VEDIC MATHEMATICS

The History, Discoveries And The Sutras

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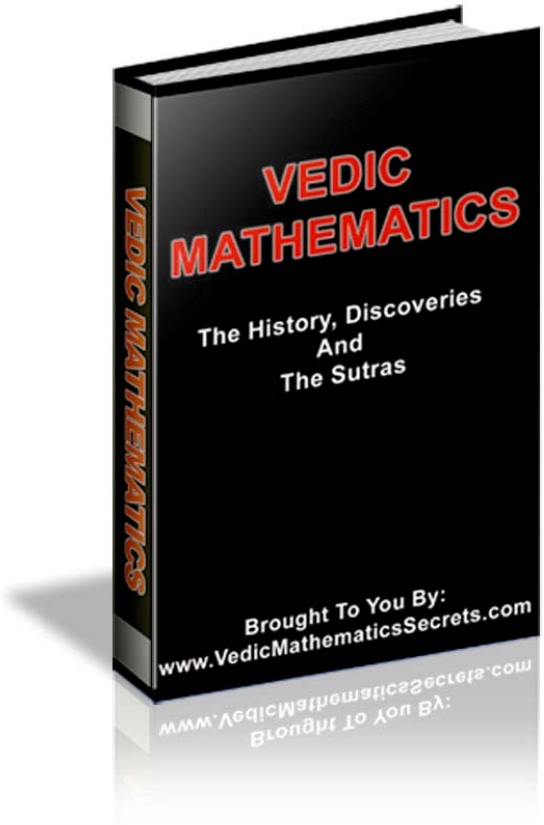

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Further Reading:-

1. VEDIC MATHEMATICS

Vedic Mathematics and Hindu religion are intertwined to an extant that separating the two would be tantamount to a sacrilege. The birth of Vedic Mathematics is lost in the womb of time. The exact date when the Vedas were written is not clear. Different dates are given by different authorities. Western philosophers and researchers have always treated Greek culture as superior to the Indian and even Arabic cultures. The birth of Vedic texts is therefore claimed to be much later than the two. It is therefore not surprising that the value of ***pi*** and the discovery of ***zero*** have been popularly viewed as Greek and Arabic in origin. It is assumed that civilization, as it is seen today, is centered on the Greeks just like the Christian belief that the Sun rotates around the earth. This unshakable dogma has for long relegated the importance of Indian civilization to the background.

It is only now that the world is realizing the importance of Indian philosophy and the way of life. Yoga in its many forms and manifestations has become a rage in America. Every street and gymnasium boasts of a Yoga guru. The elevated status of India in the world economy has much to do with the revival of interest in all things Indian. But the ignorance surrounding Indian history and its glorious past is more due to the fact that Hindu scriptures are essentially religious in nature. Vedic math as it is known today is not gleaned from a single source. It is essentially a compendium of methods derived from different Vedic literature.

Another major hurdle in uncovering the secrets of Vedic Mathematics has been the obscure language in which it has been written. A direct logic conclusion is therefore not possible. It is intuitive and requires a thorough understanding of not only the language but also the nuances of the text. The mathematical formulae have been beautifully woven into stories and allegories which are beyond the

comprehension of a common man. As we talk about the sutras directly related to the Vedic Mathematics, the complexities involved in extraction of information will become clear.

Vedic Mathematics may have been ignored for a long time for whatever reasons but it has become a rage in most of the campuses in Europe and the United States. The western world has picked up the cudgels with a vengeance. At the same time, the science of Vedic Mathematics is languishing in the country of its origin. One of the Professors in an American university expressed his amazement at to how sixteen sutras can unravel the complete mathematical code and that too mentally.

It is indeed fascinating to read about the origins of Vedic mathematics.

The impetus to Vedic Mathematics was given by the sacrificial rituals performed by the Vedic priests. The name **'sutra'** is derived from the Sanskrit which means a "***thread"***. This thread was required to measure the exact size of the sacrificial alter. Myriad calculations developed from this requirement. If the Vedic religion gave rise to a study of mathematics for constructing sacrificial altars, then it was Jaina cosmology which led to ideas of the infinite in Jaina mathematics.

