shilpashatra Parichay

Contents of the unpublished book

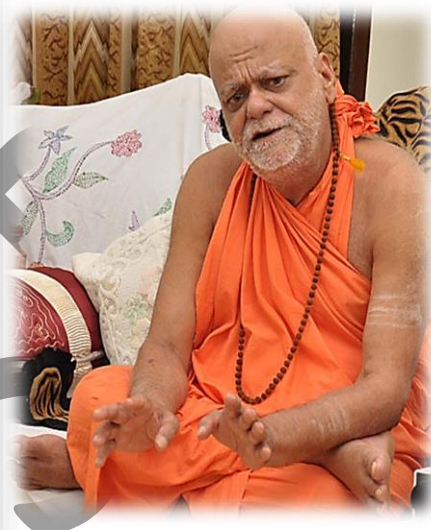
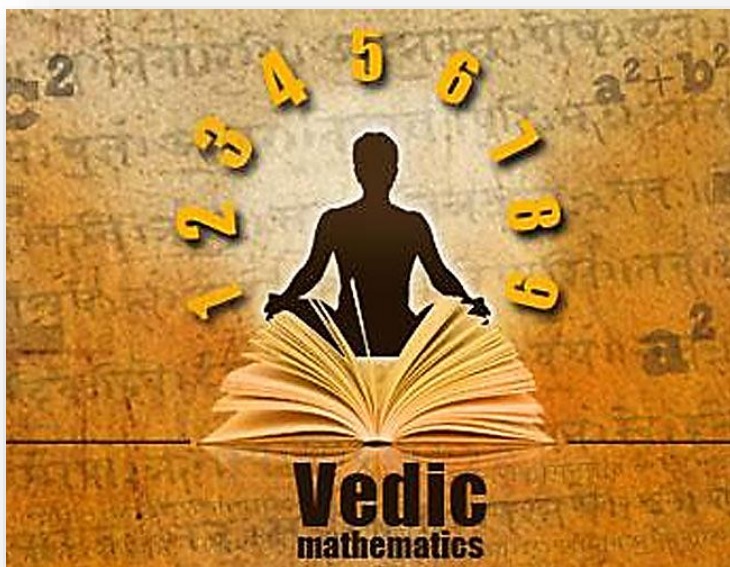
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Puri Seer imparted Vedic Maths formula to ISRO for Chandrayaan-2

Dr .M.S Tatwadi



It has been learnt that ISRO scientists consulted Swami Nischalananda Saraswati Puri Shankaracharya of Govardhana Matha before the July launch of Chandrayaan-2. This was done to dispel some of the doubts that the scientists had at the time.

Breakthroughs in science have defined human existence in the recent past like never before. And it has played a mammoth role in helping men – and women – go where no one has ever reached. Who knows this better than the scientists at the Indian Space Research Organisation (ISRO), who recently launched the Chandrayaan-2 mission to explore the far and the dark side of the Moon. While they deserve every credit possible, some of the applause may also be reserved for Vedic Mathematics.



It has been learnt that ISRO scientists consulted Swami Nischalananda Saraswati Puri- the honourable Shankaracharya of Govardhana Matha before the July launch of Chandrayaan-2. This was done to dispel some of the doubts that the scientists had at the time. According to Shankaracharya, there is an important connection of water and Earth to Moon in as per the sacred scripts of **Vishnu Puran and Shrimad Bhagwat Geeta**. And as per the **Bhishma Parva** or the Book of Bhishma- which is the sixth of eighteen books of the Indian Epic Mahabharata, the diameter of the Moon is 11,000 Yojana (1 Yojana = approximately 12.2 km) and its circumference is 33,000 yojana, while its thickness is 59 Yojana.

Renowned the world over for being an acclaimed Vedic Mathematician, Shankaracharya Nischalananda Saraswati's advise was therefore, considered extremely important. India now is at the cusp of being the fourth country – after the United States, Russia and China – to land on Moon, and could be the only country to land on the far side of Moon. The cost of the Chandrayaan 2 mission has been pegged at Rs 978 crore and thousands of scientists spent countless hours in making the launch a success.

It is certainly interesting to observe the growing closeness of Science with Spirituality for the betterment of Humanity.