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India: The Sense, Essence and Quintessence of Science from Every Conscience - An Introduction

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Abstract

India that is ***Bhaarat***, has remained the quintessential epitome of knowledge, right from the dawn of human civilization. Indians had left no stone unturned as their impeccable 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 veil of an aesthetic or devotional narration. It is very astonishing to find the results achieved in those remote times almost perfectly coinciding with the contemporary ones. The value of π, trigonometric functions, Geometrical techniques, etc. leave the modern reader wonder –struck. The progress achieved on the Mathematical frontier by masters like *Aapastamba*, *Baudhayana*, *Bhaskaracharya*, *Lalla*, *Brahma Gupta*, *Arya Bhatta*, *Ganesha Daivagnya*, etc., is par excellence. Their observations pertaining to Atmospheric Science are marvelous and meritorious. Their thorough and see-through ambit of climatic know-how thousands of years ago has won many an accolade across the globe, in light of the fact that the modern Meteorology had evolved comprehensively only in the 20^{th} century and still some weather phenomena like Rainfall, Tornadoes, the exact net effect of aerosols on temperature, Pollution trends, etc. have remained unraveled enigmatic mysteries till date. A dedicated and a comprehensive study of the Ancient Indian Sciences coupled and amalgamated with Current Sciences is the only plausible, laudable and an applaudable solution.

Key words: *Ancient Indian Sciences, Zero and Infinity, Leminiscate, Atmospheric Science,Meteorology, Vaayu, Vahni, Tapah, Big Bang, Kundalini, Praana, Vedas, Puraanas, Treatises, Chakra, Cosmic, Contemporary Sciences.*

Introduction

The word 'Science' finds its origin in the Latin term *'Scientia'*, meaning 'Knowledge'. Thus, science can be interpreted as a knowledge that can be relied upon completely. Till medieval times, the words 'Science' and 'Philosophy' were used as complementary and transposable terms. Science was often known by the name 'Natural Philosophy' till recent times, since Science and Philosophy were treated like the two faces of the same coin and to be precise, Science was considered to be an inseparable and integrated part and parcel of Philosophy. This is the specific reason why the highest degree, even in Sciences (and for that case, any other subject as well), is called 'Doctor of Philosophy (PhD)'.

It is of everyone's knowledge, that the progress of science was triggered to momentum by 'The Renaissance'. To be specific, this was the renaissance of Science, followed by Culture, more than anything else. Till then, the western world was engaged a sort of ignominious sorry state of affairs, at least as far as the formulation of various scientific postulates is concerned.

For instance, regarding ground water, the following theories have been put forward by some philosophers, thinkers and scientists hailing from 'The Occident':

1. *Lucius Annaeus Seneca* (4 B.C. – 65 A.D.) declared that "rainfall cannot possibly be the source of springs because it penetrates only a few feet into the earth, whereas springs are fed from deep down. As a diligent digger among my vines, I can affirm my observation that no rain is so heavy as to wet the ground to a depth

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of more than ten feet". This was widely accepted for the next 1500 years as an authentic proposition.

2. *Thales* (640 – 546 B.C.), stated that the springs and streams are derived from the ocean, and that the sea water is driven into the rocks by the winds and is then elevated in the mountains as springs by the pressure of rocks.
3. *Plato* (427 – 347 B.C.) stated that the water forming the seas, lakes and rivers and springs came from a large underground cavern called '*Tartarus'* and that these waters return to this cavern through some sub surface passages.
4. *Aristotle* (384 – 322 B.C.), the most celebrated disciple of *Plato* and the mentor of *Alexander* the Great, taught that ground water occurred in an intricate sponge-like system of underground openings and that water was discharged from these openings into springs.
5. The Romans also took the Greek theories for granted and their own theories were like the reflections of those propounded by their Greek Seers. (Prasad, 1980)

But, we can infer unassumingly that the Indian texts, scriptures and treatises were replete with references and discussions of hydrogeology, right from the Vedic times to the times of *Varaaha Mihira* (505 – 587 B.C.) and aftermath. Especially, *Varaaha Mihira*, in his *Brihat Samhita*, has devoted an exclusive chapter to Ground Water, where he deals with the identification, extraction, purification as well as quality and the quantity of ground water. This chapter is named '*Dakaargalam'*. Here, the word *daka* is the abridged form of *Udaka*, which means 'water'. Argalam may be considered synonymous to identification and extraction.

The Significance of the Word *Udaka*

Water has so many synonyms like *Jalam*, *Aapaha*, *Neeram*, *Toyam*, etc. But, the significance of choosing the word '*Udaka'* in this context of ground water divination/dowsing, itself shows the exemplary genius and astuteness of *Varaaha Mihira*. The root word *ut* in Sanskrit means 'upward, raise or ascending'. The single syllable (*Ekaaksharam*) *ka* has a definite meaning of 'water'. Hence, the term '*Udaka'* represents only such source of water that springs up from the earth, which happens only in the case of ground water.

However, it may also be interpreted as the one that can be obtained from above, i.e. from clouds in the sky, through rainfall. The chief source of the ground water is rainfall that creates the reservoir and replenishes it. But, whatever the interpretation may be, the choice of the word '*Udaka'* is highly noteworthy in this context.

If we peep deeper into the sense of the word scientifically, it is a proven and a firmly established affirmative principle that water exerts an upward thrust, known as '*Buoyancy'*. The word '*Udaka'* also showcases and projects the same inherent sense of an upward movement, which is the natural quality of water. Hence, the Indians were well aware of the so-called modern day '*Archimedes* Principle' and knew the in and out of this concept right from the Primordial Vedic times, when the prime progenitors of the spirit of '*EUREKA'* originated and echoed. This can be presumed from the very fact that they had given such an ingenious nomenclature of *Udaka* to water. To fortify this claim, it has been chronicled with awe and reverential admiration in the invaluable travelogues of *Megasthenes, Hieun Tsang, Fa-hi-en, Domingo Paes, Abdur Razzaq, Nicolo Conti, Marco Polo, Al-Beruni, Al-Firadaus* and others, that Indians were exceptionally good at ship-building. The ships were such that they could accommodate several metric tons of goods, hundreds of animals like elephants, horses, etc., personnel, army with loads of ammunition, food supplies and others, at a single stretch easily and were designed to voyage very long distances over oceans, sustaining even the severest of storms and calamities. In South India, the *Cholas* and the *Vijaya Nagara* kings were the masters of ship-building, using which they traded with distant lands and established their colonies in islands like *Malaysia, Indonesia, Cambodia, Java, Sumatra, Madagascar, Bali, Singapore, Sri Lanka,* etc., where one can find Indian culture and traditions flourish unabated, even today.

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Here, the main intention is to underline the undeniable statement that this was made possible only and only due to the precise proficiency of Indians regarding Buoyancy and the subsequent concept of the present day 'National Load Line' or the '*Plimsoll* Line' for their ships.

The very element that *Varaaha Mihira* acknowledges his indebtedness and gratitude to the works of all the previous *Aachaaryas* (*Gurus* or Mentors), right from the Vedic seers, which has been incorporated into his work (Prasad, 1980), provides an unflinching testimony to the equitable assertion made above.

India; that is, '*Bhaarat'*

It is highly unfortunate that we are still using an interpolated borrowed name as the official name of our nation, which has stood as an epitome of innovation, from eons of time. The Greeks first recognized our Indian territory as the land that lies beyond the river *Sindhu*, as viewed from their perspective and geographical directionality. They started calling *Sindhu* as Indus, and the land beyond that, by the name *Indica* or *India*. *Megasthenes*, a renowned Greek traveller of 3rd century B.C., recorded his 'Indian' experiences in his account '*Indica'*, meaning 'India'.

Later, when the *Arabs* invaded the *Sind* province during the early part of 8th Century A.D, precisely around 712 A.D, they called the river *Sindhu* as *Hindu* and the region *Hindusthan*. Later, this particular word *Hindu* has become synonymous to a religion that has the third largest number of followers in the world, only after *Christianity* and *Islam*. We are using a pseudo-nomenclature *'Hinduism'* for the most ancient religion in the world. This particular word *Hindu* has nothing to do with any aspect of religion, spirituality and Theism. It is only a misnomer with a geographical attribute alone. This so-called '*Hinduism'* is a Vedic religion (*Veda Dharma*), also known as *Aarsha Dharma* (the venerable way of life) and *Sanaatana Dharma* (the way of life that has existed always with no chronological barriers). Our religion is called a '*Dharma'*, meaning 'the righteousness'. That's why spiritual exponents like *Swami Vivekananda* proudly proclaimed that this so-called *Hindu* religion (*Sanaatana Dharma*) is not a confined set of beliefs, traditions and practices and that it is the divine righteous way of life applicable universally, transcending all the boundary limits.

When this sole geographical trait of the word *'Hindu'* is considered (of course, this is the only trait for the word originally), then, each and every individual living in India, irrespective of his religion, is a *Hindu*, beyond any qualms and reservations. In this way, this naming should bind all the countrymen in unity and integrity. But, in contemporary times, this is not to be, as this word has been consistently used to build walls and fences between the hearts of Indian fraternity, ignoring its genuine spirit.

However, the most pitiable part here is that after the partition of united India into India and Pakistan, Indus River almost entirely went into Pakistan's sovereignty. Hence, given these circumstances, continuing with the names of *India*, *Hindu* and *Hindusthan* officially on the international front, is definitely an issue of some constructive debate and dialogue.

The present Indian region was called by the name '*Bharata Varsham'* right from the Vedic times. Even now, our country is often referred to as *Bhaarat* or *Bhaarata Desa* at some domestic levels. Fig. 1 shows the map of *Bharata Varsham* during 6th century BC.

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Fig. 1: Map showing Bharata Varsham (India) during the 6th century BC

This ought to be made the official name of the nation. The very syllable *Bha* means light or brightness and *Rata* means to unite or blend. This implies that Indians are bright, intelligent, in whose lives light or fire adorns a pivotal and coveted role. The treasure-chests of knowledge *Vedas* originated in India and even Goddess *Saraswathi*, the personification of Knowledge and Wisdom is known by the name '*Bhaarati'*, fortifying this hypothesis. Indians are worshippers of fire and the oldest of the *Vedas*, *RigVeda*, starts with the verse '*Agnimeede Purohitam*' (I pray to the Fire-God, who is the first and foremost well-wisher and benefactor of this entire abode of human world (Right from the beginning of the creation)). Fig. 2 shows sacrificial ritual, *Yagnya*, offering prayers to *Agni,* the Fire God. Fire (*Agni*) has a name '*Jaata Veda'*. Among other interpretations, this can also be read as 'The Knower (*Veda*) of the birth (*Jaata*)'. This means the *Agni* is well-aware of the birth of all the three-tier forms of creation. The *Andaandam* (the creatures born from eggs like birds, reptiles, etc.), *Pindaandam* (creatures born directly from the womb of the mother after crossing the stages of an embryo and a foetus) and *Brahmaandam* (The Magnificent/*Brahma's* (expanding) Egg (*Andam*; the root word *Briha* means 'to expand'), that is, the entire creation). Coming to the case of *Andaandam* and *Pindaandam*, right from the time of fusion of male and female gametes and the resulting fertilisation to form a zygote till the birth of an off-spring, it requires proper temperature, optimal for development of the baby inside. Even after the birth, the external and the internal temperatures play a decisive role in keeping a creature alive. If temperature in the body rises beyond the limit, we feel feverish and lowering of temperature is an even more critically serious condition. Obviously, it is needless to mention that the source of this temperature is the Sun (i.e. The *Agni* in Him). Hence, *Agni* accompanies you and witnesses as well as facilitates each and every activity/development in your body, right from the stage of a zygote till death. The Sun is also a form of Fire, which causes seasons and particularly, induces rainfall. From this rainfall, plants and food grains crop up and from these, living beings evolve by taking oxygen and nutrition. Hence, in this way also, *Agni* (Fire) is the *Jaata Veda'*.

When we talk about *Brahmaanda*, here unleashes the ultimate manifestation of Indian thought. The first text of this Earth *RigVeda* describes the

Fig. 2: The age-old tradition of Fire-Worship and performance of Holy Yagnyams in India, which continues unabated till date.

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Primordial period of creation thus:

"At that time there was neither Non-Existent nor the Existent. There was neither wind nor the celestial region beyond. What did it consist of? Where did it? Under whose protection was it? Was there water dense and deep? At that time, there was neither death nor immortality. There was neither Night nor Day. IT took breath by itself without wind. Except that, none else was there beyond. Darkness pervaded by Darkness was there in the beginning. It was an indistinguishable state having filled with water. That was covered in void that arose from the power of heat……." (*RigVeda*, *Naasadeeya Sukta*, *Mandalam* 10, *Sooktam* 129 (Fig. 3)) (Rani Sadasiva Murty, 2007)

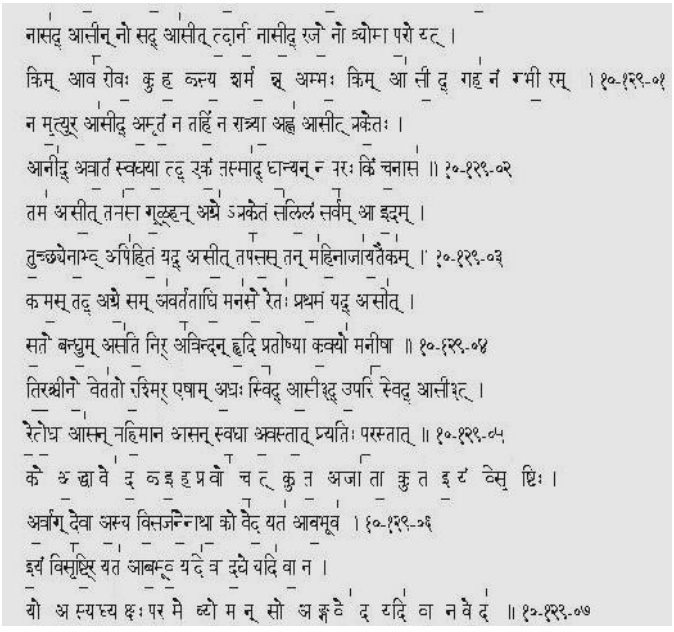

Fig. 3: The Naasadeeya Sooktam, the Rigvedic hymn describing the primordial times of Creation

Therefore, an undifferentiated primordial fluid/Waters (*Naara*; In Sanskrit, *Naara* or *Salila* means 'Waters') existed. Then, the Self-Manifested (*Swayambhu*) Supreme Entity emerged. He was therefore called '*Narayana'* (The One who has the Waters as His Place as well as Path and Destiny of Movement). Even the Genesis of The Bible (1.1-2, 1.6-7) and The Quran (921.30) proclaim that there was only endless and indistinguishable water in the beginning. *Narayana* established the first seed of creation into the water in the form of a 'Golden Egg'. He entered the egg as '*Vishnu'* (Vis means 'enter or pervade') and then, from His navel, the first Creator/ Progenitor Lord *Brahma* emerged. It is said that Brahma could not make out the purpose of His existence and was caught in a state of ambiguity. Then, He heard the splashing of water currents around Him, which generated a sound '*Tapah'*. Then, He grasped the message and performed penance, after which He was enlightened and began executing His ordained duty of Creation of this Universe. If we observe closely, this term '*Tapah'* basically means 'to heat' (Siva Ram Babu, 2007). Hence, this follows that due to the generation of heat in the Golden Egg, the process of creation started. This is the principle of the 'Big Bang Theory' as well, which states that when the temperature and pressure inside the densely packed lump of matter reached its saturation, then, the Great Explosion took place, marking the expansion of the Universe gradually. Lord *Vishnu* is the endless Universe itself and Lord *Brahma* is the expanding creation inside that Universe (Space). Hence, from this, the significance of *Brahma* being born from *Vishnu* and considered to be His Son, can be realized. Any rotating fluid (Indians knew that the time and creation were cyclic; that's why they compared time with a wheel, calling it *Kala Chakra*), gradually assumes the shape of a spheroidal ellipse, resembling an egg and hence, they called the Universe '*Brahmaanda'*, unlike the western concept of a spherical universe. From the orbits of the electrons around the nucleus to the orbits of the planets around the Sun or other stars, the elliptical shape dominates. However, the 'Big Bang theory' or the 'Hypothesis of the Primeval Atom' of Georges Le' maitre of Belgium in 1933 has many contradictions with the ancient Indian model. The Vedic/Indian model and the one described in the *Vishnu Puranam* successfully overcomes many shortfalls that the Big Bang Theory could not surpass, as all its castles were founded on Einstein's Theory of Relativity, Michelson-Morley Experiment and the concept of a 'Void Space'.

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The Egg is termed 'Golden' because of the influence of Heat. It is tremendously heated in order to make it expand till its entropy reaches saturation and it collapses ultimately. Anything that is Super-heated appears to be golden in colour. That is why, the idols of Gods, who represent different forms of energy, are often decorated with Gold ornaments. Especially, Lord *Vishnu* who has a name '*Hiranya Garbha'* (The one with a golden womb, even Sun is called '*Hiranya Garbha*. All the metals in the Earth's crust (including Gold) are derived from the Sun because Earth itself emerged from the Sun) is extensively adorned with jewelry. Lord *Vishnu*, who is a personification of this endless universe (*Anantha Viswam*), when decorated with various ornaments, appears like the Universe studded with innumerable stars, galaxies, quasars, pulsars, etc. This tells us why He is particularly described to be of 'black/dark complexion' and His idols (even the idols of other deities) are made with black stones like the *Saalagrama* and others. The *Viswaroopam* of Sri *Krishna*/*Swaraat* or *Viraat Purusha,* shown in Fig. 4, has so many faces on both sides that emit flames, as described by Sage *Vyaasa* (Siva Ram Babu, 2007). This pictorial depiction has a mystic secret encoded in it that takes us back to the initial phases of creation, described above.

Fig. 4: The Viswaroopam (Universal Manifestation) of Lord Sri Krishna (Swaraat or Viraat Purusha). Notice the flames being breathed out of many faces on either side of the Universal form, suggesting that heat/fire initated the Creation of this Universe.

This clearly explains the nomenclature of *Agni* as '*Jaata Veda'* in terms of *Brahmaanda*.

Further, Dr. Siva Ram Babu (2007) also opines that, going by the *Rigvedic* verse 10.72 which states that the universe became steady after collapsing seven times and was stabilized during the 8th, we can decipher the mysterious birth of the *Viraat Purusha* Lord *Krishna* (Fig. 4) (i.e. the Universe itself) as the eighth and the lone surviving baby of His mother *Devaki*, believed to be the reincarnation of *Aditi*, after the premature and abrupt death of His 7 predecessor babies. *Aditi*, besides being hailed as the Mother of Gods, acquired a lot of prominence in the Vedic lore (Rani Sada Siva Murty, 2007) as the manifestation of the Supreme Being Himself (*Prajapati*; The Creator and The Destroyer; Life and Death). Literally, '*Aditi'* means the 'Inseparable/Indivisible' or 'Non-Dual (*Advaita*/*Adviteeya*)', which is the chief attribute of the Almighty/*Brahman*. This Almighty oversees the cycle of Creation, Sustenance and the Destruction of the Universe, without actually involving himself in it. The *Chakra* in the hand of Lord *Vishnu* signifies this eternal rotatory cycle. The *Chakra* is called '*Sudarshana'*, which means 'an effective/auspicious perception'. This sense points to the cycle of creation as everything perceptible lies in the creation itself. The Almighty is above creation and perception as envisaged by this Upanishadic verse: *"Yato Vaacho Nivartante, Apraapya Manasaa Saha"* (*Taittireeya Upanishad*, II, iv.1)

This means that 'the words (*Vaak*) which set out in quest of the Supreme Being, return helplessly and even the mind/intellect (*Manas*) is completely incapable to grasp 'IT'. The *Chakra* can be taken to represent time, which is cyclic and based on which all understanding and perception in the Universe originate. It can also be understood as the Divine Light or Knowledge/Consciousness of the Divine, abiding by the name '*Sudarshana'*. *Sudarshana* is also described to possess the radiance of multitude of Suns and always emits Divine Fires that annihilate Demons (i.e. exterminates Demoniac

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thoughts expelling the darkness of ignorance and filling the hearts with the Wisdom of the Almighty, enabling an abstract perception of The Omnipresent, The Omniscient and the Omnipotent Super-Cosmic Entity (the quality of *Sudarshana*)).

This is why Indians have a great affinity towards Gold (Siva Ram Babu), which has many other beneficial and healing properties on human body.

This has been passed on to other religions like *Zoroastrianism* and others eventually. The Sun-worship is the most important feature of Indian culture, from times immemorial. Since this region was under the rule of legendary mythological emperor *Bharata*, this land came to be called *Bharata khanda* (Indian sub-continent) and *Bharata Varsha* (Indian mainland), after his name. Some scholars even claim that in the word *Bhaarata*, *Bhaa* stands for *Bhaava* (Meaning), *Ra* denotes *Raaga* (musical notation and tune) and *Ta* signifies *Taala* (systematic rhythm). Indians are music-lovers and the music itself has originated from the primordial sound *AUM* (*Pranava naadam*). The *Saama Veda* is said to be the manifestation of music. From this, it can be concluded that Indians lead a well-planned, structured and a disciplined life. Such a name that assigns rightful multifarious noble attributes to the country and her people should be the natural and obvious choice over an irrelevant and an interpolated misnomer that has been borrowed and handed over to us, as an alien heirloom.

The field of Atmospheric Science or Meteorology has been at the crest of Indian Sciences right from the Vedic period. Studying the weather was accorded the position of a prime and paramount branch of science, for which, opulent and irreplaceable literature in the form of *Vedas*, *Puranas*, treatises like the *Brihat Samhita*, *Artha Shaastra*, etc., epics like *Ramayana* and *Maha Bhaarata*, and classics like *Megha Dootam*, *Kaadambari*, etc., has been produced over several millennia. Some of these are brimming with meteorological information, while others host some valuable, passive and symbolic references to atmospheric phenomena.