Later mathematical advances were often driven by the study of astronomy. Well perhaps it would be more accurate to say that astrology formed the driving force since it was that "science" which required accurate information about the planets and other heavenly bodies and so encouraged the development of mathematics.

Religion too played a major role in astronomical investigations in India for accurate calendars had to be prepared to allow religious observances to occur at the correct times. Mathematics then was still an applied science in India for many centuries with mathematicians developing methods to solve practical problems.

Tracing the history of mathematics during the earlier centuries, the name of ***Yavanesvara***, in the second century AD cannot be overlooked. He played an important role in popularizing astrology when he translated a Greek astrology text dating from 120 BC. His specific contribution goes beyond the literal translation. He popularized the text, by resetting the whole work into Indian culture using Hindu images with the Indian caste system integrated into his text. This is an important contribution since, mathematics seen as separate from religion would have been unacceptable to the general public and more so to the Hindu pundits of that era. This merger into Hindu gods and goddesses was an effective method to assimilate the knowledge of other civilizations.

By about 500 AD the classical era of Indian mathematics began with the work of ***Aryabhata***. His work was both a summary of contemporary Jaina Mathematics and the beginning of new era for astronomy and mathematics. His ideas of astronomy were truly remarkable. He beautifully wove a scientific thread of reason and popular religion with and astronomical calculations, based on the Greek epicycle theory, giving a new interpretation of the two demons ***Rahu***, the ***Dhruva Rahu***, which causes the phases of the Moon and the ***Parva Rahu*** which causes an eclipse by covering the Moon or Sun or their light, with a modern theory of eclipses. He introduced trigonometry and integer solutions indeterminate equations which arose in astronomical theories.

Aryabhata, a renowned scholar and astronomer worked and lived in Kusumapura in the northeast of the Indian subcontinent. His work was of such seminal importance that his ideas formed the basis of further research in mathematical and astronomical research in India for many centuries to come. At the same time, Ujjain rose as another epicenter of astronomical research.

Varahamihira another scholar in Astronomy was a gigantic figure who worked from this center of knowledge. His work on trigonometry is noteworthy. It is to be

noted that mathematics remained a tool for exploration of the heavenly bodies. The concept of mathematics as a pure science was not an acceptable concept in India. This is because mathematics evolved as a means for conducting religious ceremonies and later in Jaina philosophy as a tool to determine the position of the stars and planets.

The fascination of Jaina philosophy with astronomy and the science of celestial bodies automatically led to an interest in the concept of infinity. It continued to flourish with scholars such as ***Yativrsabha***. He was a contemporary of ***Varahamihira*** and of the slightly older ***Aryabhata***. Together, the two schools of Astronomy were involved in the continuing developments of the numerals and of place-valued number systems. By the seventh century a new figure rose from the Ujjain school. ***Brahmagupta***, made one of the most major contributions to the development of mathematics with his outstanding contribution on negative numbers and zero. It is a sobering thought that eight hundred years later European mathematicians would be struggle to cope without the use of negative numbers and of zero. These were certainly not Brahmagupta's only contributions to mathematics. He made other major contributions to the understanding of integer solutions to indeterminate equations and to interpolation formulas invented to aid the computation of sine tables.

It is important to understand the social, cultural milieu of the times when these seminal works were produced. The educational system in India at the time did not allow talented people with ability to receive training in mathematics or astronomy. Rather, the whole educational system was family based. There were a number of families who carried the traditions of astrology, astronomy and mathematics forward by educating each new generation of the family in the skills which had been developed. We should also note that astronomy and

mathematics developed on their own, separate for the development of other areas of knowledge.

The tradition of family education led to a situation where knowledge databases, so to say, were confined within the families themselves. The commentaries and explanations most probably continued to be passed from generation to generation. Many of the commentaries would be commentaries on commentaries on commentaries etc. Mathematicians often wrote commentaries on their own work. They would not be aiming to provide texts to be used in educating people outside the family, nor would they be looking for innovative ideas in astronomy.