Indian Meteorology is based on scores of centuries of meticulous observation and documentation. But, the lack of available tangible information, records pertaining to the technical, instrumental and statistical aspects of measurement, calculation and prediction made the western world project this genuinely germane science as a meager mundane one. The Vedic Seers were well versed with the systematic procedure of the fire or heat from the Sun causing the Winds to circulate, absorb water in the form of vapours, rise up, form clouds and cause precipitation. They were amazed at the sight of lightning and the succeeding sound of thunder. Hence, their core worship was concentrated around the Powers of Nature like *Surya*/*Mitra* (Sun), *Agni* (Fire), *Vaayu*/*Pavana* (Wind), *Varuna* (rain or Water), *Indra* (Clouds and Thunder), etc. initially during the Early Vedic period. Then, the horizons of their intellect expanded encompassing the entire universe and began probing the real Progenitor and Sustainer of Everything.

In this process, they developed so many Arts, Sciences and other disciplines. By the time of Upanishads, that the Brahman could not be realized by any Physical means such as Words, Instruments, Senses and even the Mind (*Manas*). But then, they understood tacitly that realizing oneself would lead to the realization of the Almighty (*Aatma Saakshatkaaram*). Hence, the transit which started from mere observation and eulogy of Surroundings and the Mother Nature and after undaunted attempts and experimentation to reach the unreachable (*Durgama* and *Durlabha*, as in *Vishnu Sahasra Naamavali*), they started an inward journey towards Self-Realization by the time of *Upanishads*. Hence, by around 1000 B.C., when the rest of the world was after 'elf' realization, India had already ascended the sacrosanct summits of 'Self' Realization.

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The term '*Meteorology'* dates back to 340 B.C., when *Aristotle* brought out a book on Natural Philosophy named '*Meteorologica'*, which deals with the weather and climate in those days, Astronomy, Geography, Chemistry, clouds, wind, rain, snow, hail, thunder and hurricanes. It is highly noteworthy that all those things that fell from the sky, and anything seen in the air, were called '*Meteors'*. Hence, the term '*meteorology'* actually comes from the Greek word '*meteoros'*, meaning "high in the air". But, now-a-days, we have a clear-cut and well-defined perception of and distinction between meteors that come from extra-terrestrial sources outside our atmosphere (meteoroids) and particles of water and ice observed in the atmosphere (hydrometeors). Later, a distinguished disciple of *Aristotle*, *Theophrastus,* compiled a book on weather forecasting called 'The Book of Signs', which attempted to foretell the weather by observing certain weather-related indicators. Even though, many of their ideas were found to be erroneous, the works of *Aristotle* and *Theophrastus* remained a dominant influence in the field of meteorology for almost 2000 years (Donald Ahrens, 1998). This, of course, applies to western world alone, and not to the East, especially India, where the knowledge of the atmosphere was at its zenith, even much before *Aristotle* and his mentors. A brief overview of the developments in the field of meteorology in the West has been presented chronologically in table 1 (Donald Ahrens, 1998)

Table 1. Some milestones in the long journey of Meteorology

Year/Period	Significant Development(s) in Atmospheric Science
Late 1500s	Italian Physicist and Astronomer *Galileo* invented a crude water thermometer
1643	A student of *Galileo*, *Evangelista Torricelli*, invented mercury barometer to measure air pressure
Around 1650	*Blaise Pascal* and *René Descartes* demonstrated that atmospheric pressure decreases with increasing altitude
1667	A British scientist *Robert Hooke* invented a swing-type/plate Anemometer for measuring wind speed
1719	German Physicist *Gabriel Daniel Fahrenheit* developed a temperature scale, based on boiling and freezing of water.
1735	British meteorologist *George Hadley* explained how the Earth's rotation influences the tropical winds
1742	Swedish astronomer *Anders Celsius* developed the Centigrade (Celsius) temperature scale, which is being widely followed today.
1752	American statesman and scientist *Benjamin Franklin* practically proved the electrical nature of lightning, by flying a kite in a thunder storm
1780	A Swiss geologist and meteorologist *Horace de Sausure* invented the hair hygrometer for measuring humidity
1787	French Chemist *Jacques Charles* discovered the relationship between temperature and a volume of air.
1821	The first crude weather map was drawn
1835	French Physicist *Gaspard Coriolis* mathematically the effect f Earth's rotation on atmospheric motions
1840	Partial knowledge about winds and storms was obtained
1843	Invention of the Telegraph; used for rapid dissemination of weather observations and other related information
1869	*Isobars* (lines denoting equal pressure) appeared on a weather map for the first time
1920	The concepts of air masses and weather fronts were formulated in Norway
1940s	*Radiosonde* observations, RADAR gave a 3-dimensional view of the atmosphere; High-flying military aircraft discovered the existence of *jet streams*
1950s	High-speed computers were developed to solve the mathematical equations that describe the behavior of atmosphere. At the same time, under the leadership of *John von Neumann* and *Jule Charney*, a group of scientists at *Princeton, New Jersey*, developed numerical means (models) for predicting the weather.
1960	The first weather satellite *Tiros – 1* was launched, ushering in space-age meteorology

The main aim of the present article is to focus on the various significant achievements of ancient Indians in the field of Science and Technology, taking the support of relevant references in some ancient Indian texts and try to validate their efficiency through some interpretations and discussions in order to assess and appraise the extent of their correlation with the present-day sophisticated dexterity.

Discussions

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A fleeting look at the multi-faceted Indian prowess in the arena of Sciences

1. Chemistry

Ancient Indian chemists were well aware of the process of distillation. In the '*Rasa Ratna Samucchaya'* of *Vaagbhata*, it has been mentioned thus:

"Place the chemical in a vessel provided with a long tube inserted in an inclined position, which enters the interior of another vessel arranged as a receiver. The mouth of the vessel and the joint should be luted clay and cloth. Now, put a strong fire at the bottom of the vessel containing chemicals, while the other vessel is in cold water. The apparatus is used for distillation" (*Rasaratna Samucchaya*, I. 48 – 50).

This apparatus was called '*Tiryak Patana Yatra'* and is believed to be introduced by Nagarjuna for the extraction of cinnabar essence. This was also used for the distillation of perfumes and ointments.

2. Batteries

"Place copper plates in an earthen pot, cover it with copper sulphate and moistened saw dust. Spread Zinc powder and cover it with mercury. Due to chemical reaction, positive and negative charges and consequent current is produced" (*Agasthya Samhita*).

Surprisingly, this produces a voltage (1.1 Volt) almost equal to that of the modern day dry cell (1.5 Volt)

3. Shape of the Earth

"As the Earth is round, every person considers himself at the top of the Earth where he is standing. So, downward direction is towards the center of the earth for everyone" *Bhugoladhyayaha*, *Surya Siddhanta* of *Arya Bhatta*.

"Earth is situated suspended in space st the center of the *Bhugola* (Celestial Sphere), surrounded by the orbits of the planets. The Earth is made up of water, soil, fire and air and is circular on all sides, spherical in shape" (*Aryabhattiya*, IV, 6)

Arya Bhatta, for the first time, emphatically pronounced that the earth is spherical and that it rotates around the Sun and all other stars are relatively stationary. It is to be prominently observed that *Nicholas Copernicus* had postulated his '*Helio-centric theory'*, condemning *Ptolemy's* established '*Geo-centric theory'*, only after 1000 years.

4. Duration of Day

Arya Bhatta in 476 A.D. has derived the duration of one sidereal day on Earth to be 23 Hours 56 Minutes 4 Seconds and 0.1 Fractions, without any substantial sophisticated astronomical equipment and not even looking at the sky literally. The modern value is 23 Hours 56 Minutes 4 Seconds 0.091 Fractions. The comparison between these two values speaks volumes about the accuracy of ancient Indian science.

5. Velocity of Light

Saayanacharya (1315 – 1387 A.D) is the brother of *Vidyaranya* who was the guru of *Hari Hara Raya* and *Bukka Raya*, on whose initiation; they founded the famous *Vijaya Nagara* Empire in 1336 AD. *Saayana* wrote one of the most authoritative commentaries on Vedas (*Saayana bhaashyam*). In his commentary on the *RigVeda*, a straightforward reference to the velocity of light (originally in the *RigVeda*) can be found, which reads:

"Thus it is remembered: [0 Sun!] bow to you, you who traverse 2,202 *yojanas* in half a nimisha" (*Saayanacharya's* commentary on 4th verse of the hymn of *RigVeda*, I.50).

If the value of one *yojana* is taken to be 9.06625 mile and half a *nimisha* equals to 8/75 seconds (as specified in the 231st verse in *Shaanti Parvam* of the *Maha Bhaarata*), then, the velocity of light comes out to be 186, 413.22 mile/second. One would be stunned to find this value in extreme

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congruence with the contemporary popular scientific figure put at 186, **300** mile/second.

6. Atomic Size

"The tip of a human hair is divided into 100 parts and each part is in turn divided into 100 parts" (*Swetasvaropanishad*, 5.9)

This shows that our learned ancestors attempted to arrive at some plausible estimation of highly microscopic atomic sizes by employing scales pertaining to known and familiar objects around them. This is approximately about 10^{-8} cm. In Atomic Physics, the atomic sizes and distances are measured in terms of Angstrom units (1 A^0 = 10^{-8} cm)

7. The VIBGYOR

The concept of 'Seven-coloured' visible solar spectrum is not of Newtonian origin, but, dates back to the primeval Vedic period. The first and the foremost of the Vedas, *RigVeda*, the most ancient text known to mankind, describes the colours embedded in the pure white light of the Sun as Violet, Indigo, Blue, Green, Yellow, Orange and Red. Another verse in *RigVeda* goes thus:
"(Where) the seven rays of the Sun are incident, there, I may live with my family" (*RigVeda*, 8-72-16).

Further, in the traditional '*Suryaashtakam'*, we have a *slokam* (verse) like this:

"Saptaashwa Radhamaarudham - Prachandam Kasyapaatmajam
Swetha Padmadharam Devam – Tam Suryam Pranamaamyaham"
(*Suryaashtakam*, *slokam* 2)

"O Sun (*Surya*)! I offer my salutations to You (*pranamaamyaham*), who is seated on the chariot driven by seven horses (*Saptaashwa radhamaarudham*), He who is the Son Of *Kasyapa* (*Kasyapaatmajam*) and fierce (*Prachanda*) and the God (*Deva*) who adorns a white lotus in his hand" (*Swetha Padmadharam*).

The famous *Aaditya Hrudayam*, rendered by Sage *Agasthya* to *Sri Rama* in the epic *Ramayana*, also bears a testimonial reference to this concept, as follows:

"Haridaswaha Sahasraarchihi Sapta Saptirmareechimaan……."
(*Srimad Ramayana*, *Yuddha Kaanda*, *Aaditya Hrudayam*, *slokam* 11)

The word *Harita* in Sanskrit stands for 'Green Colour'. The Sun is said to possess Green Horses (*Harit* + *Aswaha* = *Haridaswaha*; *Aswam* means '*Horse'*). The ancient seers believed that the greenery on the earth is nothing but one of the inherent qualities of the Sun. Green is exactly placed at the centre of VIB-G-YOR, dividing the spectrum in terms of wavelength and frequency as well. Some recent photographs of the Sun, captured by the NASA, also reveal the greenish lustre of the Sun. The photographs also presented the Sun in various colours, which is a magnificent pageant to the on-lookers.

In the above *slokam*, the Sun is described to be shining and glowing with lights of seven different colours (*sapta saptirmareechimaan*; the term *mareechi* may be taken to be synonymous to light here).

Here, though it may appear to be a poetic description and eulogy of the Sun-God (Fig. 5), there is intricate science capsulated in it. The seven horses are the embodiments of the seven colours of the spectrum. Though the Sun's light has so many colours, it only appears to be white. That is the significance of the term '*Swetha Padmadharam'*. This is a symbolism denoting that white colour is the combination of seven different colours, which appear to be white as a whole. When dispersed through a prism, rain drop and similar objects, the seven-storeyed grandeur is inaugurated in front of our eyes. Hence, it could be quite effortlessly presumed and predicated that right from the beginning of History, the en'light'enment pertaining to light was widespread in India.

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(While preparing the article, this discussion about VIBGYOR, turned out to be the 7th point in sequence, which is a marvelous coincidence)

8. Capillary Action in Roots

The *Shaanti Parva* of the *Maha Bhaarata* has this following reference to the capillary action of the roots, while drawing water from the soil through suction.

"Just as water may be drawn up by sucking the lotus petiole with the mouth, so also plants drink water (from the soil), assisted by the air (pressure gradient)"

The uniqueness of Indian epics and classics is that even though the central theme of the work revolves around a social, political or family drama, several meritorious concepts of science, spirituality and ethics have been inserted and incorporated, wherever, there is the minutest and remotest of probabilities.

Fig. 5: The Sun-God riding his 7- Horsed Chariot, the seven horses representing the seven colours of the VIBGYOR

The modern theory of capillary suction force was proposed by Dickson and Jolly in 1984, while *Maha Bhaarata* dealt with it easily as a commonplace concept and example, at least 5000 years ago. This proves that how advanced the know-how of various sciences at that time was, in India.

9. Rationalistic approach to Eclipses

Varaaha Mihira in Chapter V, *Raahu Chaaraha* of the *Brihat Samhita*, humbly as well as vehemently condemns the antiquated and futile notions about the prevalent notions pertaining to eclipses as they are of no avail and take us nowhere if we get entangled in those versions. He opines that certain symbolism is vested in such descriptions (Vanadeep et al, 2012), which seem to be preposterous superficially and this ought to be deciphered and understood in correlation to the actual astronomical phenomenon on scientific lines (Vanadeep *et al*, 2012).

Besides, the following verse from the *RigVeda* also points to this:

"O Sun! When the demon *Svarbhaanu* (*Raahu*) engulfed you by his **shadow**, the people of the whole world were stunned and have forgotten their position. Then, the Sage *Atri* could locate the Sun covered by the darkness, caused by *Svarbhaanu*. Nobody else (other than Sage *Atri*) could do that" (*RigVeda*, 5/40)

The very word *Svarbhaanu* given to *Raahu* (Cause of Solar Eclipse) is quite remarkable and encrypted. This conjunction (*Sandhi*) can be split as *Svaha* + *Bhaanu* (*Visarga Sandhi*). The word '*Sva'* means '(Him) Self' and *Bhaanu* means 'the Sun'. This means *Svarbhaanu* or *Raahu* is none else than the Sun (caused by the Sun). This is because eclipses are caused by shadows and *Raahu* is said to be a shadow-planet in Indian Astrology (*Chhaya Graham*). Shadows are created and perceived only through light and the only major source of celestial self-luminous light is Sun alone. So, *Raahu* is created and perceived through Sun's rays when Moon obstructs the optical path of the Sun's rays bound to reach the Earth. This shows our ancestors' comprehensive perspicacity pertaining to eclipses.

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Lalla, a reputed Indian astronomer of 8th century AD, in his work *'Sishya Dhi Vrridhida'* (meaning 'the one which enhances the intellect of the disciples') explains like this:

"People at different places of earth see different parts of the Sun, to be eclipsed. At some places, eclipse is not visible at all. When this concept is grasped, who will say that *Raahu*, (a demon), causes eclipse?" (*Sishya Dhi Vriddhida*, 20 – 26)

10. Gravitation

Aadi Shankaracharya, in his commentary on the *Prasnopanishad*, states categorically that "If the famous Goddess of the Earth (*Bhu Devi*) would not hold on this body by supporting *apaana* (apaana vayu is a kind of vital and life-sustaining wind circulating in the body), this body would have floated anywhere in the space or might have fallen down relatively" (*Shankarabhaashya* on *Prasnopanishad*).

One should retain in mind that this was written almost 1,500 years prior to the birth of Isaac Newton.

11. Relative Motion

Many wild theories have cropped up in the West and elsewhere that the Earth was flat, stationary and was situated at the center of the universe, making all heavenly and celestial bodies like the Sun, the Planets and the Stars revolve around it.

All the darkness of such ignorance would be put to permanent rest when the Sun of knowledge in the form of *Arya Bhatta's* treasured treatises rises. In his *Arya Bhattiyam*, he unambiguously states thus:

"Just as a man moving forward in a boat sees the objects (on his side) as moving backward, it is exactly so when the people of Lanka (Equatorial regions) perceive the movement of the other-wise stationary stars towards the West" (*Arya Bhattiyam*, Chapter 4, *slokam* 3).

It was lately recognized by the modern science that it is the Earth that moves from West towards the East, that makes the Sun, Planets and the Stars appear to move from East towards the West.

12. Metallurgy

The following are the living examples of India's mastery over metallurgy:

a. The known history of metallurgy in India dates back to 2500 B.C. and lasted till 13th Century AD.

Fig. 6: The 1600-year old rust-free Iron Pillar at Delhi that stands as a titanic testimony to the metallurgical prowess of the Ancient Indians

b. Techniques of Iron production and utilization were in practice from about 1400 BC.
c. The massive statue of *Gautama Buddha* discovered in *Sultanganj*, *Uttar Pradesh*, belonging to the *Gupta* era measuring 2 meter and weighing about 1 ton, shows that Indian craftsmen were well-versed with metal casting and molding.
d. The most titanic testimonial to Indian metallurgical skills is the spectacular iron victory pillar at Delhi (Fig. 6), located near the famous monument *Qutb Minar*. It was erected during the *Gupta* period around 5th Century AD. One is left to marvel in dumb founded state about the most outstandingly extraordinary feature of this pillar that, being a massive iron pillar and keeping in view the great affinity of iron to moisture as well as

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the colossal time period, it had remained corrosion-resistant and rust-proof for almost a staggering 1600 years. One could only say 'kudos to Indian skills!'

The Indian know-how regarding the physical and chemical properties of metals is matchless. The following examples testify this assertion:

"Gold, Silver, Copper, Iron, Lead, Zinc are the six types of metals, whose resistance towards corrosion/weathering due to oxidation is in the order that is reverse of the above sequence" – *Rasaarnavam*, 12th century AD.

"When strongly heated in the fire, the loss of weight for Gold is nil, for Silver 2%, Tin 8%; for Lead and Copper 5% and for Iron, it is 10%" – *Yaagnyavalkya Smriti*

13. The Time Scales, from the Tiny to the Titanic

Indian seers have dealt with times that were tinier than the tiny and enormous than the enormous. First, we shall examine the macro time scales as envisaged in *Hindu* Cosmology. The fraternities of the eternities have been presented below, just like the 'tip of an ice berg'

This period of four *yugas* is known as a '*Maha Yuga'*, which has time duration of almost 43, 20,000 sidereal years of the Earth's revolution around the Sun.

Moving further, we encounter astounding time scales as follows:

One *Maha Yuga* =		43,20,000 years	sidereal
One *Manvantaram* =	71 *Maha Yugas* =	3,06,720,000 years	sidereal
	+ 1 *Krita Yuga* =	17,28,000 years	sidereal
=		30,84,48,000 years	sidereal
One *Kalpa* =	14 *Manvantarams* =	4,31,82,72,000 years	sidereal
	+ 1 *Krita Yuga* =	17,28,000 years	sidereal
=		4,32,00,00,000 years	sidereal

One *Manvantaram* (308 million years) is in proximity to the time taken by the Sun to complete one revolution around the center of the *Milky Way*. Modern Astronomy estimates it to be around 230 Million years. This period of time is known as a 'Cosmic year'. It is believed that the orbital velocity of the Sun around the center of the Milky way is about 220km/s and at this speed, it is presumed that the Sun might have completed about 20 revolutions in a time of about 5 billion years and he is likely to complete another 20 by the end of his life time, in another 5 billion years. This *kalpa* period, concurs with the age of the earth and to some extent, with the age of the universe as well. The entire lifespan the Creator of the universe Lord Brahma has been estimated in the following manner:

Day of Brahma	=	4,32,00,00,000 sidereal years
Night of Brahma	=	4,32,00,00,000 sidereal years
One full Day of Brahma =		8,64,00,00,000 sidereal years
× 360 days in a year =		3,110,400,000,000 sidereal years
× 100 years	=	311,040,000,000,000 sidereal years
	=	Total life span of Lord *Brahma*

Actually, this is an unimaginable number in terms of modern mathematics. However, our ancestors dealt with such mammoth numbers quite easily and fluently. Indian astronomers like *Arya Bhatta* were able to calculate even the number of revolutions of a planet around the Sun in a *Maha Yuga*, i.e. 43, 20,000 years, very precisely.

On the other hand, they divided the time in its micro aspect as well as shown below:

2 *trutis*	=	1 *lava*.
2 *lavas*	=	1 *nimesha*. (16/75 second = 0.2 second approximately)
5 *nimeshas*	=	1 *kaashtha*
30 *kaashthas*	=	1 *kala*.
40 *kalas*	=	1 *naalika*, or the time during which one *aadhaka* of water passes out of a pot through an aperture of the same diameter.
2 *naalikas*	=	1 *muhoorta*.
15 *muhoortas*	=	1 day or 1 night.

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Thus, Indians proved themselves to be 'timeless' and tireless travelers, in pursuit of the knowledge and wisdom of the truth.

14. Astronomical Statistics

Arya Bhatta provided an exemplary account of the planetary motion in this following verse**:**

"All the planets, whether they are moving in their orbits or in eccentric circles, do exhibit an anti-clockwise motion from their apogees (farthest points) and clockwise motion from their perigees (nearest points)" (*Arya Bhattiyam* – Chapter 3, *slokam* 17)

Johannes Kepler promulgated his planetary laws from 1609 AD onwards, almost after 12 centuries from the period of *Arya Bhatta*.

The distance between the Earth and the Sun is about $1.5x\ 10^8$ km. This is technically called 'Astronomical Unit'. Generally, it has been a convention to measures the distance between Sun and other planets of the solar system in terms of 'Astronomical Unit', proportional to the distance between the Sun and the Earth, which is taken to be 1.000 (One Astronomical Unit), as shown in table 2.

The sidereal period of the Earth is 24 hours and its one revolution around the Sun takes around 365.25 days. *Bhaskaracharya* had envisaged this value to be 365.2578756484 days, correct to 10 decimal places in his famous treatise named '*Siddhaanta Siromani'*, around 1150 A.D.

Table 2. Distance of planets from the Sun in terms of Astronomical Unit (Au)

Name of the Planet	Distance from the Sun in terms of Astronomical Unit as postulated by *Arya Bhatta*	Distance from the Sun in terms of Astronomical Unit as observed by modern astronomers
Mercury	0.375	0.387
Venus	0.725	0.723
Mars	1.538	1.523
Jupiter	5.16	5.20
Saturn	9.41	9.54

Moon is the only natural satellite of Earth. It takes about 27 days to execute one revolution of the Earth, whereas, one revolution of the Moon around the Sun also takes about 27 days. The sidereal periods of some planets, compared with the ancient values are given in table 3.

Table 3: Sidereal Periods of planets compared with ancient Indian values

Name of the Planet	Sidereal Period of the planet as per *Arya Bhatta*	Sidereal Period of the planet as per Modern Astronomy
Moon	27.322 days	27.322 Days
Mars	687 days	687 Days
Jupiter	4332.29 days	4331.94 Days
Saturn	10,766.10 days	10, 760.44 Days
Venus	224.70 days	224.70 Days
Mercury	87.97 days	87.97 Days
Earth	365.26 days (approx.)	365.26 days (approx.)

In his *Arya Bhattiyam*, *Arya Bhatta* calculates the maximum declination of the Sun to be 24 degrees, while the modern value places it at 23 degrees 30 minutes ($23^0\ 30^1$). Further, the declinations of other planets are also given by *Arya Bhatta* (*Arya Bhattiyam*, Chapter 1, *Slokam* 8), which are compared with the contemporary values in table 4.

At a time when the whole world was swirling in the whirl winds of wild and bizarre theories pertaining to various aspects of science, ancient Indian scholars devised many brilliant and fool-proof predictions, theories and applications, which were congruous to the most sophisticated experimental results of the present day.

15. Mathematics

Mathematics was a field that received utmost attention of ancient Indians, right from the beginning. The Vedas are replete with treasurable concepts of Mathematics, which make the Mathematicians all over the world salute Indian prowess in this field.

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Table 4: Declinations of various planets compared with the values propounded by *Arya Bhatta*

Name of the Planet	Value propounded by *Arya Bhatta*	Value propounded by Modern Astronomy
Sun	24 deg. 0 min.	23 deg. 30 min.
Moon	4 deg. 30 min.	5 deg. 0 min.
Saturn	2 deg. 0 min	2 deg. 30 min
Jupiter	1 deg. 0 min.	1 deg. 30 min.
Mars	1 deg. 30 min.	1 deg. 51 min.
Venus	2 deg. 0 min.	3 deg. 23 min.
Mercury	2 deg. 0 min.	7 deg. 0 min.

Vedaanga Jyotisham speaks volumes on the place of Mathematics among all Indian or Vedic sciences, with a *slokam* that reads thus:

"Yathaa Shikha Mayuraanaam, Naagaanaam manayo yatha
Tadvadvedaanga saastraanaam Ganitam moordhani Sthitam" (*Vedaanga Jyotisham*, 4)

"Like the crests on the heads of peacocks, like the gems on the hoods of the cobras, Mathematics is adorned at the top of the *Vedaanga Saastras* (Sciences)" (Balachandra Rao, 1994)

Significant Landmarks in the Journey of Indian Mathematics

1. It is not an exaggeration to say that the invention of zero by Indian mathematicians is the one innovation that has drastically changed the very course of our perception of mathematics and philosophy. Subsequently, this forayed into all other sciences as well.

"…..The importance of the creation of the zero mark can never be exaggerated. No single mathematical creation has been more potent for the general, on go of intelligence and power" - ***George Bruce Halsted*, American Mathematician who introduced 'Non-*Euclidean* Geometry into the United States.**

2. *Baudhayana*, the most reputed Geometric genius of India formulated and introduced the '*Sulva Sutras'*, used extensively for constructing the sacrificial altars with pin-pointed preciseness. His '*Sulva Sutras'* proved to be a potential tool to solve the general linear equations of the form:

Ax + By + C = 0

This dates back to almost 2000 years prior to the period when western mathematicians solved it. *Baudhayana* lived in India 2600 years ago.

One more remarkable achievement of *Baudhayana* using his '*Sulva Sutras'* lies in finding the accurate value of square-root of 2, correct to seven places of decimal.

Square-root of 2 = 1 + 1/3 + 1/ (3 X 4) – 1/ (3 X 4 X 34) = 1.4142156….

The modern calculator (model: *casio-fx-300w*) gives it as: **1.4142135…..** (Sen & Beg, 1983)

The *Sulva Sutras* also contain the following invaluable information on various aspects of mathematics:

"The areas (of the squares) produced separately by the length and breadth of a rectangle, together equals to the area of the square produced by the diagonal" (*Sulva Sutras*, 1.12)"
(Sen & Beg, 1983)

"Multiply the length of a right-angled triangle by the same length and breadth by the same breadth; the square-root of the sum of these two results gives the hypotenuse" (*Manava-Sulva Sutra*, 10.10) (Sen & Beg, 1983)

i.e

$AB^2 + BC^2 = AC^2$ (Hypotenuse)

This is nothing but the famous *Pythagoras* theorem.

"The diagonal of a square (of side **a**) produces double the area of the square" (*Baudhayana Sulva Sutra*, 1.9) (Sen & Beg, 1983)

(Diagonal) $^2 = a^2 + a^2 = 2a^2 = 2$ (Area of the square)

(Using the *Pythagoras* theorem as the diagonal of a square divides it into two equal right-angled triangles)

3. **The Value of π**

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Today, we simply know that the ratio of the circumference of a circle to its diameter is constant, denoted by π. *Arya Bhatta* gives the value of this constant in the following fashion:
"Add 4 to 100, multiply by 8 and add to 62,000. This approximately (*aasanna*) is the circumference of the circle, whose diameter is 20,000". (*Arya Bhattiyam, Ganita Paadam*, 10)

This means a circle whose diameter is 20,000 units has its circumference approximately equal to **(100+4) x 8 + 62000 = 62, 832 units**

Since, the ratio of circumference of a circle to its diameter is a constant, it follows that:
62832 ÷ 20000 = 3.1416

The importance of the word *aasanna* (approximate) used by *Arya Bhatta* is that he knew that this was an irrational constant, which cannot be expressed exactly as a ratio of two integers. *Arya Bhatta* was well aware of this fact, way back in 5th century AD itself. Later, in 1761, after a yawning time span of 13 centuries, *Lambert* proved that π is irrational and further in 1882, *Lindermann* established that π is transcendental. (Balachandra Rao, 1994).

4. Indian Trigonometry

Indian trigonometry is based on the arc of a circle (*jya*), rather than on an angle. Hence, Indian trigonometry was named '*Jyotpatti* (*Jya* + *Utpatti*) *Ganitam'*, meaning the mathematics of generation (*utpatti*) or construction of '*Sines'*, or simply '*Jya Ganitam'* (Balachandra Rao, 1994).

But, based on the western nomenclature of Trigonometry, emphasizing on a triangle, now- a – days, we are calling this branch of Mathematics by the name '*Trikonamiti'*, meaning measurement of a triangle (*Trikonam* stands for triangle; *konam* in Sanskrit means 'angle') and moreover, we started calling Geometry by the name '*jyaamiti'* (measurement of chords of a circle). The word *jya* in Sanskrit means a 'bow string', which resembles in shape to the bow string and the circle's arc looks like a bow.

Origin of the word 'Sine'

Arya Bhatta used the word *Jya* or *Jeeva*, to give the sense of 'a chord' in 499 AD. The Arabs interpolated this Sanskrit word and read it as *gib*, which means 'fold'. Using this meaning, *gib* was translated into Latin as '*Sinus'*, which is again synonymous to 'fold'. Later, this '*Sinus'* was transformed into the present-day '*Sine'*. (Venkatesha Murthy, 2005).
The word 'Geo' (as in Geometry, Geography, Geology, etc.) must have been derived definitely from the Sanskrit word '*Jya'*.

5. Radian Measure

Surya Deva Yajvan (b.1191 A.D), mathematician of the 12th century and the commentator of *'Arya Bhattiyam'* states thus:
"When the diameter of a circle is multiplied by the central angle made by the circumference in minutes and the resultant product is divided by the circumference, then, it gives the circumdiameter. Half of this circumdiameter is the basis for all scientific calculations"
That is, from above, we have,
20000 (Diameter) x 21600 (Central angle made by the circumference) ÷ 62832 (Circumference)
= 6875.47746
= 6876 (approx.)
Half of 6876 = 6876/2 = 3438

This number has been used by *Arya Bhatta* in many of his scientific, astronomical and astrological calculations. (Venkatesha Murthy, 2005)
As per the principles of Mathematics,
One radian = $180^0 \div \pi = 180^0 / 3.1416 = 57.3^0$
If we convert this into minutes, we have,
57.3^0 x 60 minutes = 3438 minutes
This is an astonishing result that proves uncompromisingly that Indian Mathematics was well-developed and sophisticated even in those remote times.

6. Power series of π

In the annals of the history of Mathematics, the power series of π have been attributed to *Gottfried*

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Wilhelm Leibnitz (1646 – 1716 AD). But, the famous Indian Mathematician *Madhava* (1350 – 1410 AD) envisioned this series and formulated it in the following *slokam*, which can be translated as:

"Multiply the diameter (of a circle) by four. Subtract from it and add to it **alternatively** the quotients obtained while dividing four times the diameter (4d) by the odd integers three, five and so on (to get the circumference of the circle)"

Therefore,
Circumference of a circle (C) = πd = 4d – 4d/3 + 4d/5 – 4d/7 +…… (*Madhava* Series)
Dividing this throughout by 4d, we have,

πd/4d = 1/4d [4d – 4d/3 + 4d/5 – 4d/7 +….]
Hence, this becomes,
π/4 = 1 – 1/3 + 1/5 – 1/7 +…… (Leibnitz Series)

Madhava arrived at this result at least 300 years before *Leibnitz*. Hence, *Madhava* should be given credit for inventing this series before *Leibnitz* and the series should be named '*Madhava – Leibnitz* Power Series' (Venkatesha Murthy, 2005)

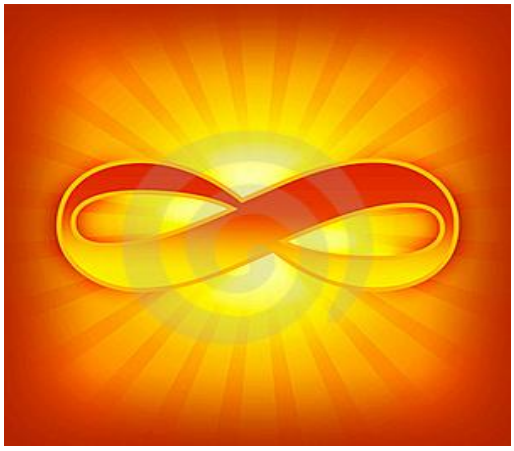

Fig. 7: The Symbol of Infinity (The Leminiscate)

7. Concepts of Zero and Infinity

Etymology of Zero:

a. It was called '*Shunya'* in Sanskrit meaning 'empty' or 'void'
b. Arabs adopted this as *'Si-fr.'*
c. *Leonardo Fibonocci* (1170 – 1250 AD) introduced the Latinized word '*Cifra'* derived from '*Sifr'*. This later became '*Cipher'*
d. In French, this '*Cipher'* became '*Chiffre'*
e. In German, this was adapted as '*Ziffer'*
f. Italians took possession of this word by calling '*Zefiro'*.
g. It is from this '*Zefiro'* that we derived our contemporary '**Zero'**. (Georges Ifra, 1985)

Our Indian Mathematicians like *Brahma Gupta* in his magnum opus '*Brahma Sphuta Siddhantam'*, *Mahaveeracharya*, *Bhaskaracharya*-II in his *Siddhanta Siromani* and *Beeja Ganitam* (Algebra), *Ganesha Daivagnya*, et cetera knew the pros and cons of all the mathematical operations involving zero. They vividly stated that addition and subtraction of any quantity from zero, makes the zero itself become that quantity, i.e. that quantity is retained.

When it comes to multiplication, anything multiplied by zero is a zero and the square, cube, square-root, cube-root, etc. of zero remains zero. If zero is divided by any quantity, then, the end result is again zero. But, when zero divides any quantity (other than zero), then, it becomes infinity. This follows from the rule that the lesser the denominator is, the more the resultant value of the fraction. Here, denominator is cipher (zero), which is absolutely nothing and so, the result would be the exact converse of that, i.e. absolutely everything, which is nothing but infinity (∞) (Fig. 7). However, the quantity 0/0 remained indeterminate. But, addition, subtraction, multiplication, squaring, cubing, etc of zero with itself, ends up in zero.

This invention of zero has resulted in another set of numerals, parallel to the then existing positive numerals, i.e. numerals with a negative sign.

This division of numerals into positive, negative and neuter (zero has no sign assigned to it), prompted the thought of an existence of such concept in the entire universe. Zero being the base of all numbers as seen from its addition and subtraction from other numbers is a consequence of

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the Indian philosophical and spiritual thought of the Single un manifested getting manifested in multifarious proportions. Here 'Zero' is synchronous to the Supreme Soul or *Paramaatma*. Even the modern numerologists accept this prospect and follow this concept.

Later, the discovery of an electron (negatively charged particle), proton (positively charged particle) and neutron (neutral particle) in an atom, fortified this theory. This same concept might have prompted *Paul Dirac* and *Carl*. D. *Anderson* to surface the concept of **anti-matter**.

Further, the combination of a positive and a negative numeral results in nullification and the result is zero. This means both the anti-numerals mutually annulled themselves to merge into their original basic state, that of zero. The same thing happens with antimatter, say an electron and a positron (positive electron) when they encounter each other. Both of them lose their individual identities and get destroyed, releasing a huge amount of energy. This process is called 'Annihilation'. This shows that Mathematics and Physics always go hand-in-glove, with each other.

Coming to the concept of infinity**,** *Bhaskaracharya*-II in his path-breaking work '*Beeja Ganitam'* gives a very unique account of infinity as follows:

"A fraction having zero as the denominator has a peculiar property that can be likened to the quality of the Almighty. All the beings merge with Him during the time of dissolution (*Pralaya*) and they are re-created with the same grandeur and plentitude from the same Supreme Godhead. But, during these two processes, He does not undergo any changes, whatsoever. Similarly, a fraction with zero as its denominator does not undergo any change even if a very huge number is added to it or subtracted from it. They make no difference at all". (Venkatesha Murthy, 2005)

Let 'n' be any numeral. Now, it follows that:

A. (n/0) value + a very huge number = (n/0) value
B. (n/0) value – a very huge number = (n/0) value

Thus, it can be concluded quite legitimately that **0** and ∞ represent the basic qualities of the Almighty; *Anantha, Avyaya* and *Durlabha/Durgama*. *Anantha* means 'the endless', *Avyaya* means 'the unspent or the non-exhaustive' and *Durlabha* means '(the entity) that cannot be obtained' and *Durgama* means the '(the entity) that cannot be accessed'. (The Holy *Vishnu Sahasra Naama'* describes the Supernatural Being as '*Anantha Ruupo Anantha Sreehi'*, which means 'One who possesses Infinite Forms and Infinite Supreme Virtues').

This is particularly true because one cannot obtain zero by going on decreasing the value of any given numeral, to any extent. However small the number may be, there will always be a smaller numeral. This goes on infinitely. The same applies with respect to infinity. We cannot arrive at infinity by increasing a given numeral to any humongous and mammoth proportions. There always lies a larger numeral and this continues infinitely. Zero can be obtained only by subtracting a given number from the same number.

In addition to this, if any number is divided by infinity, then, the result would be zero and if it is divided by zero, then, the result would be infinity. So, this shows that zero and infinity complement each other very well. Hence, they can be said to be the qualities of the same entity, i.e. the Almighty. Hence, 'zero' and 'infinity' can be described to be the boundaries of the Almighty, which know no bounds at all. Hence, as per calculus, Almighty's Limit tends from **0** to ∞ (or should I say 'Unlimit' here?????).

This universe is frequently called '*Anantha Shunyam'* in Sanskrit, meaning 'the endless space or void', signifying both Zero and Infinity in sense and essence. But, when they said *Shunyam*, our ancestors did not mean that there is nothing present and everything is absent there. Among the

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thousand names of Lord *Vishnu* (*Vishnu Sahasra Naamaavali*), the first and the foremost name is '*Viswam'*, followed by '*Vishnuhu'*. Here, the Almighty is attributed with the infinitely macro form of this entire Universe and immediately by calling him '*Vishnu'*, He is being conferred the characteristic of an All-Pervading Power, even from the level of unimaginably minutest of the minute entities. This again is the Absolute correlation to 'Zero and Infinity' concept entrenched in Mathematics. The modern astronomers are trying to avoid the notion of a 'void', as they found that the entire mass of the visible universe is only around 4% of the anticipated mass. This created tremendous tremors in their intellects and they started abstractly perceiving and began pursuing the concepts of 'Dark matter – Dark Energy' and of the '*Higg's Boson'* or simply the '*God Particle'*, by way of experiments like the **LHC** (**Large Hadron Collider**).

The *Isaavaasya Upanishat* of the Vedas enshrines this most popular 'Peace Invocation Hymn (*Shaanti Mantram*), which is as follows:

"Poornamadaha Poornamidam – Poornaat Poornamudachyate
Poornasya Poornamaadaaya – Poornamevaavasishyate
AUM Shaantihi Shaantihi Shaantihi"

The literal meaning of this mantra is:
"That is Absolute (*Poornam*), this is Absolute, Absolute arises out of Absolute, If Absolute is taken away from Absolute, Absolute remains AUM Peace, Peace, Peace".

Here, the '*Poornam'* may be taken to be either zero or infinity. Besides the spiritual grandeur of the hymn, this also has an immaculate mathematical flavour embedded in it. Whatever is added to or subtracted from Zero or Infinity (including themselves), the same entity (zero or infinity, as the case may be) remains, without undergoing even an iota of change or transition. From this, we know that Science is the mirror that shows what already exists, gradually.

A true scientist in due course of time will definitely transform into a great philosopher or a *Yogi*, as he would be acquainted more with the mysteries, fantasies, marvels and grandeur of Almighty's *modus operandi*, than anyone else. This is the reason why almost all the ancient Indian scientists and mathematicians were *Rishis*, Yogis, Philosophers, Sages and Seers. They were scholars who were basically saints, i.e. Scholarly Saints and sometimes Saintly Scholars. In modern days, among the Western Scientists, Albert Einstein remains a stand-out example of such people mentioned above. Einstein had studied Philosophy and Spirituality and could realise the presence of a mysterious Supreme Super-Natural Cosmic Power that is in complete possession and control of all the proceedings ranging from 'Zero to Infinity'. This is evident from many of his statements. In one instance, Einstein is said to have given a testimony that the '*Bhagavad Geetha'* was his greatest inspiration behind formulating the 'Mass-Energy relation' $\mathbf{E = mc^2}$, as he found this very principle radiantly emanating from the Holy Book.

Vedas describe the Almighty as '*Anoraneeyaan*

Fig. 8: The Supreme God Head Pervades Each and Every Atom in the Universe as its Nucleus

Mahato Maheeyaan' (Fig. 8). This means' He is minuter than the minutest and more enormous than the most enormous', i.e. He is infinitesimally tiny and at the same time, infinitely outsized. Hence, Mathematics serves as a window and a potential

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tool to realize the Mysterious and the Super-Cosmic Truths.

The decimal notation and the place value system

The decimal point notation accompanied by the 'place value system' is seen as the most profound ingenious contribution of India to Mathematics, which changed the entire course of this branch of knowledge.

"In the units place, the digit has the same value, in the tens place, 10 times the value and in 100th place, 100 times the value, as woman is called mother, daughter and sister" (*Vyaasa Bhaashya* to *Yoga Sutras*)

Laplace had this to say regarding Indian proficiency in Mathematics:

"It is India that gave us the ingenious method of expressing all numbers by ten symbols, each symbol receiving a value of position, as well as an absolute value. We shall appreciate the grandeur of this achievement when we remember that it escaped the genius of *Archimedes* and *Apollonius*" – *Pierre Simon De Laplace*, a famous 18th century French Mathematician and Astronomer.

8. **Angles**

Our Indians had developed a very comprehensive, reliable and an efficient system for measurement of angles. Later, the modern system that is in vogue now, seems to have evolved on the same lines.

According to *Arya Bhatta*,

60 *Vikaala* = 1 *Kaala*
60 *Kaalas* = 1 *Bhaga*
30 *Bhagas* = 1 *Raasi*
12 *Raasi*s = 1 *Bhagana*

Here, *Vikaala* is equivalent to 'second', *Kaala* is a 'minute' and *Bhaaga* is a degree. 30 such *Bhaagas* make a *Raasi* and 12 such *Raasis* constitute a *Bhagana*, which forms a celestial sphere (*Surya Siddhantam*, 128).

Arya Bhatta's calculations are used extensively in the preparation of the *Hindu* Almanacs (*Panchangams*) till date.

9. **Miscellaneous**

a. The word 'Algebra' has been derived from the word '*Al-jabr'*, the term Arabs gave to Indian '*Beeja Ganitam'*.
b. Mathematicians like *Lalla*, *Bhaskaracharya* II, etc. composed not only mathematical treatises with their innovations, but also, compiled some works that would aid the students and beginners to understand and practice the concepts in an aesthetic and entertaining manner. *Sishya-dhi-vriddhida tantram* of *Lalla* (In Sanskrit, '*Sishya'* means 'disciple', the word '*dhi'* means 'intellect', '*vriddhi'* means 'development', '*da'* means giving/bestowing and '*tantram'* stands for 'an intertwining of a formula (*sutra*) and its practical application) and *Leelavati* of *Bhaskaracharya* II are the outstanding examples of such texts.
c. Brahma Gupta devised an operation called '*Bhaavana'* in 598 AD, which generates integral values for x and y, satisfying the second order indeterminate equations of the type $\mathbf{Nx^2 + 1 = y^2}$.
d. *Jayadeva* (11th century AD) and *Bhaskaracharya* II (12th century AD) devised a 'cyclic method' to solve $\mathbf{Nx^2 + 1 = y^2}$, known as the '*Chakravaala'* method, which is an improvement over the '*Bhaavana'* method of *Brahma Gupta*.
e. *Brahma Gupta* also founded a branch of higher mathematics, known by the name 'Numerical Analysis' in the present days. In the chapter '*Kuttakaadhyaya'* of his '*Brahma Sphuta Siddhantam'*, he dealt with zero and its operations for the first time in the world in 628 AD.