Astronomy was considered to be of divine origin and each family would remain faithful to the revelations of the subject as presented by their gods. The problem was that accepting new concepts and ideas was almost blasphemy and religious beliefs being intertwined with astronomy became a major hurdle in the acceptance of new ideas. Another issue which has been remarked upon is that there was no systematic calculation or observation and there does not seem to have been a major observational program set up. Paramesvara in the late fourteenth century appears to be one of the first Indian mathematicians to make systematic observations over many years.

A contemporary of ***Brahmagupta*** who headed the research centre at Ujjain was ***Bhaskara*** who led the Asmaka School. This school would have the study of the works of ***Aryabhata*** as their main concern and certainly ***Bhaskara*** was commentator on the mathematics of ***Aryabhata***. More than 100 years after ***Bhaskara I*** lived the astronomer ***Lalla***, another commentator on ***Aryabhata***.

The ninth century saw mathematical progress with scholars such as ***Govindasvami***, ***Mahavira***, ***Prthudakasvami***, ***Sankara***, and ***Sridhara***. Some of these such as ***Govindasvami*** and ***Sankara*** were commentators on the text of

Bhaskara I while ***Mahavira*** was famed for his updating of Brahmagupta's book. This period saw developments in sine tables, solving equations, algebraic notation, quadratics, indeterminate equations, and improvements to the number systems. The agenda was still basically that set by ***Aryabhata*** and the topics being developed those in his work.

The main mathematicians of the tenth century in India were ***Aryabhata II*** and ***Vijayanandi***, both adding to the understanding of sine tables and trigonometry to support their astronomical calculations. In the eleventh century ***Sripati*** and ***Brahmadeva*** were major figures but perhaps the most outstanding of all was ***Bhaskara II*** in the twelfth century. He worked on algebra, number systems, and astronomy. He wrote beautiful texts illustrated with mathematical problems, some of which we present in his biography, and he provided the best summary of the mathematics and astronomy of the classical period.

It was over 200 years before any other major contributions to mathematics were made on the Indian subcontinent. In fact for a long time it was thought that ***Bhaskara II*** represented the end of mathematical developments in the Indian subcontinent until modern times. However in the second half of the fourteenth century ***Mahendra Suri*** wrote the first Indian treatise on the astrolabe and ***Narayana*** wrote an important commentary on ***Bhaskara II***, making important contributions to algebra and magic squares. The most remarkable contribution from this period, however, was by ***Madhava*** who invented Taylor series and rigorous mathematical analysis in some inspired contributions. ***Madhava*** was from Kerala and his work there inspired a school of followers such as ***Nilakantha*** and ***Jyesthadeva***.

Some of the remarkable discoveries of the Kerala mathematicians include a formula for the ecliptic; the Newton-Gauss interpolation formula; the formula for the sum of an infinite series; Lhuilier's formula for the circum-radius of a cyclic

quadrilateral. Of particular interest is the approximation to the value of π which was the first to be made using a series.

This formula, as well as several others referred to above, was rediscovered by European mathematicians several centuries later. ***Madhava*** also gave other formulae for π, one of which leads to the approximation 3.14159265359.

The first person in modern times to realize that the mathematicians of Kerala had anticipated some of the results of the Europeans on the calculus by nearly 300 years was Charles Whish in 1835. Whish's publication in the "*Transactions of the Royal Asiatic Society of Great Britain and Ireland"* was essentially unnoticed by historians of mathematics. Only 100 years later in the 1940s did historians of mathematics look in detail at the works of Kerala's mathematicians and find that the remarkable claims made by Whish were essentially true.

2. VEDIC MATHEMATICS IN MODERN INDIA

One of the names worth mentioning in the development of Vedic mathematics in modern India is that of ***Sant Kumar Kapoor***. He has authentically expounded the foundations of all order in nature, as the basis of the Vedic literature available to us through the time honored oral Vedic tradition. His Ph.D. thesis has reaffirmed the authenticity of the Veda and Vedic literature .With mathematical precision he has reestablished the credibility of Vedic literature as the most orderly and comprehensive literature. Modern Indian philosophers believe that this has the potential to revolutionize education in all parts of the world and bring perfection to life on Earth. It is claimed that this revival of the absolute order with which the unified wholeness of natural law functions and maintains orderliness at every stage of evolution of life is a blessing in this scientific age.