Brahma Gupta estimated the diameter of the Earth to be 7905 miles. Modern scientists calculated it to be 7918 miles. He was the first scientist to distinguish between Arithmetic and Algebra and treated them as two different branches of knowledge.

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He had discovered gravity which is evident from his words:

"Bodies fall towards the Earth because of the nature of the Earth to attract matter".

Brahma Gupta's hand book of four chapters on astronomy entitled '*Karana Khandakhadyaka'* proved to be very handy to Indian and Arab astronomers and scholars for many centuries, even till recent times and now, the appointed time has arrived to amalgamate and evaluate this ancient diamond in conjunction with the modern pearls of current Science.

Leelavati of *Bhaskaracharya* II was translated into Persian by *Abul Fazal* in the court of *Akbar* in the year 1587 AD. His *Beeja Ganitam* was translated into Persian by *Attah-ullah-Rushdie* in the year 1634 AD. (The composition of '*Leelavati'* has a tragic background. *Leelavati* was the daughter of *Bhaskaracharya* II, who, by his astrological dexterity, found that his daughter is going to be widowed soon after her marriage. *Bhaskara* was such a genius that he found a remedy to counteract this impending predicament to his dearest daughter. He instructed his relatives to see that the marriage ceremony is culminated with '*Maangalya dhaarana'* at a specific time, by giving them a sand-clock, which was perfectly set accordingly by himself and subsequently marriage went on as per his direction. But, ironically, the husband of the girl passed away, leaving *Leelavati* to be a widow. *Bhaskara* was shell-shocked and was ashamed of his own astrological wisdom. Then, other great astrologers of the time convinced him that the time designated by him for the marriage was flawless and there might have been some other reason behind this and advised him not to get depressed. Later, on meticulous investigation, *Bhaskara* was astonished to find that, due to a minute technical problem, the granules of sand did not fall in time, thereby creating a discrepancy of a few seconds from the actual assigned time for the ceremony. *Bhaskara* marveled at the might of fate and then, got down to the work of composing a mathematical wonder '*Leelavati'* to console himself and his daughter and with the aim of providing a student-friendly work book of Mathematics, wherein very lively and commonplace instances were selected to impart vital mathematical knowledge to the readers. That is why; we find almost all the problems in the work '*Leelavati'* addressed to a young girl/a group of girls.

Thus, this '*Leelavati'* remains an eternal living example of the prospect that some of the greatest works are produced in adverse conditions. From sorrow (***sokam***), great verses (s***lokam***) are born, where the difference between ***sokam*** and ***slokam*** is the letter **'l'**. This **'l'** signifies the **'light' of knowledge** that is spread from such works in the entire world ***(lokam).*** Hence, to put this together, a ***slokam*** that is born from a ***sokam*** tends to enlighten the ***lokam***.

The first such instance, in spirit, as mentioned above, in the history of mankind is that of The *Ramayana*, where the sage *Valmiki*, the author, was terribly depressed after seeing a hunter arrow-down the male *Krouncha* bird in a pair of birds, when they were joyously engaged in romantic sport. The Sage could not bear the agony of the female bird and cursed the hunter to death **(*Maa nishaada pratishthaatvam……*" where *nishaada* means 'hunter'),** which marks the initiation for the concomitant composition of the world's first classic (*Aadi Kaavyam*) and epic; 'The *Ramayana'*.

Nagarjuna's Diabolic Magic Square and the marvelous "'*Ka-ta-pa-ya'adi"* system

Unlike other mathematicians, our Indian mathematicians and scientists hungered to play with very large numbers from the beginning. The list of some very enormous numbers dealt with, by the Vedic Indians is given in Table 5.

Table 5: Sanskrit nomenclature and Mathematical representation of some huge quantities dealt by the Vedic Indians

Sanskrit name of the numerical Quantity	Quantity in Figures
1. *Shatam*	10^2
2. *Sahasram*	10^3

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3. *Ayutam*	10^4
4. *Niyutam*	10^5
5. *Prayutam*	10^6
6. *Arbudam*	10^7
7. *Nyarbudam*	10^8
8. *Samudram*	10^9
9. *Madhyam*	10^{10}
10. *Antham*	10^{11}
11. *Paraardham*	10^{12}
12. *Ushas*	10^{13}
13. *Vyashtihi*	10^{14}
14. *Udeshyas*	10^{15}
15. *Udyat*	10^{16}
16. *Uditam*	10^{17}
17. *Suvargam*	10^{18}
18. *Lokam*	10^{19}

Foot note: Sanskrit nomenclature and Mathematical representation of some huge quantities dealt by the Vedic Indians. The number of *Vaanaras* in *Rama's* army is given by 10^{10}+ 10^{14}+10^{20} + …+10^{54} + …+10^{62}+…+ 10^{69}. This number is unimaginable to the modern mathematicians even today. In the Holy *Lalithaa Sahasranaamam*, there is a *slokam* that goes thus: "*Udyat Bhaanu Sahasraabha*….." Superficially, this means 'She (Goddess) shines with the brightness of a thousand (Innumerable) rising Suns". But, according to Mathematics, *Udyat* means 10^{16} and *Sahasram* means 1000 (10^3). Hence, this verse means the Mother Goddess shines with the radiance of 10^{16} x 10^3 = 10^{19} Suns. This quantity 10^{19} is called a '*Lokam'*. In Sanskrit, the word '*Lokam'* means: 'that which can be seen (i.e. A World)'. This expression has been employed by our scholastic sages to convey the sense that the Almighty possesses the brightness of an entire world of Suns, i.e., Infinite Brightness.

In the later times, this number raised to 10^{19} and even much more. Mathematicians from Kerala and the Jain as well as Buddhist mathematicians contributed a lot to the drastic development of Indian Mathematics from about 2nd Century B.C. till the advent of the medieval times.

Hence, since this numbers are substantially large and their representation as numerals may create ambiguity, keeping this in mind, ancient Indians have devised a system wherein numerals are expressed in the form of alphabets, by assigning a unique numerical to each alphabet. Superficially, this looks like a *slokam* dealing with some Spiritual, social or any other issue. But, the original intention is different. Some Mathematical or Scientific principle, formula or some important values might have been encoded in the verses, the clue or indication to which also may lie in the *slokam* itself, when interpreted and analysed scholastically. This system of notation is known as the '*ka ta pa ya di kramaha'* or '*Bhoota Sankhya'*

This shows that ancient Indians were the pioneers in the art of communicating through codes, long before the '*Morse* Code' evolved. Table 6 gives the numerical assigned to each alphabet in the '*ka-ta-pa-ya di'* system:

Table 6. ka ta pa ya di notation in Ancient mathematics

1	2	3	4	5	6	7	8	9	10
Ka	Kha	Ga	Gha	ṇya	Cha	Chha	Ja	jha	iṇi
Ta	Ttha	Da	Dha	aṇa	Tha	Thha	Da	dha	Na
Pa	ppha	Ba	Bha	Ma					
Ya	Ra	La	Va	ṣa	Sha	Sa	Ha	ḷa	

From table 6, the reason for such nomenclature to this system is quite evident. The four rows start with the alphabets *ka*, *ta*, *pa*, *ya* respectively and hence, this name was chosen. This system was followed extensively in South India.

While decoding the numerals from alphabets using this system, the following rules are to be retained in mind:

1. **In a mixed alphabet (*Samyuktaakshara*), the vowels are to be ignored and only the last consonant has to be considered and half-letters also follow the same rule, the same is the case with half-letters.**

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2. **Place value of the digits of a number move to the left in multiples of ten**

For instance, consider the following *slokam*:

Go pi bhaa gya ma dhu vraa tha shrungi sho da dhi sa ndhi ga
3 1 4 1 5 9 2 6 5 3 5 8 9 7 9 3
Kha la Jee vi tha khaa thaa va ga la ha laa ra san dha ra
2 3 8 4 6 2 6 4 3 3 9 3 2 7 9 2

This is a wonderful verse as we can observe that this gives a value of **3.14159265358979323846264339327 92**, up to 31 decimal places. (Venkatesha Murthy, 2005)

Based on this *ka-ta-pa-ya* di system, *Acharya Nagarjuna*, also known as the 'Second *Buddha'* and also called the '*Einstein* of India', developed a 4 x 4 magic square, which always gives a sum of 100.

Nee lam chaa pee da yaa cha lo
0 3 6 1 8 1 6 3
Na ta bhu vam kha ree va ram
0 1 4 4 2 2 4 2
Raa ginam bhu po naa ree va go
2 3 0 4 1 0 2 4 3
Ja raa cha ra ni bham taa nam
8 2 6 2 0 4 6 0
Shatam yojayet
(Venkatesha Muthy, 2005)

The first four lines fill the 4 x 4 magic square. However, it is to be remembered that the numbers are to read from the right towards the left, while filling the cells of the 4 X 4 magic square. As discussed earlier, there is a hint in the above *slokam* regarding the real purpose of framing the verses in the last line. *Shatam* is the key word here because; '*Shatam'* means 100 in Sanskrit.

***Nagarjuna's* 4 X 4 magic square, which gives a sum of 100**

30	16	18	36
10	44	22	24
32	14	20	34
28	26	40	06

In general, if we desire to construct a magic square for a magic sum which is an even number, then, the following method can be applied:

General format for generating a magic square for any even number sum

m-3	1	m-6	8
m-7	9	m-4	2
6	m-8	3	m-1
4	m-2	7	m-9

Here, if '2m'be the desired even number, for which the magic square is to be prepared, then, take the half of that number 'm' and proceed in the format, as shown in the table above.

When the desired magic sum is an even number, then, this magic square is a' diabolic magic square'. These diabolic or pan-diagonal magic squares are magical giving out magical sum not only in each row, column and diagonal, but also on broken diagonals. They remain magical even if the bottom row is shifted to the top or *vice-versa* or despite the column being moved from one side to another. (Venkatesha Murthy, 2005)

This presents to us the mastermind of the ancient Indian mathematicians in a nut-shell.

Hence, from all these discussions, one could totally feel that Mathematics is the invisible utility behind all sciences. We may recall here one very fitting verse (*slokam*) from the *Bhagavad Geetha*, which goes thus:

"Mattaha parataram naanyat
kinchit asti Dhananjaya
mayi sarvam idam protam
sutre mani-gana iva"

(The *Bhagavat Geetha*, *Vignyana Yogaha*, Chapter 7, *Slokam* 7)

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"O conqueror of wealth [*Arjuna*]! There is no Truth superior to Me. Everything rests upon Me, **as pearls are strung on to a thread**."

As the thread that supports the pearls is invisible, likewise, the sustaining and integrating string of underlying Mathematics is also invisible beneath the pearls of various disciplines of Science. This particular aspect of Mathematics was ably recognized by the ancient Indians, who hailed it to be the '***Crest Jewel'*** among all the decorous divisions of Science.

16. Medicine and Surgery

The pursuit of excellence in India began with the conception of the '*Ayurveda'*, which even today is the most sought-after alternative system of medicine in the entire world. This system of Ayurveda formed the basis for many other systems of medicine that developed during the later period, like the *Siddha*, *Unani*, etc.

Sushruta, who belonged to 4th century B.C., is proudly acclaimed in the world of surgery, to be the first surgeon in the world to perform a plastic surgery and administer anesthesia. He is believed to have performed a plastic surgery on a man's disfigured nose. The ever-lasting contribution of *Sushruta* to medicine is his '*Sushruta Samhita'*. The *Sushruta Samhita* contains 184 chapters and description of 1,120 illnesses, 700 medicinal plants, a detailed study on Anatomy, 64 preparations from mineral sources and 57 preparations based on animal sources. It is one of the most revered reference texts for *Ayurvedic* surgeons. In this treatise, *Sushruta* enlists some 101 types of surgical instruments, which were assigned nomenclature after the animals or birds they resemble. The modern day names like Crocodile forceps and Hawk-bill forceps in surgery are the result of such classification made by *Sushruta*. *Sushruta* learnt this art of surgery from his mentor *Divodasa Dhanvantari* in *Varanasi*. Fig. 9 shows *Sushruta*'s Statue in *Patanjali Yogpeeth*, Haridwar and some of the images of surgical instruments described in *Sushruta Samhita*.

The following are some of the primary surgical techniques explained in the *Sushruta Samhita*:

1. *Chhedya* (Excision)
2. *Bhedya* (Incision)

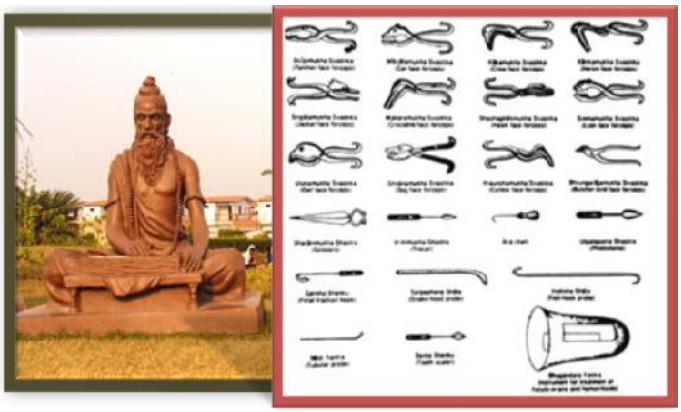

Fig. 9: Statue of Sushruta in Patanjali Yogpeeth, Haridwar and some Surgical Instruments described in Sushruta Samhita

3. *Lekhya* (Scarification)
4. *Vedhya* (Puncturing)
5. *Eṣya* (Exploration)
6. *Arhya* (Extraction)
7. *Sraavana* (Blood-letting/Evacuation)
8. *Sivya* (Suturing)

Charaka was the first Physician to demonstrate the concept of digestion, metabolism and immunity. His period extended from 3rd century to 2nd century B.C. *Charaka* was the court-physician of the great king of *Kushaana* dynasty, *Kanishka*. His *magnum opus* '*Charaka Samhita'* has not lost its efficacy and relevance even a bit, in *Ayurvedic* medicine till date. This treatise is believed to be a modified revision of the original work of his *Guru Agnivesha*. *Charaka* is ascribed to be the first principal exponent of a system of medicine, popularly known as '*Kaaya Chikitsa'*, wherein he opines and firmly asserts that any Physician must first try to enter the body (*Kaayam*) of the patient with the light of his medical and physiological knowledge and then start the treatment (*Chikitsa*) only after studying other endemic factors like the environment, surroundings, etc. He is the first proponent of the concept 'Prevention is always

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better than cure', which is so widely held now-a-days.

According to *Charaka*'s Anatomy, the human body comprises 360 bones (he had divided the bones more subtly, as the modern medicine tells us that it is only 206). He reiterated that any defect, whatsoever, in the body is a result of the imbalance among the three primary entities (*tattvas*), namely, bile (*pittha*), phleghm (*kapha*) and wind/gas (*vaata*). *Charaka's* medicines were targeted at restoring this balance. He did not pay much attention towards *Pathology*, as he believed germs/pathogens could only attack the body if its immunity is weak, which resulted from an imbalance among the fore stated three *tattvas* ultimately. He was also proficient in *Genetics* and his work '*Charaka Samhita'* establishes his knowledge on various plant, mineral and animal resources to treat a plethora of dis-'eases'.

There were three great universities in India in the olden days (1500 B.C to 200 A.D), where Astronomy, Mathematics, *Yoga*, Philosophy, Economics, Political science, including Moral education, Geometry, *Vaastu Saastra*, *Ayurveda* medicine and Surgery were taught. One was at *Banaras* (*Varanasi*) on the bank of River *Ganga* in the East, where head of medicine was *Sushruta*, followed by *Nagarjuna*. Here, surgical techniques and principles were taught. The other was at *Takshashila* in the West, on the bank of *Jhelum* River, where medicine, physiology and human Anatomy were taught under the mentorship of *Atreya*, succeeded by *Agnivesha* and then, followed by *Charaka*. One other great university was at *Nalanda* where *Kashyapa* was the head of medicine. Pediatrics, Gynecology and Obstetrics were the principal specialisations. A lot of references are available, which clearly indicate that the students from many other regions of the world also came here for learning and gaining proficiency in medicine and surgery.

Besides these two, many other luminaries like *Vagbhata*, *Nagarjuna*, *Atreya*, *Agnivesha*, *Dhanvantari*, *Kashyapa*, *Chyawana* (the product *Chyawanprash* is believed to be his preparation), etc. have been the torch-bearers of this 'life-line' science of human existence, which was passed over from Lord *Brahma* to *Aswini Kumaras*, from them to *Indra* and from him to Sage *Bharadwaja* and to the sacred lineage of Sages and doctors up to the present day, continuing unabated.

This is proof par excellence that India flourished as the 'World Head Quarters' of medicine and surgery for so many centuries.

17. Nuclear Physics

Today, at a time when we still continue to call that entity (Atom) by the name which it is known today ('*A - Tomio*' means 'the indivisible entity'), even when the atom has been divided and sub-divided infinitesimally and investigative search for more and more and subtler divisions is on, one would really remain dumb-struck when he goes through the '*Vaiseshika Sutras'* of Sage *Kanaada*, formulated way back in the 6th century B.C, about **2,600 years ago**. His real name was *Kashyapa*. The following story throws some light on the reason behind *Kashyapa* being called *Kanaada*:

Kashyapa lived in the 6th century B.C. From his childhood, he displayed a keen sense of observation. The minutest of the entities attracted his attention. Once, *Kashyapa* accompanied his father on a pilgrimage to the Holy place *Prayaaga*. He found that thousands of pilgrims littered its roads with flowers, grains of rice, which they offered at the temple. While everybody else was busy offering prayers, or bathing in the *Ganges*, the young *Kashyapa* started collecting the grains (*kana*) of rice that littered the streets of *Prayaaga*.

Somasharma, a scholarly sage noticed and asked him why he was counting discarded grains. *Kashyapa* replied that howsoever miniscule an object might be, it nevertheless is a part and parcel of the universe. The reply of *Kashyapa* impressed the sage deeply, who blessed *Kashyapa* by saying that he would evolve into a celebrated Scientist and Philosopher. Further, he also added that in recognition of his extraordinary perception of microscopic objects, he would be known as '***Kanaada'***, from the word '***Kana***, which stands for 'specks of grain' here.

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Kanaada propounded the famous and masterful theory of '***Vaiseshika Sutras'*** (**The Peculiarity Aphorisms**), wherein *Kanaada* became the first expounder of atomic concept all-prevalent in the entire universe. He was also the pioneer promulgator of the existence of binary molecules and atoms. The stunning profound observation of *Kanaada* was that of the presence of *Paramaanu* at the core of each and every atom. When matter is divided and sub-divided until any further division is impossible, the only remaining indivisible entity is called '*Paramaanu'*. *Paramaanus* are eternal and indestructible and do not exist in a free state and nor can they be sensed through any human organ (*Chinmaya* Mission, 2003).

The original sense of the word '*Kashyapa'* is '*Pasyaka'*, which means 'the one through which everything could be seen' or 'the one that shows everything'. This feature can be attributed to light. Hence, here, in this case, the light (rays of knowledge) of *Kashyapa* penetrated the substance and reached the nucleus (*Paramaanu*). In other words, this *Kashyapa* had seen that entity and had shown it to all of us. Hence, Sage *Kanaada* is truly a '*Kashyapa'*.

These *Paramaanus* can be equated to modern-day Nucleus or may be even to more miniscule sub-atomic or elementary particles in the atom. The concept of the most powerful and deadly weapons found in our Epics and *Puranas*, like the *Brahmaastam*, *Narayanaastram*, *Paasupataastram*, etc. may be the prototypes of modern day atomic bombs and Hydrogen bombs or some chemical/bio-chemical weapons as well. India possessed nukes, before most of the world was dormant like an infant that did not even open its eyes to the bright light of culture and civilization (Certainly, this was much before the 1974 *Pokhran* test!!!).

Our hearts would be replete with reverence when we find that these spectacular and monumental observations were made some 2,600 years ago, when most of the countries of the world were just at the verge of commencing their own civilisations, evolving from their erstwhile barbarous and nomadic cultures and life-styles.

18. Atmosphere: The Utmost Sphere of Influence in India, right from the Vedic Times

The concept of Environmental Conservation

It is our pristine and heralded duty to gift a pure and pollution-free nature to our future generations. Hence, our learned predecessors envisioned this dire necessity and showcased their keen intent on this iconic issue, as can be perceived from the verses that ensue:

Invocation for the pollution free earth

"Let the aspects of Truth *(Satya)* and the universal order (*rta*), severe austerity, penance, The Ultimate Reality and Sacrifice hold the Earth. Let the Earth, abode of all potencies and herbs, may strengthen us and bring us prosperity and brilliance. The earth is the Mother and I am her son. I wish that She should always be free from all pollutions". (*Bhumi Suktam*, *Atharvana Veda*, 12.1)

This is the spirit of this *Bhumi Suktam* in support of conservation (Rani Sadasiva Murty, 2009).

Water pollution and purification

The genius chemist of India '*Vaagbhata'* has provided us with several methods of purifying stale, foul, stinking and unfit water to make it potable for human consumption:

To summarize the views of *Vaagbhata* in this context, the excretal release of insects and reptiles, formation of aquatic moss layers over the surface, the gut, the fall of dry leaves in plenty and the state of being in dark shades away from the contact of the rays of Sun and Moon are some causes of water pollution. Such polluted water will forego its taste. Some unacceptable smell will also be added. It is suggested that it is better to avoid drinking such water. If one has to inevitably drink such water the ancient masters of *Ayurveda* recommended some purification methods such as boiling the water, dropping the seeds of *Kataka* in the vessels, filtering with four- time folded cloth, keeping the lotus stalks or *Patala* and *Karavira* flowers or red hot iron balls in the vessels for some time and also by using the gems such as *Gomeda* and Pearls.

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These methods have been approved by modern scientific generations. The *Taittiriya Aranyakam* strictly prohibits the attitude of releasing excreta, spitting and taking bath with uncovered/naked body in the flowing waters. (Rani Sadasiva Murty, 2009)

Invocation for a pollution-free Atmosphere

The well- known ***Pavamaana Sooktam*** **in the** ***Atharvana Veda*** enlists all the advantages purifying the air. Thus, for the better progress of a region and on the whole a nation, a clean, pollution-free and hygienic living surroundings are primarily required as they are directly related to both human health and economic productivity prospects. (Vanadeep and Krishnaiah, 2011)

According to the Vedic seers *Pavamaana* is not just the wavy breeze or breezes but it is the entire enclosure of the Air and gasses surrounding the **biosphere**. Hence they emphasized on its purity for the purity of all the regions of universe, earth, rivers, mountains, galaxies, activity of all living beings and of the sacrificial performances. (Rani Sadasiva Murty, 2009)

This can be summarized as follows:

"May the air that purifies the Earth and the sky, day and night, directions and sub-directions, Sun, Moon and Stars, all beings, seasons and years, trees and herbs, the snowy mountains, *Vaiṣvaanara* fires, rivers, seas and oceans, atmospheric environment, Order, Righteousness (*Ṛtam*), Truth, Penance, Perseverance/Dedication and austerity purify us from within. May this *Pavamaana*, that holds or is in possession of every entity and which purifies all these, and purifies everything manifested and non-manifested and everything concrete as well as abstract, purify us from within" – (*Atharvana Veda*, *Paippalaada Samhita*, 9 – 23)

The '*Pavamaana Suktam'* mentioned above, may look only like an exaltation of *Pavamaana* (Wind). But, a deeper analysis may provide considerable insights into the encrypted atmospheric awareness of our scholarly forerunners.

The circulation of wind enables the proper mixing between the layers of atmosphere and their contents. Studies also proved that an increased wind velocity would ensure the dispersion and dilution of pollutants in the atmosphere, thereby decreasing their concentrations and relieving the load of pollution borne by the ambient environment drastically. Some gases also kill the bacteria in the air and create a healthy environ. A room or a place kept sealed from air flow will make the ambience stale, whereas circulation of wind makes the surroundings sterile and serene. Winds also carry pleasant fragrances that make us overwhelmingly ecstatic and many a time, the winds blowing over herbs transport their efficacious essence to us. A puff of such air enriches our health. Hence, the proclamation that the wind purifies Earth, Sky, day and night, directions, sub-directions and atmospheric environment is validated completely.

Further, it is a universal fact that the Sun and Stars undergo nuclear fusion process in themselves, that keeps them glowing with perennial quantities of light and heat. In a nuclear fusion, two hydrogen nuclei combine to form a Helium nucleus, generating tremendous amounts of energy. In this way, wind (Gases) is the sustainer of Sun and all the stars. Moreover, the ultraviolet rays of the Sun are filtered by the protective sheath Ozone layer in the stratosphere and only beneficial Solar Radiation reaches the Earth. The Moon's rays also pass through the atmosphere, where its beneficial features are enhanced and imparted to human beings, trees, herbs, waters, etc. Besides, winds transmit pollen grains and fertilise the plants and produce fruits. It is a commonplace sight to almost everyone that wind carries certain types of seeds with it and deposits them randomly and helps in the flourishing of that plant species. Thus, it helps in propagation and reproduction in plant kingdom. Hence, we can easily gauge the authenticity of the declaration that the Sun, Moon, Stars, all beings, trees and herbs are purified by wind. It is known obviously that oxygen is vital for life and further, Carbon-di-oxide is helpful in carrying out Photo synthesis in plants.

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Our yogic principles state that, inhaling adequate oxygen (*Prana Vayu*) purifies mind, body and soul, by rescinding toxic entities and inducing noble virtues in the person. It also revitalizes, rejuvenates and re-energizes each and every cell in the body. Hence, going by the popular saying 'A Sound Mind in a Sound Body', we can effortlessly grasp the rationality of the entitlement that wind purifies Righteousness, Truth, Penance, Perseverance, Dedication and Austerity.

To begin with, water (**H_2O**) itself, is a product of the combination of the gases Hydrogen and Oxygen, which is self-explanatory of the inseparable elemental intimacy of air and water. The water from rivers, seas, oceans, etc. gets converted to water vapour and reaches the atmosphere. When they get saturated, clouds are formed and rainfall occurs. The water from the seas, oceans and other water bodies contains so many impurities like salts, minerals and other wastes. But, when this water is drawn into atmosphere and returns to earth as precipitation, it is quite pure, free from impurities. Though this water cycle is induced by the Sun, the atmosphere is the medium through and in which this entire mechanism occurs incessantly. In this way, the water from aquatic bodies is purified by the atmospheric air and showered on the Earth, sustaining life. Chlorine gas is pumped into water to get rid of pathogenic microorganisms present in it to make it fit for drinking and cooking. In addition to this, now-a-days, water is being purified using ozone gas, which renders it highly decontaminated and disinfected. Hence, one must second our precursors' proclamation that the waters (i.e. rivers, seas, oceans, etc.) are cleansed and purified by air, without any second thought.

Snow is also a form of precipitation. Hence, snow is also purified in the same way as water, in the atmosphere before it falls down and gets deposited at several places on land and on hills and mountains, like the *Himalayas*, etc. In this way, snows are purified by winds, as mentioned in the '*Pavamaana Sooktam'*.

Innumerable varieties of trees, herbs, etc. are found more in the forests and valleys atop hills and mountains, than on the land. Many lakes, ponds, rivers, etc. originate or flow through hills and mountains. Wind rises when it is obstructed by hills and mountains and begins rising till the air parcels are saturated. Then, it results in extensive rainfall on that side of the hill/mountain. This side of the hill/mountain is called the **'Windward side'** and this entire process of rising of air is termed **'Orographic Uplift'**. This rainfall provides the necessary water for the sustenance of various life forms, trees, herbs, etc. on that hill/mountain by replenishing the surface water resources and the water table. All the undesired impurities, wastes, dust and other extraneous discarded litters and scum are washed away by rain waters and the hills/mountains appear clean and immaculate to our eyes as well. The very fact that, all of these phenomena are caused by air, as explained, implies that hills and mountains are thoroughly purified by air.

We know that fossil fuels like Petrol, Diesel, Kerosene, Coal, etc. are not fully combustible and produce a lot of residual gases as by-products, which tend to pollute the atmosphere. The calorific value of these substances, though refined to a great extent, is not so remarkable. But, on the other hand, gases like Hydrogen, Butane, Methane, Propane, etc., derived from natural gas, have a very high calorific value and are completely combustible, leaving behind no residues like, toxic gases, ashes, other hydrocarbons, etc. Thus, these gases are completely utilized, giving high energy and producing no pollution. Hence, these gases produce pure fires (clean combustion).

Further, it is a basic fact that combustion occurs only in the presence of air (Oxygen). The more the availability of pure, unrestricted and uncontaminated Oxygen, the 'cleaner' the combustion will be, often characterized by a bluish flame. Moreover, Oxygen also aids in digestion, metabolism and respiration processes. Here, Oxygen purifies digestive, metabolic and respiratory fires (*Vaisvaanara Agni*/ *Deepana Agni*), resulting in the release of energy required for the body. Hence, from the discussions above,

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we can conclude fairly that the fires are rendered pure by air.

Seasonal transitions are effected by the circulation of winds. For instances, in a tropical region like India, hot and arid winds devoid of moisture blow from the north-west, resulting in scorching heat. Then, due to the air pressure gradient between land and the sea, the onset of South- West and North-East winds occurs, marking a transition to rainy season. Then, again due to high pressure (anti-cyclonic) on land and formation of inversion layers, the foresaid circulation is sealed and even the local convective activity is paused. This allows some cool breezes from the Northern part of the globe (say Siberia, etc.) to invade Indian Territory, turning it into a chilling paradise. Then, this cycle repeats itself cyclically as if someone had pre-planned its itinerary. This ordained order or uniformity is called '*Rtam'*, and since seasons presage this order, sages have named them '*Rtu'*. Many treatises like the '*Brihat Samhita'* enshrine many predictions pertaining to weather during a season or a year, particularly the pattern of rainfall, is forecast based on the trend of wind on a particular day at a particular time (say, on the full-Moon day of *Aashaadha* month). Hence, wind is like a seer which foretells the near future with regard to Meteorology. In this way, there should be no doubts when coming to the avowal that wind purifies the 'order' and in turn, the seasons and the years as well.

In modern times, the fuels like liquid Oxygen, liquid Nitrogen, etc. are used as rocket fuels. They are liquefied gases. Such liquefied gases are also prepared in Gas plants to study phenomena which demand temperatures near 'Absolute Zero' (0^0 K or -273.15^0 C (approx.)). They are particularly of extreme utility to study certain applications in 'Super Conductivity' like the '*Meissner Effect'* of levitation and others.

Aircrafts and rockets fly in the sky based on their construction adhering to the 'aero-dynamic lift' and 'drag' of the air in the region of their flight. The air upholds the aircrafts and makes way for its transit through it. Radio waves and other electro-magnetic radiations are propagated to their respective destinations due to ionospheric reflection and transmission from its D,E and F regions, as the case may be (Altitude from the Earth's surface: **D - 60 km., E - 120 km. and F – 180 km**.). So, communications are carried out with the aid of atmosphere.

In the field of Spectroscopy and Photonics, LASER (Light Amplification through Stimulated Emission of Radiation) technique is widely employed. Among them, we have many Gas LASERS like Helium – Neon (He-Ne) LASER, Argon ion LASER, Krypton ion LASERS, Carbon di oxide (CO_2) LASERS, Excimer LASERS (Gas-Halide LASERS, exciplex LASERS), Nitrogen LASERS, Hydrogen LASERS, Metal Vapour LASERS, Alkali Vapour LASERS, Chemical LASERS, Raman Gas LASERS, etc. It is out of context to enlist the innumerable applications of LASERS in day-to-day life. From our common CD/DVD players to our Laptops, from super markets to Super Computers, from Food Preservation to Surgery and many more, LASERS find numerous uses in every walk of life.

In Atmospheric Science, the temperature profile, aerosol and cloud characteristics, constitution of water vapour and other gases, is studied using an instrumental technique called LIDAR (Light Detection and Ranging), where a LASER beam is sent into the atmosphere and the received beam that is transmitted back, is analysed for obtaining the required information. Hence, atmosphere provides a vast area and wide scope of study for many researchers working in the field, like me.

From the elaborate discussions above, atmosphere (Air) has been bestowing us with a lot of knowledge and is consistently opening up new avenues, thereby allowing us to study, carry out research and improve our awareness on various topics of interest. It is driving away the darkness and igniting the torch of wisdom in our minds and hearts, which is nothing but purification. So, it is an extremely fitting acknowledgement of our scholarly Vedic sages that the wind (air) purifies minds and hearts, by purifying our intellect with the right knowledge.

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For mechanical purposes like welding, shaping and casting of metals, etc., gas flames generated from the combination of Oxygen and Hydrogen (Oxy-Hydrogen flame), Oxygen and Acetylene (Oxy-Acetylene flame), etc. are used. In this way, air purifies metals and other non-living substances and immovable entities as well.

Air Pressure is a vital component that is crucially essential for many applications. Refrigerators, Air Conditioners, Water motors, Vacuum cleaners and other suction devices use this principle of pressure gradient.

It is not an exaggeration to state that air pressure is an indispensable factor in maintaining the cycle of seasons on the Earth. The capillary action of blood vessels in our body, the process of osmosis, the suction force employed by the roots of a plant to draw water from the soil; all of these employ pressure difference alone. In our body, the heart maintains the blood pressure by its systolic and diastolic modes. A high or low blood pressure is a great health risk. In addition to this, if the air in the body becomes disproportionately distributed, then, that leads to paralysis of certain organs of the body. Generally, the ancient Indian texts subscribed to the concept of five types of winds circulating in the body, *viz*. *Praana*, *Apaana*, *Vyaana*, *Udaana* and *Samaana*. Among these, *Praana* flows upwards (inhale) and *Apaana* flows downwards (exhale). Lord Krishna declares in the *Bhagavad Geetha* thus:

"Aham Vaiṣvaanaro bhutva
Praaninaam Dehamaasritaha
Praana Apaana samaayuktaha
Pachami Annam Chatur vidham"
(The *Bhagavad Geetha*, Chapter 15,
Purushottama Praapti Yogaha, *Slokam* 14)

"I'm the digestive fire (*Vaisvanara agni*) in everyone which using their incoming (*Praana*) and outgoing (*Apaana*) breath digests all the four types of food" (namely, *Bhakshya*, *Bhojya*, *Choshya* and *Lehya*)

Hence, energy is produced in the body due to the conjunction of digestive fires with wind. This is a direct reference to the process of 'Respiration' that generates energy in the body. The complex molecules of food are broken down into simpler molecules with the help of oxygen and consequently Carbon-di-oxide and other trace gases are released. So, there is no need to mention separately that Indians were well-versed with the concepts of metabolism (Catabolism, i.e. breaking complex molecules into simpler ones, as in human beings, animals, birds, etc. and Anabolism, where simple molecules are developed into complex molecules and used as food, as in Plants) and cell respiration from the earliest times of human civilization. Hence, wind produces energy inside the body and sustains/holds the body and life as a whole.

As per the *Ayurveda*, if the *Vaata* (Wind) defect prevails, then, it may also lead to *Pitta* (bile) and *Kapha* (phlegm) defects. Hence, a disturbance in the composition of 'Wind' in the body leads to an increase in the entropy of our entire system. Hence, we can stress and second this notion and motion that Wind purifies the body and life, unequivocally.

Motor Vehicles; from a bicycle to an airplane (during take-off and landing) move on tyres with tubes inflated with air, that supports smooth locomotion. Travel is the inevitable daily necessity of each and every man in the world and transportation is the chief source of income and even major exports and imports are done through transportation on wheels, which boosts the economy of a nation immensely.

Further, jet planes and rockets move forward with great velocities as the exhaust from the fuel greats a tremendous thrust in the backward direction and the rocket/jet itself moves forward at amazing speeds. This is an application of 'Newton's third law of motion' obviously.

Now-a-days, we generate a substantial share of our electricity also through wind energy, using wind mills extensively. Wind can be considered to be 'blowing/flowing energy'. Water, which is formed from Hydrogen and Oxygen, also exhibits the property of generating electricity. Steam engines, domestic pressure cookers, boilers and

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functions of several other devices are based on vapour/steam energy.

Hence, a glance at all these instances cited above, makes us feel that air purifies the very life of every human being on Earth not only internally, but also externally. All the humans together, constitute this world. Hence, can anyone question the spirit of the *Pavamaana Sookta* in decreeing that the world/Earth itself is purified by the Wind? Hence, it is said by the *Madhva*/*Dwaita* sect followers thus: *"Hari Sarvottama – Vaayu Jeevottama"*, which means '*Hari* (Lord *Vishnu*) is the Best among All and *Vaayu* (Air/Wind) is the Best among the Sustainers of Life'.

Last but not the least; air is the main source of speech. Different sounds, syllables and language developed only through air. It is very unique that Sound originates from air and is also propagated through air, i.e. we can produce sound only with the help of air and again, are able to perceive it by hearing with our ears, only through air. In *Yoga* and spirituality, breathing techniques of *Praanaayaama* occupy a prominent position, as the intake of *Praana Vaayu* (Oxygen) in the air is believed and proved to confer physical, mental and spiritual resurrection rejuvenation and resurgence, accompanied by bliss, solace as well as an elegant ecstasy.

In *Hinduism*, some principle deities like Lord *Vishnu*, Goddess *Saraswati*, etc. are depicted as being seated on birds, which are said to be their carriers and vehicles. Lord *Vishnu's* carrier is Lord *Garuthmantha*, in the form of an enormous, mighty Eagle and that of Goddess *Saraswati* is a milky white Swan (*Hamsa*). There are so many interpretations to these vehicles. However, we are not going into those spiritual intricacies now. The only aspect we are concerned about is, the aspect of *Praana* seated on *Vaayu*. The God Head is the Personification of *Praana Sakti* (The Basic Energy that sustains Life in the beings). Since, the *Praana* is sustained and carried on by the breath (*Śwaasa*) itself, which is nothing but air (Oxygen), *Garutmaan* and The Swan are symbols of *Praana Vaayu* (Oxygen) and their two wings are the Inhalation (*Ucchwasa*) and Exhalation (*Nisswaasa*). The Lord or the Goddess seated at the back of their respective vehicles, situated exactly at the middle of the two wings, highlights the fact that the span of *Praana* lies in between inhalation and exhalation. If that rhythm is disturbed, *Praanic* energy becomes out of balance and if that *Uccwaasa-Nicchwaasa* cycle stops, then, the *Praana* leaves the body. The converse is also true, i.e. when the *Praana* leaves the body, the cycle of breath comes to an end. In general terms, if the owner/rider (Lord/Goddess here) gets down, there is no need for the vehicle to work (i.e., these birds do not fly with their two wings when their owners get down, which means the *Praana Sakti* leaves the body and the journey of life comes to a halt). This is the embedded significance of choosing birds like Eagle, Swan, etc. as their vehicles, which in physical terms also **fly in the 'Air'**.

Lord Vishnu is depicted as reclining on an enormous coiled serpent called '*Anantha'* or '*Aadi Sesha'*. Generally, *Kundalini* power or the basic life energy (*Praana Sakti*) is portrayed as a serpent in sleep. It is channelized into some 72,000 invisible intersections/junctions called '*Naadis'*, which culminate into 3 most important naadis called '*Ida'*, '*Pingala'* and '*Sushumna'*. *Ida* operates in the left part of the body and its influence is recognized by the breath from the left

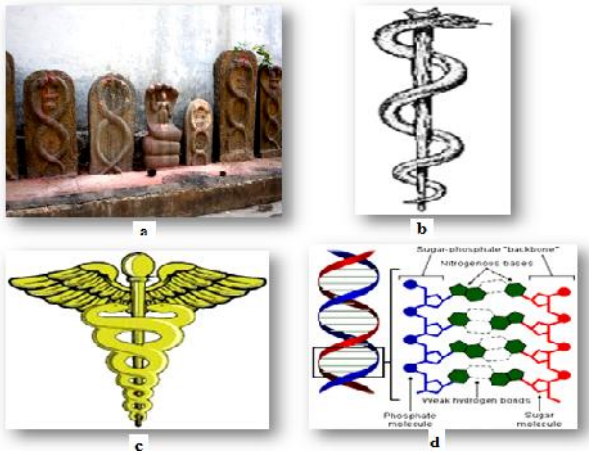

Fig. 10: a. The age-old tradition of Snake Worship (Nagaaradhana) in India; Notice that the shape resembles the double-helical structure of the DNA strands; b. Rod of Asclepius; c. Image of Caduceus; d. The double-helical structure of DNA

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nostril, which is usually cold. This has a feminine attribute and is known as 'Lunar Breath'. Similarly, *Pingala* operates in the right side of the body and its influence is recognized by the breath from the right nostril, which is usually hot. This has a masculine attribute and is known as the 'Solar Breath'. The middle channel is called '*Sushumna'*, which is attributed to Spiritual awakening, which lies at the centre of *Ida* and *Pingala*. *Ida* and *Pingala* are visualized like two snakes inter-coiled with each other over a vertical pole/staff. Hence, Lord *Vishnu* represents the dormant All-Pervading latent Super-Cosmic Power that is enshrined in the *Kundalini* serpent's energy.

Ancient Indians possessed a high degree of awareness regarding environmental conservation and safeguarding the biodiversity. Stringent laws were in place to protect the flora and fauna in their respective kingdoms. Birds and animals were depicted as the 'Divine Vehicles' of Gods and Goddesses. For instance, Lord *Vishnu* has *Garutmantha* (An Eagle/Hawk), Lord *Siva* has a Bull (*Nandi*), Lord *Brahma* has a Swan, Lord *Krishna* is seen as a *Gopaala* (Cowherd), Lord *Subrahmanya* has a peacock, Lord *Ganesha* has a rat (Lord *Ganesha* Himself has the face of an elephant), Lord *Indra* has a white elephant (*Airavatam*), Lord *Varuna* (Goddess Ganga also) has a crocodile, Lord *Manmatha* (*Kaama Deva*) has a parrot (Goddesses like *Goda Devi* (*Andal*), *Madurai Meenakshi*, etc. can be seen holding parrots in their hands). Lord *Kubera* has a Man as his vehicle. Such attributes of animals and birds to Divine Beings is intended to promulgate the noble message that all the humans, all the birds and animals are to be treated with due love and affection, including rats that cause a lot of damage to humans. Even the dreadful snakes are connected with Gods, exhibiting the Universal compassion of the ancient Indians, highlighting the benevolent motto **"Live and Let Live"**.

This is really extremely far-sighted and tactful on the part of our ancestors that on one hand, they tried to avert any sort of cruel treatment being meted out to birds and animals and on the other hand, implanted a subtle philosophical and spiritual truth in assigning a particular animal or bird to a particular God or Goddess.

This ancient Indian concept of 'Snake Icons' has crept up into other civilisations of the world as well. This is quite evident from the image of '*Caduceus'*, which is a staff, entwined by two snakes(shown in fig. 10.c), held by the Greek God *Hermes*, who was adopted later by the Romans as *Mercury*. Sometimes, this is used as a symbol of medicine, mistaken for the rod of *Asclepius*. (fig. 10.b) (Asclepius is a deified Greek Physician, whose daughters had remarkable names; *Meditrine*, *Hygea* and *Panacea*, literally meaning 'Medication, Hygiene and Healing' respectively, denoting different stages of treatment). The ***Caduceus*** almost represents the Indian concept of *Naadis*. The two snakes symbolize the *Ida* and the *Pingala*, while the staff in the middle represents the spinal cord through which *Sushumna* rises up. The *Ida* and *Pingala* merge with the *Sushumna* between the two eye brows (*Bhru Madhyam*; Indian Spirituality ascertains that the life (*Praana*) enters and leaves the body through this point. That's why, it is an infallible Indian tradition to decorate this place in between the eyebrows with a *bindi* or a *tilakam*), denoted by the two wings of the staff. This conjunction is called '*Aagnya Chakram'*. The intellect of a spiritual traveller, who attains this stage of enlightenment, becomes fully bloomed. This is the significance of the fact that *Mercury* (*Budha*), the presiding deity of intellect (*Buddhi*) holds this staff in his hands always.

The wings of the *Caduceus* also signify the dependence of Life Energy on Wind (*Prana Vaayu*), i.e. the life of a being flies with the help of air (is sustained by the circulation of air in the body). This, in addition to the external 'Atmospheric Science', there is an even more intricate and complex 'Internal Atmospheric Science' operating inside the human body.

Mercury is believed to be the messenger of Gods. This houses an innate and an intricate sense that the intellect of a person who reaches this state of enlightenment (*Budha Jana*), will receive the messages of the Gods, i.e. he will experience the

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Divinely Blissful Ecstasy. From there, he can proceed to attain the highest grade of Spiritual Enlightenment, like that of the *Buddha*.

One more shockingly and self-evidently similar structural revelation of the 20th century is the discovery of the structure of DNA (Deoxy ribo nucleic acid) by Sir James Dewey Watson, Francis Crick and Maurice Wilkins in 1953, for which they were awarded the most prestigious Nobel Prize in the field of Physiology or Medicine in the year 1962.

The double-helical structure of the DNA is as shown in fig. 10.d. The structure of the DNA is strikingly same as that in fig. 10.c**,** representing the Indian concept of Spirituality. This is the real secret behind the Snake-Worship (*Nagaaraadhana*) (fig. 10.a) in India (Predominant in South India). This is not the superficial concept of worshipping the species of snakes, but, the invocation of the life-energy *Praana Sakti*/*Kundalini* Serpent power in every body. Shiva being adorned by Snakes also points to this fact and moreover, Lord *Shiva* is mostly posturized as being in a profound meditative state. We find the same idols, images and rock edicts of 'double-helical' inter-twining of two snakes, in almost every South-Indian temple. But, common people worship them as Snake-Goddesses (*Naga Devatha*), rather than perceiving them in their original grandeur. This double-helical structure of DNA bearing a resonant similarity to the meta-physical theory of *Ida* and *Pingala* interwoven over the *Sushumna* makes a clear-cut declaration that each and every strand of DNA in the body is illuminating the above superlative hypothesis of Spiritual Science and the presence of 'The Infinity' in each and every iota of the physique of humans and other creatures. Hence, the prominence of the two snakes inter-coiled to the staff-like rigid structure in Indian culture also tells us that, in India, Spirituality and Scientific quest are intertwined to human life always. Moreover, the symbol of 'Infinity' coincides perfectly with the structure of the DNA and matches with the depiction of 'two inter-coiled snakes' and also with the coils of the Great Serpent '*Aadisesha'*. This coiling of snakes reveals the mystic quality of the Almighty. It looks like a combination of sine and cosine waves. It also symbolizes the two energies, positive and negative intertwined to the base neutral energy in the middle. Spiritually, this represents the entities of *'Prakruti'* and *'Purusha'* which spring up from the same Supreme Soul (*Paramaatma*). The symbol also resembles the vibrations of a stretched string tied tightly at both the ends.

Therefore, it can be stated with certainty and complete conviction that as far as the modern day Indian religion (Vedic religion/*Hinduism*) is concerned, some obscurantist and irrational religious beliefs have over-shadowed the noble, scientific and supreme spiritual truths that Ancient Indian Philosophy, religion and knowledge stood for and advocated ardently. This is the main drawback of today's Hinduism. The age-old knowledge transfer had been interrupted by various invasions and imperialistic tendencies of colonial powers, which rendered Indians as laymen in their own land for centuries together. This resulted in an utter pitiable, appalling and abysmal situation where we were made to know our own history and blindly interpret it through the brains and perspectives of some methodically mad, foreign fanatic and racist sources. This darkness of sheer ignorance prevailed for centuries and now.

Kota Venkataachalam (1954) had worked up the dates of Indian history based on meticulously sound logic and practicality and found that there were great barriers of discrepancies, ranging several thousands of years, between the actually perceived dates and the modern dates put forward by the contemporary historians. For instance, he works out the date of *Mahaa Bhaaratha* war to be 3067 BCE, which corresponds very well to the popular belief that the climactic battle occurred 5,000 years ago. He also proposes astonishing dates for *Buddha* and *Aadi Shankara*. According to *Kota Venkatachalam*, *Buddha's Maha Pari Nirvana* took place on March 27, 1807 BCE and not in 544 BCE as per modern history. He also gives the year of birth of *Adi Shankara* to be April 5, 509 BCE going by the horoscope given by *ChitSukhaacharya*, a boy hood friend of *Aadi Shankara* in his work

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Brihat Vijaya. Professor *Narahari Achar* established the date of beginning of the *Mahaa Bhaarata* war to be November 22, 3067 BCE. He confirmed the date FEB. 10, 1807 BCE, coinciding with *Kota Venkatachalam's* date for *Buddha's nirvana* based on the details furnished in the *Samyutta Nikaya* and by using the *Planetarium Software*. He also reinstated the accuracy of the date for *Aadi Shankara's* birth put at April 5, 509 BCE. Prof. *Narahari Achar* also pointed out that the mix up of the names of *Ashokaaditya* of the *Gupta* dynasty with *Ashoka* of the *Mauryan* dynasty lead to the misdating of *Buddha*. It is *Samudragupta* of the *Sri Gupta* dynasty who was known as '*Ashokaaditya Priyadarshin'*. The actual "**Inscriptions**" of *Ashoka* belong to this *Gupta* emperor and not to *Ashoka Maurya*, who came to power after 218 years after *Buddha*. (Narahari Achar, 2007). Regarding *Aadi Shankara*, further consolidation of his birth date came from the enlightening essay of V.G. *Ramachandran* (Ramachandran, 1998).

Some Indological Scholars like Dr. *Padmakar Vishnu Vartak* reiterate firmly that the antiquity of the *Vedas* is not a mere 5000 years, but is at least 25000 years as is evidenced from the astronomical data presented in the *RigVeda* and the *YajurVeda*. The record of the *RigVeda* of beginning of the rainy season when the Sun entered *Mrigasira Nakshatra* and the record of *Yajurveda* that the New Year began with the *Uttara Phalguni Nakshatra* in *Vasant Rutu*, proves their date 23720 years Before *Christ*. The *Vedas* were not composed during one period of time. The period of *Vedas* spanned several centuries before they acquired a comprehensive form. There were more than 1000 sects of *Vedas*, named after the tutelary Sage who propounded them. But, among them, not even 20 Branches/Schools are available today. Of these very few, the oldest record in *RigVeda* relates their date back to about 26,000 years. From this, it can be presumed authentically that the *Vedas* were written very much before 26,000 years **"at least".**

It's a great misery that some of our own revered historians and scholars like Professor *Sen Gupta*, D.C. Sircar and others have discarded the invaluable astrological references in our ancient texts as mere myths and 'astrological effusions fit for mother goose's tales' (Sen Gupta, 1947 and Sircar, 1969). Now, there is a ray of hope as some of such renovation and reconciliation responsibilities are being efficiently shouldered by 'Young Intellectual India'.

Hence, this concept of *Praana*, *Naadi*, *Chakras* and others discussed till now, are the direct consequences of the meticulous circulation of wind through various channels in the body.

Like this, air remains to be the principal benefactor and sustainer of life in every possible manner. Lord *Hanuman*, the Son of *Vaayu Deva* (Wind-God), is worshipped across India and in many parts of the world. Spiritually, He is thought to be a Personification of *Manas* (Mind/Heart). The exemplary and immaculate character of *Hanuman* depicted in the epic *Ramayana* imparts an important moral that if the air that we breathe is pure, the Mind will be pure. Hence, to contain Mind Pollution, the mother of all Pollutions, Air pollution has to be checked and curbed. This is the interdependency of Air and Mind. This entire cycle of creation and dissolution is being described as the exhalation and inhalation of the Primordial Supreme Soul respectively. Hence, if we pollute the environment, it is equivalent to polluting the very benign breath of the Almighty!!!

In this way, Air purifies everything; concrete and abstract, living and non-living, movable and stationary as well as in and out. Such Wind (*Pavamaana*) will definitely purify us from within, as desired and wished ardently by our Vedic pioneers. Wind is hailed to be the most expressive and effective embodiment of the Almighty Supreme Soul (*Paramaatma*/*Para Brahma*).

Such is the reverential prominence attributed to *Pavamaana* (Wind/Air) by the Vedic Indians. If such 'Universal Purifier and Sanctifier' itself is polluted indiscriminately by anthropogenic activities, then, there will be no savior of mankind and environment from the clumsy clutches of extermination. One may wonder if those Vedic Sages have envisioned the imminent future and inserted an advisory warning to all of us in the

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form of such *Sooktams* to awaken people's dormant consciousness pertaining to polluting the environment recklessly. I personally feel that the invocation 'May that *Pavamaana* sanctify us from within' is an indirect indication to the present and the future generations to combat this menace of (Air) pollution by getting rid of the most dreadful form of pollution, i.e. **Mind Pollution** within ourselves. Our well-wishing and far-sighted forefathers have thus prayed to the All-Pervading *Pavamaana* to assist us in all our endeavours to conquer that root and mother of all troubles; Mind Pollution.

"Aano Bhadraaha Kratavo Yantu Viswataha" - RigVeda

(Let noble thoughts come from all corners of this universe and fill my mind)

The *Pavamaana Sooktam* may appear to be very precise as well as concise (of course, in a very highly encrypted form), but, if we attempt even a simple analysis, like what I tried humbly to do now to a little extent, it speaks volumes, if not more. Hence, *Vedas* are like condensed 'Glaciers of Knowledge', from which renewable and perpetual rivers of wisdom pertaining to various disciplines spring up infinitely and incessantly; just as the perennial rivers like The *Ganga*, *Yamuna*, *Saraswati*, *Brahmaputra*, etc. have been emanating from the Himalayan Glaciers for what seems to be eternities.

References to Atmospheric Science in the *Vedas*, Epics, *Puranas* and some other random miscellaneous sources like Treatises and Classics

The theory that the white/colourless Sun light is composed of seven-coloured rays was known to Vedic *Aryans*. There is a hymn (*mantra*) in the *RigVeda*, which means:

"The Sun containing the rays of seven colours is the cause of water flow in the rivers (because of rain). After rain it again attracts water from earth and this cycle goes on" (*RigVeda*. II, 12.12):

This proves that the Vedic Indians were very much aware of the concept of evaporation, cloud formation and condensation to give precipitation and possessed the knowledge that this was a cyclic mechanism. (Hydrological Cycle)

Another hymn states thus:

"The water which gets divided into minute particles due to the heat of Sun is carried by wind and after its conversion into a cloud, rains again and again". (*RigVeda* I, 6.4)

This particular verse shows that they had the information about the micro physics of the formation of cloud droplets and the subsequent rain droplets.

Another hymn proclaims that 'The God has created the Sun and placed it so that the whole universe gets illuminated. Likewise, this is the rule of the universe to extract water upwards continuously and then convert it into cloud and ultimately discharge that as rain". (RV I, 7.3)

Similarly, the following hymns of the *RigVeda* explain the transfer of water from Earth to the atmosphere by the wind (I, 19.7), breaking up of water into small particles and evaporation due to Sun rays and subsequent rain (1, 23.17), the cloud-formation due to the water evaporated from the mother Earth and then its desire to return to its mother in the form of rain (I, 32.9).

Another verse (I, 32.10) says that the water is never stationary, but it continuously gets evaporated and comes down and due to smallness we cannot see the up-going or ascending water particles.

The verses II, 30.1 and II, 30.2 also reflect the same spirit as envisaged above, saying that the 'rays of the sun are the cause of rains and that the sun extracts water from all parts of the world and the initiation of creation is through fire only (The Sun) and that fire, is continuously engaged in extraction and discharge of water. Here, the simile

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of a mother and child in terms of rainfall and Earth portrays the poetic heart of the Vedic seers.

A verse of *RigVeda* states as follows:

"The waters which are from heaven, of those which spring up by themselves, the bright pure waters that tend to the sea, may those divine waters protect me here". (RV, VII, 42.2)

Like these, various other verses (RV, VIII, 6.19; VIII, 6.20; and VIII, 12.3) deal with the causation of water evaporation, formation of cloud, rain, flow of water and its storage in oceans etc.

This interesting verse of the *RigVeda* reads as follows:

"At the start of Creation, Sun etc. were created. The Sun caused rainfall from the sky and the vegetation is created by the combination of cloud, air and Sun. The Sun extracts water in the form of vapour & air, resulting in the formation of cloud and rain" (RV, X, 27.23)

In the *Saama Veda*, the knowledge of hydrologic cycle had reached one step ahead of the *RigVeda*. A verse from the *Saama Veda* reads as follows:

"One type of water goes up and other type of water comes down, both of these may go to the atmosphere after treatment of Sun's heat. From up they flow into rivers after rain and get stored there". (*Saama Veda*, VI, 607)

Likewise, the *Yajurveda* explains the process of water movement from clouds to earth and its flow through channels and storage into oceans and further evaporation (*Yajurveda*, X, 19).

Verse I, 32.4 of the *Atharvana Veda* states the entry of rain water into earth and its continuous movement in the cycle from earth to atmosphere by Sun rays.

Another verse of the *Atharvana Veda* (V, 24.5) articulates that the water from earth goes to atmosphere due to Oxygen and then it comes down (rains) due to Carbon dioxide.

This is a very fascinating and an intricate observation made by the *Atharvana Veda*.

This branch of studying water circulation from earth to atmosphere and from atmosphere back to Earth is known as 'Hydrometeorology'.

The epic *Mahabharata* (XII, 183.15 and 183.16) explains that the water ascends to sky with the help of fire and air and then its humidity gets saturated and it is condensed and subsequently rainfall occurs.

Furthermore, *Shanti Parvam* houses some verses (184.15, 184.16 and 184.17), which pronounce that the plants drink water through their roots. The mechanism of water uptake by plants is explained by the example of water rise through a pipe. It is said that the water uptake process is facilitated by the conjunction of air.

In the *Maha Bharata*, it is also explained that the air and the Sun's rays get dispersed and fill the whole universe together. The verse 8 further declares that the Sun's rays shower water in the rainy reason (four months) and in the next eight months, the same water is again extracted by the Sun's rays. Thus it explains two faces of hydrological cycle clearly, *viz.,* Condensation and Evaporation. (M.B., XII, 362.4, 362.8)

Like in the *Vedas* and the Epics, in *Puranas* also, we come across several significant references of hydro science during those periods. *Matsya Purana* (Vol. I, chapter 54, *Slokam* 15), reveals that the air saturated with moisture (Precipitation) is the cause of creation.

In verses of *Matsya Purana* I, Chapter 54, *Slokams* 29 to 34 and *Vaayu Purana,*Chapter 51, *Slokams* 23 to 26, we come across the knowledge of evaporation, burning (heating) of water and conversion to smoke (Water Vapour). The above *Puranas* claim that this is caused by the Sun's rays, by which water ascends to the atmosphere with the help of air, which again rains in the next 6 months for the goodness of the living beings.

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In *Linga Purana* a full-fledged chapter (Volume I, Chapter 36) has been devoted to the science of hydrology. It explains the evaporation, condensation and rainfall with suitable examples, very scientifically and says that the water cannot be destroyed; only its state is transformed.

This proves that ancient Indians were very much acquainted with the knowledge of the 'Law of Conservation of Energy'.

"After getting heated by the Sun, the water contained in most of the materials on the Earth gets converted to smoke (vapour) and ascends to sky with the air and subsequently gets converted to clouds. Thus the combination of smoke, fire and air is the cause of cloud formation. These clouds cause rainfall under the guidance of Lord *Indra* having thousand eyes". (*Linga Purana*, I, 36.38 and I, 36.39)

Since Lord *Indra* represents clouds, thunder and rainfall, these thousand eyes can be taken to be the innumerable droplets of rain, thunders and streaks of lightning, symbolically and figuratively.

Similarly, in *Linga Purana* (Volume I, Chapter 36, *Slokams* 66 - 67) says that the water is never destroyed or lost, but only converted from one form to other i.e., water to vapour by the Sun's heat, then to cloud and subsequently rainfall occurs.

"The water evaporated by the Sun ascends to atmosphere through the capillary action of air, and there, it gets cooled and condensed. After the formation of clouds, it rains by the force of air. Thus the water is not lost in all these processes but only gest converted from one form to another continuously". (*Vayu Purana*, 51.14, 51.15, 51.16)

Brahmanda Purana (Volume II, Chapter 9) gives some information on hydrologic cycle. It says that the seven colour rays of the Sun extract water from all sources, by heating them (II, 9.138-139). Thereafter, the clouds of different shapes and colours are formed. Then they rain with high intensity and great noise. (II, 9.167-168).

The *Rigvedic* Aryans had keenly and carefully demarcated the variation in seasons and divided the whole year into six such divisions. (*RigVeda,* Volume I, Chapter 23, *Slokam* 15)

The Sun was clearly known as determinant of seasons and the seasons were formed for the benefit of the earthly creatures. (RV, I, 95.3)

The *Aaditya Hrudayam* in the *Ramayana* also echoes the same spirit, by declaring thus:

"……***Rutu Karta Prabhaakaraha***" (*Ramayana*, *Aaditya Hrudayam*, *Slokam* 9)

This means: "The Sun (*Prabhaakara*) is responsible for the conception and formulation of seasons and order of time in a year (R*utu*)".

Radiation, convection currents, rainfall and their mechanisms are described in the *RigVeda* (I, 164.47, VII, 70.2 and I, 161.11-12).

.Verses of *RigVeda* Veda (I, 27.6; I, I, 32.8; 32.14; I, 37.11; II, 24.4; V, 55.3) describe the formation of clouds by evaporation of water by Sun, wind circulation and occurrence of rainfall. They also affirm that there is no other cause of rainfall other than the Sun.

Furthermore, the *Aaditya Hrudayam* describes the Sun as the bestower of heavy rains (*Ghana Vrishtihi*) and the friend (*Mitraha*) of waters (*Aapaha*).

"……***Ghana Vrishtihi Apaam mitro***……" (*Aaditya Hrudayam*, *Slokam* 13)

During the *RigVeda* period itself, the seasonal variation of rainfall or the onset of monsoon was known, which is depicted through the verses RV, VI, 20.2 and VI, 30.3, saying that the Sun extracts water from earth during eight months and then this water rains during the monsoon season extending over four months.

Verse (I, 79.2) of the *RigVeda* states that the Sun's rays strike against moving clouds producing the black shredders of rain-roar, after that the

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shower comes with delightful and smiling flashes of lighting. The rains then descend and finally the clouds thunder.

Two verses of the *RigVeda* (V, 54.2 & V, 55.5) explain the cloud bearing winds as the cause of rainfall thus:

"O cloud bearing winds! Your troops are rich in water, they are the strengtheners of life, and are your strong bonds, they shed water and augment food, and are harnessed with steeds (waves) that wander far and spread everywhere. Combined with lighting, the trio of winds, clouds and lightning roars aloud, and the circum-ambient waters fall upon the Earth". (RV, V, 55.5)

In the two *mantras* (RV, VIII, 85.8 and V, 53.17) there are references to sixty three and forty nine types of winds respectively. Their climatological and meteorological implications are still unraveled and they are mostly treated as merely mythologies.

The importance of *Yagnya* to purify environment and to cause rainfall was well understood during the Rig Vedic time. (RV, X, 98.4; X, 98, 6/12; X, 98.7 and X, 98.11)

The three other Vedas, namely *Sama*, *Yajur* and *Atharvana* Vedas furnish some additional information on climatology and meteorology which we do not come across *RigVeda,* hinting that sciences progressed empirically to a considerable extent after the Rig Vedic times.

"From the ocean, O *Maruts*! You make the rain to fall; you are those that are rich in moisture". (*Tattiriya Samhita*, II, 4.8.2)

The *Maruts* or winds are described to be carriers of moisture. This is in great association with the modern day concept of relative humidity and saturation of air parcels and the release of that moisture as precipitation.

Like *RigVeda*, *Yajurveda* also tells about the influence of the *yagnya* (sacrifice) in purifying air, water and environment as a whole and help in causation of rainfall. The *Mantra* (I, 12) can be read as follows:

"If the substances like water, air, etc. get polluted, they will be purified and consequent pure rainfall occurs, if they be broken into minute particles by fire (with the help of *yagnya*)"

Mantra (VI, 10) states that the materials used in a *yagnya* get divided into minute atomic form due to attraction of the Sun and ascend to the sky. This causes plenty of rainfall. Likewise, the *mantras* (VI-16 and XIII-12) also reveal the same fact.

The above hymns clearly point to the fact that the knowledge of 'condensation nuclei', aerosols and their role in the formation of clouds, along with environmental consciousness pertaining to pollution, was prevalent in those days.

The *Taittireeya Aranyakam* (I, 9.8) says that there are seven types of air currents or winds in the atmosphere which produces seven types of clouds of the same appellation.

These are:

i. *Varaahava*/*Varaavaha*
ii. *Swatapasa*
iii. *Vidyunmaya*
iv. *Dhoopam*
v. *Swapaya*
vi. *Grihamegha*,
vii. *Ashimividwisha*

The *Varaahava/Varaavaha* creates circumstances which are responsible for condensation and good rainfall, as the word '*Vara'* signifies the best quality of auspiciousness. The word '*Aavaha'* means 'the one that which holds efficiently and comprehensively'. The significance of naming wind as '*vaha* or *aavaha'* has been discussed elsewhere in the chapter/article. I feel that the word '*Hawa'* (Air/Wind) in Hindi and Urdu, originally of Arabic origin, is also an interpolated form of the Sanskrit word '*Vaha'* for Air. The naming of the '*Hawaii'* islands may also bear some relation to this Sanskrit word '*Aavaha'*

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during remote past (*Ha-wa-ii* and *Aa-va-ha*; these two syllable patterns when interchanged, sound similarly. The 'aa' syllable in Sanskrit word is replaced by 'ii'. Also, many westerners (Women) have a name '*Hawa'* as it is believed to be one form of *Eve*. The *Swatapasa* is that whose temperature condition is little affected by the insolation of the Sun and perhaps occur at a higher altitude and is responsible for precipitation. Here, in Sanskrit, *Swa* means 'self' and *tapa* means heat. This shows the aptness of naming it so.

The *Vidyunmaya* gives rise to thunder storms, as the word '*Vidyut'* itself means 'electricity', which points to powerful lightning, typical characteristic of a thunderstorm. This nomenclature '*Vidyunmaya'* is of extreme significance in light of the fact that western world had realized this fact practically with *Benjamin Franklin's* 'Kite' experiment in 1752. *Taittireeya Aranyakam* was compiled many thousands of years before this date.

The *Dhoopam* cloud might possess some latent property of aroma which it may impart to the objects with which it comes in contact, thereby expanding quickly and the *Gruhamegha* affects the humidity or moisture content of the atmosphere. Here, *Gruha* signifies the quality of an entity to attract and absorb by creating affinity. These six belong to a single genus and have similar regions of activity. The *Ashimividvisha* belongs to another genus and its geographical realm or region is different from the preceding six. However, it is highly favourable for agricultural purposes. These seven classes of clouds bring rainfall accompanied by seven types of winds.

In (I, 10.9) of *Taittireeya Aranyaka*, two more types of clouds are mentioned. They are:

i. *Shambara*
ii. *Bahusomagi*.

The former is responsible for profuse rainfall. The latter '*Bahusomagi'* literally means 'the moving one (cloud) that gives plenty of *Soma* elixir (Rain)'. These two may be synonymous to the modern day variants of cumuliform clouds and Nimbostratus type of clouds, respectively. Hence, including these two, a total of nine types of clouds, along with their properties, have been identified in the *Taittireeya Aranyaka*.

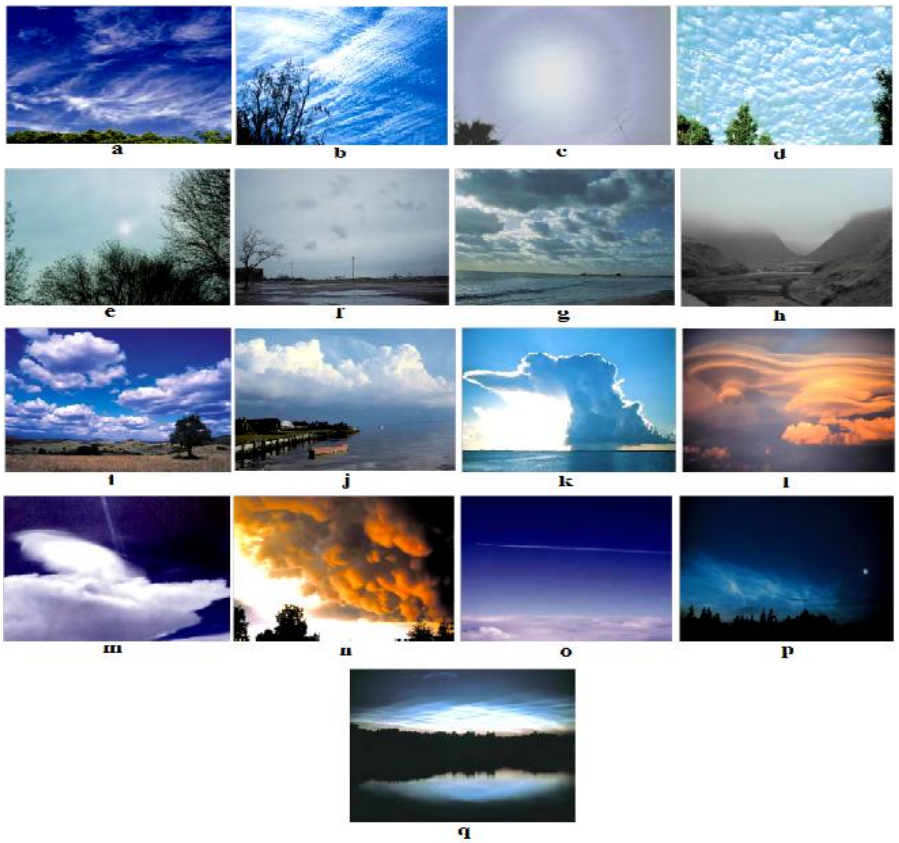

Fig. 11: Various types of common as well as rare and special clouds
a. Cirrus b. Cirrocumulus c. Cirrostratus d. Altocumulus e. Altostratus
f. Nimbostratus g. Stratocumulus h. Stratus i. Cumulus Humilis j. Cumulus Congestus
k. Cumulonimbus l. Lenticular m. Pileus (Cap) Cloud over Cumulus
n. Mammatus o. Contrail p. Nacreous q. Noctilucent
(Source: "Essentials of Meteorology-An Invitation to Atmosphere" by C. Donald Ahrens, pp. 94 – 104)

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Verse VII, 4.3 of *Ramayana* speaks of three kinds of clouds – *Brahmaja* (born from Lord *Brahma*) *Agneya* (produced from fire, related to *Agni*) and *Pakshaja* (born from mountain flanks).

The root word *'ja'* means '(to be) born'; in Sanskrit; *Paksham* stands for a 'side or a wing' (in literary sense as well, like that of a bird). According to the Hindu Scriptures, at the beginning, mountains had wings, using which, they flew at their will and landed randomly at any place, causing a lot of havoc and destruction. Then, Lord *Indra* had severed the wings of all the mountains with his weapon *Vajraayudha* and thenceforth, they remained stationary.

This nomenclature '*Pakshaja'* designated to a group of *orographic* clouds and this mythological story, when put together, seems to me, as an indication to an atmospheric phenomenon, where the wings of the mountains can be assumed to be the rising winds along the mountain's altitude and Indra, being the personification of a dense thunder-cloud and his mighty *Vajraayudham* of the thunderbolt and the fact that these *Pakshaja* clouds rain profusely, one can infer that this is the phenomenon of orographic uplift and the consequent tremendous down-pour on the wind ward side (may I call it *Vaayu Paksha*?) of the mountain. It is a commonplace observation that the other side (leeward side) of the same mountain experiences a surge in temperatures after it rains on the wind ward side as the winds which had risen to the top of the mountain will start to descend on the other side of the mountain, heating the surroundings on the other side. This is because condensation is basically a process in which heat is released and the condensed substance becomes cooled and the released heat is transferred to the surroundings, whereas in case of evaporation, heat is absorbed rendering that particular entity hot and the surroundings are cooled consequently. Here, there are floods on one side and famine on the other side of the mountains. *Indra*, during that particular episode, might have cleared these clouds by making them rain and thereby restored the balance on both sides of the mountain, which signifies the severing of the two wings, i.e. the wind ward and the leeward *pakshams*, resulting in calm and clear weather conditions (i.e. stationary mountains). This spectacular weather phenomenon might have been eulogized by the Vedic Seers in the form of this legend. The mountains flying here and there on wings may be understood as the influence of the presence of a mountain on the atmosphere of that region and now, it is quite perceivable that the influence of a mountain is spread only and only through winds and those hyper-active and dynamic winged-winds are cut-short and curtailed by rainfall accompanied by thunder (*Indra* with his *Vajraayudham*), by which clear weather conditions prevailed. This is similar to the most popular mythological tale of Lord *Indra's* confrontation with *Vritra*, a demon (*Asura*), found in the Vedas. Here, this is almost a same circumstance encountered, where *Vritra* is a huge whirl of dense clouds encompassing the mountainous regions, freezing all the surface water resources and preventing rainfall. The clouds were dense, laden to the brim with saturated moisture; one can even say super-saturated moisture content. But, it wasn't producing rain nor gave way to clear weather, thereby rendering the region devoid of any solar radiation, for months together. The chief source of the people residing at the foot-hills of the Himalayas during the Vedic period is the water from the perennial rivers like the *Ganga*, *Yamuna*, *Saraswati*, *Brahmaputra*, etc. We know that these rivers originate from melting of the Himalayan glaciers. If there would be no insolation and the temperatures drops down to sub-zero temperatures, then, the Aryan inhabitants of the region would not be able to survive without water for drinking, cooking and daily chores. They cannot perform sacrificial rites without worshipping the Sun directly during the three twilights (*Trikaala Sandhya vandanam*) and even the sacrificial fire cannot be ignited in the auspicious altar amid freezing temperatures, which is absolutely inevitable in their daily life. From this, we can rasp he inherent spirit of the statement that *Vritra* tortured the sages by destroying their *yagnyas* and other sacrificial rites. Then, Lord *Indra* sought the

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help of Lord *Vishnu* and conquered the demon, making all the people happy. In this case, Lord *Vishnu* is a symbolism for the Sun. The word *Vishnu* originated from the root word '*Viṣ'*, which means to 'enter' or to 'pervade' (everything). Setting aside the super-cosmic quality of Lord *Vishnu* for a while, the Sun is the real *Vishnu* as far as the Earth and the entire Solar system are concerned. He executes exactly all the duties of lord Vishnu here. Most importantly, Sun's energy is stored in each and every atom in some or the other form and He is All-Pervading. One of the 12 names of the Sun (*Dwaadasa Adityas*) is *Vishnu*. So, *Indra*, the mighty thunder cloud formed and it had provided the required condensation nuclei for the chain of dense *Vritra* clouds, there by facilitating them to produce precipitation. Modern meteorology says that in case of insufficient or excess condensation nuclei, it wouldn't rain. In this story, we find the former case validated. To fortify this, the story has it that *Indra* used a weapon made of foam drawn from the sea to combat the monstrous demon. Today, we know that sea-salt and other micro mineral particulates or aerosols from seas make good condensation nuclei. Hence, *Indra* using sea-foam as a weapon against *Vritra* is of utmost prominence. Those unfavourable dense clouds were dispersed by the formation of congenial thunder storm clouds, which originated from the waters of the sea due to the evaporation by the Sun (*Vishnu*) and transported to this particular region in contention, by the winds, the basis for whose circulation is again the Sun Himself. The wind travels from areas of areas of high pressure to areas of low pressure. Generally, land gets heated quickly than the sea and hence, the movement of air or clouds is from sea to land because a low pressure area develops on land due to rapid convective activity. The heated air on the surface of the land rises up, making way for the relatively cool breeze from the seas to occupy that space. Hence, these *Indra* clouds travelled from sea to this region, aided by *Vishnu* (Sun), provided the requisite condensation nuclei (sea-foam weapon) and required temperature to melt the thickly frozen moisture accumulated in those *Vritra* clouds by means of their thunder bolt streaks of mighty lightning (*Vajraayudham*, the principal weapon of Lord *Indra*) and effected proliferate rainfall.

These relatively warmer drops of rainwater immediately melted the frozen glaciers and waters started emanating from them replenishing and recharging the rivers, lakes, ponds and other water bodies, to the extreme ecstasy of the people. This melting process was further substantiated and accelerated by the Sun's rays; since the weather was cleared thereafter (i.e. *Vritra* was annihilated).

This episode may also refer to the primordial times when everything on the land in the Indian sub-continent was dead-frozen and embodies the transition from a snow-age to a rain-age. Hence, discarding the discussion whether the events of the actual story really took place or not, one cannot stay away from saluting the exceedingly exceptional intellect of the Vedic Sages in encrypting and embedding such key and invaluable ancient atmospheric phenomenon into such legendary mythological tales. Now-a-days, this mechanism of clearing the cloud/fog/mist by introducing some condensation nuclei artificially, is being followed at busy International Airports (on run-ways), military air-bases, important national and international highways, strategically crucial railway lines, key harbours, at vital multinational oceanic routes through Suez canal, Panama Canal, Gibraltar, etc.

The *Pakshaja* clouds may be the clouds produced due to convective activity on hot afternoons at the hill-sides. But, the clouds formed due to the phenomenon of 'Orographic Uplift'

and even the '*Lenticular* Clouds' are the best candidates complying with this description. Various types of common as well as rare and special clouds are shown in Fig. 11 while Table 7 gives various Cloud Types and their altitudes from the Earth's Surface.

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Climatic vagary in the absence of rainfall is referred to in the verses I, 9.8 and I, 9.9 of the *Ramayana*, where it speaks of atmosphere free from dust, fog, frost and mist, after the occurrence of a rainfall, implying the above sense indirectly. This shows that by the time of *Ramayana* itself, the cleansing/scavenging action of rainwater on atmospheric particulate matter was understood.

Table 7. Cloud Types and their altitudes from the Earth's Surface

Cloud Type	Altitude from the Earth's Surface (Feet)
1. High Clouds (*Cirrus*, *Cirrostratus*, *Cirrocumulus*)	20,000 to 60,000 (6000 to 18000 m)
2. Middle (*Altostratus*, *Altocumulus*)	6500 to 26000 (2000 to 8000 m)
3. Low (*Stratus*, *Stratocumulus*, *Nimbostratus, Cumulus, Cumulonimbus*; Unlike all other clouds, *Cumulus* clouds exhibit pronounced vertical development)	Surface to 6500 feet (0 to 2000 m)

Mist and its disappearance through the diurnal rise of temperature is alluded to, in the verse I, 55.25 of the *Ramayana*, which presents a thorough know-how of temperature and saturation dynamics.

Like Ramayana the second epic *Mahabharata* also contains valuable material related to atmospheric science. In the twelfth *Parva* of the epic, the atmosphere is divided into seven regions or *Skandas* or spheres (XII, 328.31), and they are discussed in considerable detail.

"That wind which is the first in the above sequence is known by the name *Pravaha*, which is prevalent along the first course (first *Skanda*/Sphere), where masses of clouds are born of smoke (Water Vapour) and heat. Thus during this time the constituents of a cloud were also predicted accurately.

"This wind (*Pravaha*) blows across the sky and comes into contact with water in the clouds (*Maha Bharata*, XII, 328.36).

This coincides with the modern-day description of winds being horizontal to the extent of '*Tropopause'* (The terminal point of the lowest region of atmosphere, i.e. Troposphere) in the atmosphere.

The second wind called *Aavaha* blows with a loud noise (MB, XII, 329.37).

The third wind is called '*Vuddaha'*. As the very name (*Vut* + *Daha*) suggests, it has been described as that sort of wind which drinks up water from the four oceans and having sucked it up gives it to the clouds, presents them to the Gods of Rain (MB, XII, 328.38-39-40).

Next, the winds that support the clouds, divide them into various parts, melt them for pouring down precipitation and then, once again solidify them, which are perceived as the sounds of roaring, are known by the name *Samvaha*. (NIH, 1990)

The winds in the fifth layer are called *Vivaha*, in the sixth, *Parivaha*, and in the seventh, they are known as *Paraavaha*. (MB, XII, 328.41-42-43-45-47-48-52).

It is quite possible that the seventh category of winds are those that are observed at the higher limits of thermosphere, often known as 'Exo Sphere', where the winds constantly blow out into the outer space because at that altitude, their root-mean square velocity (RMS) velocity overcomes the Earth's gravity. Our genius seers have named it '*Paraavaha'*, where the word '*para'* in Sanskrit means 'other or outer (Exo)', indicating the highest terminal region of the atmosphere, which is nothing but the 'Exosphere'. Hence, the spirit of the two nomenclatures 'Exo Sphere' and *Paraavaha* coincide completely.

The Significance of the Word '*Vaha'* and its Derivative '*Vahni'*

The word '*Vaha'* in Sanskrit means 'to hold' or 'to carry'. Hence, the name 'Veh-i-cle' has been derived from this root word *vaha*. A vehicle is called '*Vaahanam'* in Sanskrit. The striking

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similarity between the syllables *vah* and *veh* (in vehicle) reveal this latent relationship. The suffix '*Vaha'* has been added to the names of winds to denote the fact that winds carry scents, transport smoke as well as particulates and transmit sound. In the *Puranas*, the capital city of Lord *Vaayu's lokam* (Wind-God's world) is called '*Gandhavati'*, where '*Gandham'* means fragrance or scent and '*vati'* is the feminine form for 'a holder/carrier/transmitter'. The ancient texts describe the Earth as "*Gandhavati Prudhivi*", i.e. 'The abode/store-house of all the fragrances or scents' and that Scent (*Gandham*) can be spread, perceived, recognized and distinguished only by means of air/winds. That wind is steadfast to the Earth by the force of Gravitation, which is caused by fire, which in turn originates from wind. Therefore, the energies induced and imparted by the wind are again holding the same winds (atmosphere) in the form of gravity.

Normally, the word '*Vahni* (written as *Va-hni* and pronounced as *Van-hi*, as per the rules of the language) also is a derivative of '*Vaha'*. This is used as a synonym to Fire. The fire is known by this name because after the sacrificial rites/*Yagnyas*, the Fire-God delivers its auspicious fruits to all the Gods in the Universe and carries back and imparts their benefaction to the performers of the sacrifice.

When we think deeply in scientific lines, the force that is holds all the celestial bodies in place is the 'Gravitational Force'. The center of the Galaxy attracts all the entities of that galaxy, black holes attract and absorb almost everything, including photons of the light. The stars like the Sun attract planets and make them revolve around them (Star). Each and every planet possesses its own distinct grade of gravitation by which they hold their inhabitant creatures and everything present on them. So, even gravitation can be called '*Vahni'*. All the stars, including the Sun and all the planets, including the Earth, have molten cores at their centers, at extremely high temperatures. Certain metals like Iron, Aluminum, Nickel, etc. present in molten state, contribute significantly to the gravitational effect, which particular heavenly/celestial body exerts. From this, it can be concluded that even gravitational which holds everything (the quality of *vahanam*) is induced and caused by the fire. Hence, our scholarly ancestors gave it an extensive thought before calling the fire (*Agni*) by the name *Vahni*. When it comes to life-energy, even wind circulating in the body (*Praana*) is also called '*Vahni'*, as this holds/sustains the body (life).

If we proceed further, the fire (light and heat) in the heavenly celestial bodies is due to the nuclear fusion reactions, involving winds (gases) like Hydrogen, Helium and others. The ancient texts describe the Earth as "*Gandhavati Prudhivi*", i.e. 'The abode/store-house of all the fragrances or scents' and that Scent (*Gandham*) can be spread, perceived, recognized and distinguished only by means of air/winds. That wind is steadfast to the Earth by the force of Gravitation, which is caused by fire, which in turn originates from wind. Therefore, the energies induced and imparted by the wind are again holding the same winds (atmosphere) in the form of gravity. Hence, the affirmative statement of the '*Pavamaana Sooktam'* of the *Atharvana Veda* that 'Wind Holds Everything' is verified to be justified and accurate, time and again.

The epic gives another classification of clouds also. These are four types of clouds in the atmosphere: *Samvarthaka*, *Valaahaka*, (MB, VIII, 34.28), *Kundadhaara* (MB, XII, 271.6) and *Utanka* (MB, XIV, 55.35-36-37).

Samvartaka clouds cause uniform rainfall in all regions. The *Utanka* cloud rains in desert areas.The *Valaahaka* clouds are formed in the *Vivaha* layer of atmosphere. As the name '*Kunda Dhaara'* (as poured down from a pot) suggests, it yields copious rainfall. This corresponds to *Cumulonimbus* or in general, to *cumuliform* clouds.

Around 600 B.C, *Kanaada* in his *Vaiseshika Sutra* referred to the process of condensation and dissolution of water (*Vaiseshika Sutra*, V, 2.8), by remarking that "Condensation and dissolution of water is due to the conjunction with fire or heat".

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He again says that the rolling of thunder results from conjunction with water and disjunction from a cloud. Here it is fully evident that the great sage knew that thunder is caused due to impact of positively and negatively charged clouds. (*Vaiseshika Sutra* V, 2.11)

Discussing the falling of rain drops and flowing of streams he presents causes as the falling of water results from gravity is the absence of conjunction (*Vaiseshika Sutra* V, 2.3) i.e., falling of water in the form of rain, has gravity for its non-inherent cause.

In the *sloka*m V, 2.4 the flow/progression of any stream, composed by mutual conjunction of the fallen rain drops, is by fluidity as its non-inherent cause and by gravity as its efficient cause. (*Vaiseshika Sutra* V, 2.4)

Panini (700 B.C), the celebrated author of the *Ashtaadhyaayi*, refers to the rainy season as *Praavrusha* (IV, 3.26 and VI, 3.14) and *Varsha* (IV, 3.18). The former was the initial part of the season. The other parts were known as *Purva* (former) *Varsha*, and *Uttara* (latter) *Varsha* (VII, 3.11).

He also refers to *Varsha pramaana* (Standards for measurement of rainfall quantity). Measurement of rainfall was in terms of *Goshpadam* (rain equivalent to depression created by hoof of cow) and *Seetapam* (rain equivalent to fill the furrow created by indigenous plough (*Seetapam* means 'plough' in Sanskrit. In *Ramayana*, *Seeta* was named so because she was found by King *Janaka*, while ploughing the field at the end of the sacrifice (*yagnya*))).

It is obvious that *Goshpadam* was the measure of the rainfall, which is on the lower side. (*Ashtaadhyaayi*, III, 4.32)

Hence, we come to notice that the phenomena of evaporation, cloud formation, classification of clouds and their relationship with winds or regions of the atmosphere are quite satisfactorily discussed in several *Puranams* (*Vaayu*, Chapter 51; *Linga*, Vol. I, Chapter 36; *Matsya*, Vol. I, Chapter 54, etc.)

Describing the general genesis of clouds, the *Vaayu Purana* (51.22 to 51.25) says that there is moisture present in all the movable and immovable objects of the world and due to insolation by the Sun, evaporation of that humidity takes place and this process produces clouds.

Vaayu and *Brahmaanda Puranas* are similar in mentioning that the clouds which produce rainfall are called *Megha* and which do not bring any rainfall are known as *Abhra*.

There are three types of clouds, as discussed earlier. They are:

i. *Aagneya*
ii. *Brahmaja*
iii. *Pakshaja*

Aagneya clouds are connected with cyclonic (Thermal and Insolational), Convectional (occurring in northern parts of the northern hemisphere, Siberia and equatorial regions) and Orographic (occurring and proceeding from mountain flanks) types of rainfall respectively.

Further, these *Puranas* left no stone unturned, when they explained comprehensively that the *Aagneya* clouds occur in the winter season and it is devoid of lightning and thunder and is of immense expanse and are even found at the foot-hills of mountain ranges. It brings rainfall within a radius of a mile or two. This description approximates most to the *Nimbo Stratus* of modern days.

The *Brahmaja* clouds are produced due to convection currents. In precipitation they cover an area of radius of nearly a *yojana* (eight to nine miles). Most probably these are *Cumulonimbus*. The *Pakshaja* clouds originate from or in the wings of mountains. They assume various forms and produce rumbling sound. They are full of profuse water and bring excessive rainfall which is extremely destructive. This description confirms to a large extent to the modern class of *Altostratus*. (Sometimes cumulus clouds are also formed from the flanks of hills).

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Parjanya and *Diggaja* clouds rain in the season of *Hemantham* (winter) and are very useful for agriculture (*Matsya*, I, 54.19).

To the North and South of the snow-clad mountains occurs the *Pundra* cloud which greatly increases the stock of rain. All the rain formed there converts itself into the snow. The wind on the *Himavat* (*Himalayas*) draws by its own force, those snowflakes and showers them on the great mountains. Beyond the *Himavat*, there occurs little rain (*Matsya*, I, 54.22 to 54.25).

Thus there is a reference to a very important geographical fact; that of scanty rainfall or predominant arid conditions of the Tibetan Plateau that lies beyond the Himalayas, as specified in the *Puranic* verse above. One more important thing to focus our attention is the '*Pundra'*. It rhymes strikingly with the contemporary geo-climatological nomenclature of *Tundra*. The *Tundra* region corresponds exactly to the regions over which this *Pundra* cloud operates.

The study and knowledge of this fact is really exceptionally creditable on the part of ancient Indians.

Process of condensation and precipitation on hygroscopic nuclei are very carefully described in nut-shell.

"When the waters in the form of vapours in the clouds, come into contact with the wind (that is the air laden with moisture), then, those waters fall in the form of rain" (*Matsya*, I, 54.33).

Modern meteorology tells us that Polar winds actually never bring any rainfall in the year in the region under their influence – flanking poles or *Tundra* and only scanty summer rain occurs in those areas due to the sweeping of strong Westerlies. The same fact is stated in the *Puranic* verse.

"The air from the Poles drives away the rain" (*Matsya* Vol. I, 54.36).

The celebrated poet *Kalidaasa* also knew a lot about clouds and the allied phenomena. He defined a cloud thus: "It is an assemblage of smoke, electricity, water and air" (*Meghadootam*, *Poorvamegha*, 5).

The *Mricchakatika*, purportedly written by *Shudraka* (600 AD) refers to a kind of cloud *Drona* (X, 26) from which the rain streams forth as from a bucket. In another context, the famous drama refers to a special type of rain *Drona vrushti* that resembles a down-pour from a trough or a pot-like vessel (*Dronam*) (X, 39).

The *RigVeda* preaches that the atmospheric air get heated due to Sun, then this heat reaches to the earth and converts the humidity into vapour and collects it as clouds, which is the cause of the rain and food production (RV, VIII, 72.4).

Further, *RigVeda* proclaims and eulogizes thus: "*Savitra* (the Sun), encompassing them by magnitude, pervades the three divisions of the firmament, the three worlds, the three brilliant spheres, the three heavens, the three fold earth…." (RV, IV, 53.5).

The three divisions mentioned in the above verse may be considered to represent Troposphere, Stratosphere and Mesosphere or Ionosphere as per the modern Meteorology.

Ramayana declares that intensive insolation and high temperatures act as agents for the destruction or dispersion of the prevailing clouds (*Ramayana*, VI, 43-29).

Ramayana also speaks about the formation of clouds due to the solar heating of the ocean (VII, 32.68).

Apart from the wind, the Sun was realized to be the main cause of evapotranspiration. The *Vana Parva* of the *Maha Bharata* tells us that the Sun evaporates and draws moisture from all plants and water bodies, thereby causing rainfall (MB, III, 3.49 and 3.59).

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Various *Puranas* inform us that there are seven regions or layers in the atmosphere or there are seven types of winds (*Vayu*, 49.163). *Naarada Purana* also speaks of seven air channels (*Naarada Purana*, 60.13).

The phenomena of evaporation cloud formation and their relationship with winds or regions of atmosphere (*Vaata Skanda*) are quite satisfactorily described in several *Puranas* (*Brahmanda*, Vol. II, Chapter.9; *Vayu*, Chapter 51; *Linga* I, 41; *Matsya* I, 54).

Here, an exclusive full-fledged chapter has been devoted to Atmospheric Science in these *Puranas*, which evinces the irreversible detail that due importance was assigned to this discipline of Meteorology.

Many verses in the ancient texts describe that the transfer of water takes place between *Bhu Loka* (Earth;also called *Pruthivi*) and *Dyu Loka* (also called '*Bhuvarloka* or *Jyotirloka*). Water travels from *Bhu Loka* to *Dyu Loka* and again back to *Bhu Loka* in the form of rain. In Sanskrit, the word *Dyu* has a verbal root *Div*, which means 'to shine'. This *dyu loka* is the 'atmosphere'. The Sun's rays travel through the atmosphere and illuminate it. Even modern Meteorology says that the upper reaches of the atmosphere are quite radiantly bright owing to the refraction and scattering of the Sun's rays by the atmospheric gases and free ions. As we move out of atmosphere, it is relatively dark, despite the majestic and beaming presence of the Sun.

There are some verses which state that the Sun travels with the aid of winds. This is a much concealed scientific principle that heat transfer takes place from one place to another through the circulation of air. The intensity of heat perceived by a person is directly proportional to the number of air molecules per unit area in that region of the atmosphere. This is because the more the density of air molecules the lesser is the distance travelled by one air molecule before it collides with other air molecule(s), making these two quantities inversely proportional. Hence, an atmospheric layer with densely packed air pockets ensures and facilitates swift transfer of heat.

Even though the temperature in the thermosphere is exceedingly high, a person shielded from the sun would not necessarily feel hot. The reason for this fact is that there are too few molecules in this region of the atmosphere to bump against something (exposed skin, for example) and transfer enough heat to it to make it feel warm. The low density of the thermosphere also means that an air molecule will move an average distance of over one kilometer before colliding with another molecule. A similar air molecule at the Earth's surface will move an average distance of less than one - millionth of a centimeter before it collides with another molecule. (Donald Ahrens, 1998)

Thus, the phenomenal affirmative proclamation that the 'Sun moves and operates with the help of winds'; is quite an amazing one at that (*Saama Veda*, Previous, II, 148 and *RigVeda* I, 6.4). Further, the *Taittiriya Samhita* (TS, II, 4.9.1) says that the 'Winds rule the rain'. *Yajurveda* (YV, I, 12) declares that when the air and water pollutants are broken into minute particles, they get purified and beneficial rainfall ensues. This shows their knowledge of various chemical reactions that are likely to occur in the atmosphere. The same *Yajurveda* goes a step further to make an astonishing revelation that the materials used in the *yagnyas* are divided into infinitesimally microscopic atomic form by Sun's attraction (i.e. by convective air currents) and ascend to the sky. This causes plenty of rainfall (YV, VI, 10; YV, VI, 16 AND YV, XIII, 12). This proves emphatically that they thoroughly knew the mechanisms behind radiation, convection, nucleation, cloud formation and precipitation. The process described above is nothing but the prototype of the modern day "**Cloud- Seeding**" (***Megha Mathanam***) used for inducing **artificial rainfall**. From this, we come to know that the pious sacrifices (*Yagnyas*), besides other purposes, had the principal purpose of purifying the atmospheric environment by converting potentially toxic chemicals into harmless entities by way of the eco-friendly chemical reactions initiated and catalyzed in the

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atmosphere by various ingredients that they offer in the sacrificial fire altar (*Yagnya Kundam*).

Chaanakya (also called *Kautilya* and *Vishnu Gupta*), in his *Artha Saastra* prescribes the use of a vessel whose width is one '*Aratni'*, which is equal to 24 *angulams* or roughly 18 inches. He also quantifies the amount of rainfall likely to occur in various geographical regions of the Indian Sub-Continent in his masterful treatise. Besides these there are treatises *Mayura chitrakam* of *Varaaha Mihira* (6th century A.D), *Meghamaala*, *Tantralokam* of *Abhinava Gupta*, *Rudraaya Maala Tantram* (9th – 10th century A.D.), etc. are some of the other treatises that deal with Meteorology and Climatology.

Buddhists and Jains also contributed significantly to the progress of this field during ancient times. The *Jaataka* stories, *Tripeetakas*, *Nikaayas* and the enlightening conversation in the '*Milinda Panha'*, provide valuable information on clouds, wind and weather. For instance, the *Nikaayas* divide clouds into 5 categories, namely:

1. ***Seetha Valaahaka*** (Cool clouds),
2. ***Ushna Valaahaka*** (Hot clouds),
3. ***Abhra Valaahaka*** (Thunder clouds), (it can be identified with *Cumulus Congestus*)
4. ***Vaata Valaahaka*** (Convective Clouds; '*Vaatam'* means 'Wind')
5. ***Varsha Valaahaka*** (*Nimbostratus*)

The most praiseworthy aspect of this Buddhist division of clouds is that they perceived the concept of **'Hot and Cold Weather Fronts'**. The very fact they named the clouds ***Seetha*** (Cold/Super-cooled Clouds that produce snow or hail) and ***Ushna*** (Warm Clouds, corresponding to *Cumulonimbus* class), demonstrates their knowledge of cloud-dynamics. Many a time, we observe in case of gigantically towering clouds like the Cumulonimbus that the bottom of the cloud is relatively hot due to the rising up-drafts of air, while the cloud-top becomes cooler and cooler due to the saturation of the rising hot drafts and those cooler down-drafts result in the accumulation of rain or hail, depending on the quantity and intensity of the up-drafts. This has been recognized by the ancient Buddhists, 2000 years ago.

The Jains too were not lagging on this front. Their treatises like the '*Surya Pragnyaapti'*, *Triloka saara*, *Aavasyaka Curnis*, etc. stand out as exemplary works on Meteorology and Climate studies (Tripathi, 1969). They discussed about 15-16 types of winds, tornadoes, etc. The most remarkable prospect of Jain contribution is the clear-cut understanding of the '***Albedo'*** concept (The ratio of the amount of solar radiation/heat reflected from the surface of a body to the amount of radiation absorbed by the body. This is expressed in terms of percentage). In this fashion, different surfaces have different *albedos*, based on their inherent physical and chemical properties. Ancient Jains were very keen to estimate the intensity of solar radiation incident on a surface, at different angles of the Sun and at different times of the day as well as in different seasons of the year. Hence, our ancestral Jains were the pioneers of the modern-day Solar Energy Utilization techniques.

This is highly and uniquely commendable as all this awareness was accomplished by the prodigious Indian think-tank many epochs ago.

Acoustics and Noise Pollution

As per the modern-day environmental regulations, noise pollution is also considered of the various forms of 'Air Pollution' (Vanadeep & Krishnaiah, 2011). In ancient India, sound was worshipped as '*Sabda Brahma*/ *Naada Brahma'*, a sonic and sonorous manifestation of the Almighty (*Brahman*). The Vedas proclaim that the first sound was the *Pranava naadam* (**A-U-M**), from which Vedas and everything else originated. That is why, Music is considered to be the manifestation of 'The First Sound'. Among the Vedas, *Saama Vedam* is associated with the concept of music.

AUM is said to be the first attribute or name of God. Even The Bible says thus: "At the beginning, the Word was with God; He was the Word". This is the reason why, even Christianity and Islam have their Holy words which sound similar to ***AUM***, like ***Amen*** and ***Ameen***, though they are used in a different sense.

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In the encyclopedic dance treatise of *Naatya Saastram* ('The Science of Dance') of the great sage *Bharata Muni* (The classical Dance of Tamilnadu state '*Bharata Naatyam'* is named so in honour of its expounder, Sage *Bharata*) comprising about 6000 *slokams*, construction of a theatre in agreement with Apposite and optimum acoustical techniques, has been elaborated vividly as follows:

"While constructing a dramatic theatre, the length of the hall should not be more than 64 hands (*Hastams*) and the width should be within 32 hands. This is for human beings. The theatrical structure should not exceed these measurements. The wider the hall, the lesser is the clarity of the dramatic expression. When the hall is large, the textual voice of the dramatic presentation remains inaudible or echoing as the sound waves dissipate by spreading freely. Even the facial expressions that are suggestive of different emotional feelings based on the eye movements, miss clarity due to the largeness of the hall. Hence, the size of the theatres will be ideal only when it is mediocre. Only in such case, the textual dialogue and song shall be very much audible". (*Natya Saastram*, *slokams* 20-24)

The shape of the theatre should be as curvy as a cave with bifurcation of ground levels in the hall. The hall should have such windows which only allow controlled breezes. When the air in the hall is conditioned, the sound will be resonant. Then alone, the musical section of the presentation will be gentle and clear. For this to happen, the hall should be preventive of free air. (*Naatya Saastram*, *slokams* 85 to 87) (Rani Sadasiva Murty, 2005)

Most of these principles are in prodigious congruency with the modern-day theory of Acoustics. The 'Science of Sound' (both Linguistic/Phonetic and Acoustic) had blossomed and fully flourished in India, at least from 3000 years, as is evident from the above allusion.

Not only Sounds, Linguistics and Phonetics, but also, a number of words infiltrated from Sanskrit to other languages. Adaptation of Sanskrit by the Indian languages is obvious. But, Greek, Latin, Hebrew, Arabic, English and many others have an indelible impression of Sanskrit on their vocabulary, making Sanskrit 'The Mother of Universal Languages', truly. Given in **Table 8** are some of the instances of similarity between the Ancient Sanskrit terms and the modern English words.

Table 8: Some Ancient Indian terms and their similar terms in modern English usage

Ancient Sanskrit Term	Modern English Usage
1. *Eka*	1. Uno and from that, One
2. *Dwi*	2. Duo and from that, two
3. *Tri*	3. Tri or Three
4. *Chatur*	4. Quadra and from that, four
5. *Pancha*	5. Penta
6. *Shat*	6. Hexa/Six
7. *Sapta*	7. Hepta/Seven
8. *Ashta*	8. Octa/Eight
9. *Nava*	9. Nona/Nine
10. *Daṣa (*The origin of *Zero* has already been given in the article*)*	10. Deca/Deci
11. *Naama*	11. Name
12. *Dwaara*	12. Door
13. *Dantha*	13. Dental
14. *Naava/Nouka (*Boat/Ship*)*	14. 'Navi'gation
15. *Gow/Go*	15. Cow
16. *Chaar (*In Hindi, *Chaar* means 'four'*)*	16. Chair (Usually chairs have four legs)
17. *Div (*to shine*)*	17. 'Div'ine
18. *Surya*	18. Sun
19. *Mangala*	19. Mars
20. *Shani*	20. Saturn
21. *Ambhas (*Water*)*	21. Nimbus
22. *Shatam*	22. Centum
23. *Aagraham*	23. Anger
24. *Graasam*	24. Grass
25. *Maasam*	25. Monsoon
26. *Maata*	26. Mother
27. *Pitru-*	27. Father
28. *Bhraata*	28. Brother
29. *Mano-*	29. Mental
30. *Maanava*	30. Man
31. *Sabda*	31. Sound
32. *Pra-/Pura-/Prak*	32. Pre-/Pro/-Proto
33. *Raaja*/*Raaya* (King)	33. Royal
34. *Dina/Diva*	34. Day
35. *Naktam*	35. Nocturnal
36. *Dharitri/Dhaatri/Dharthi (Hindi)*	36. Earth
37. *Mukham*	37. Mouth
38. *Maha*	38. Mega

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39. *Gnya (root word)*	39. Know
40. *Kruta*	40. Create
41. *Nava/Naveena*	41. New/Novel
42. *Brundam*	42. Group
43. *Bandha*	43. Bond
44. *Pragnya*	44. Prowess/Pragmatic
45. *Agnya*	45. Ignorant
46. *Sambaram*	46. Celebration/Ceremony
47. *Homam*	47. Holy
48. *Mrut-*	48. Mud
49. *Kala*	49. Colour
50. *Veera*	50. Valour
51. *Soora*	51. Soldier
52. *Mada*	52. Mad
53. *Halam*	53. Plough
54. *Markatam*	54. Monkey
55. *Poota/Paavana/Pavitra*	55. Pious

There are scores of other words which are like the words enlisted in Table 8. But, that renders this article too voluminous. Hence, in a compact casing of brevity, I tried to present the above concept.

In this way, a humble, simple and yet sincere attempt has been made to enumerate, showcase and project the monumental accomplishments of the Ancient Indians in the field of Science and Technology, although to a little extent, with an emphasis on Atmospheric Science (Meteorology) and Mathematics.

Conclusion

The dawn of the 20th century has witnessed a dramatic change in the way Science was perceived till then. The discovery of X-Rays, Electron, Proton, Neutron, Anti-Matter, Electromagnetic theory, *Max Plank's* Quantum theory, etc. have paved the way for new inventions and discoveries. But, the most impactful factor was the evolution of the Theory of Relativity, both Special (1905) and General (1916), by Albert Einstein. Since then, almost each and every scientific phenomenon and discovery began to be looked upon from the perspective of Theory of Relativity. But, the recent hundred years have experienced the most dramatic of circumstances. In 1924, Einstein translated the research paper of the Indian Scientist *Satyendranath Bose* entitled "Plank's Law and Light Quantum Hypothesis" into German and published it in a journal '*Zeitschrift fuer Physik'*. The statistics thus developed were named 'Bose-Einstein Statistics' and the sub-atomic particles that obey this statistics are known as 'Bosons'. Later, *Satyendranath Bose*, along with *Meghanatha Saha* translated Einstein's research papers on Theory of Relativity from German to English, the first Physicists to do so. This is another feather in the cap for Indian Science.

Today, we are at a crucial juncture where Einstein's Theory of Relativity, the concept of Space-Time continuum, Michelson-Morley experiment, Big Bang Theory, Electrodynamics of moving bodies proposed by Einstein, etc. are shown to be a fallacy and the concept of the 'Absolute' is being postulated against the concept of Relativity. More significantly, the old concept of 'Ethereal Space' has started to come into forefront once again, replacing the idea of a 'Void Space'. (Mohammad Shafiq Khan, 2010, 2010a, 2010b, 2010c, 2011, 2012a and 2012b). But, the Ancient Indians possessed this immaculate sense of the 'Absolute', which, according to them, sustained the entire Universe that is radiant with 'Relativity' everywhere.

Fig. 12: The posture of Nataraaja
(The King – Cosmic Dancer) of Lord Shiva

Acknowledging the exceptional intelligence of the ancient Indians in every walk of Science and knowledge as a whole, some of the Western

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Scholars have paid their tributes and offered their admiring reverences to Indian intellect as follows:

"Indian Cosmologists, the first to estimate the age of the Earth at more than 4 billion years. They came closest to the modern ideas of atomism, quantum physics and other current theories. India developed very early, enduring atomist theories of matter. Possibly, Greek atomistic thought was influenced by India, via the Persian Civilization" – ***Dick Teresi*, American writer and the co-author of the book "The God Particle: If the Universe is the answer, what is the question?"**

"The invisible excludes nothing, the invisible that excludes nothing is the infinite – the soul of India is the infinite; India includes so much because her soul being infinite excludes nothing. It goes without saying that the universe that India saw emerging from the infinite was stupendous." **- *Huston Smith*, China-born American Religious Studies Scholar**

"The Indians, whose theory of time, is not linear like ours – that is, not proceeding consecutively from past to present to future – have always been able to accept, seemingly without anxiety, the notion of an alternately expanding and contracting universe, an idea recently advanced by certain Western scientists. In Hindu cosmology, the immutable *Brahman*, at fixed intervals, draws back into His beginning-less and endless being, the whole substance of the living world. There, then takes place the long "sleep" of *Brahman* from which, in course of countless eons, there is an awakening, and another universe or "dream" emerges." – ***Professor Fred Hoyle*, Leading British Astronomer**

Professor *Hoyle* said this with respect to the Cosmic-Sleep (*Yoga Nidra*) and Awakening of Lord *Narayana* (Lord *Vishnu*) and the emergence of Lord *Brahma* (The Creation).

"*But most of all, I believe the Earth actually (and obviously) resonates, quite literally, with the Hindu belief in the divine sound of OM (or more accurately, AUM), that single, universal syllable that contains and encompasses all: birth and death, creation and destruction, being and nothingness, rock and roll, Christian and Pagan, meat and vegetable, spit and swallow. You Know?*

But here's the best part: This massive wave of sound? The Earth's deep, mysterious OM, is it perpetual hum of song? Total normal- that is, if by "normal" you mean 'unfathomably powerful and speaking to a vast mystical timelessness we can't possibly comprehend.'- **Mark Marford, San Francisco Chronicle Gate Columnist** (http://www.rense.com/general82/humm.htm)

Sage *Viswamitra* is said to have perceived this All-Pervading Cosmic Sound **AUM** atop Himalaya Mountains, emanating from the rotation and movement of Earth, Sun, Stars, Galaxies and from everywhere in the Universe, filling it in and out.

"Their ancient philosophies have also influenced physicists, among them Erwin Schrödinger, Werner Heisenberg and J. Robert Oppenheimer, who read from the Bhagavad Gita at a memorial service for President Franklin D. Roosevelt." – ***Philip Goldberg*, United States Diplomat**

"The most elegant and sublime of these is a representation of the creation of the universe at the beginning of each cosmic cycle, a motif known as the cosmic dance of Lord *Shiva*. The God is called in this manifestation *Nataraaja*, the Dance King (Fig. 12)**.** In the upper right hand is a drum whose sound is the sound of creation. In the upper left hand is a tongue of flame, a reminder that the universe, now newly created, with billions of years from now will be utterly destroyed. ... is the only religion in which the time scales correspond... to those of modern scientific cosmology. Its cycles run from our ordinary day and night to a day and night of the *Brahma*, 8.64 billion years long, longer than the age of the Earth or the Sun and about half the time since the Big Bang". – ***Carl Sagan*,**

American-astronomer, astrophysicist, cosmologist, author, science popularizer and science communicator in astronomy and natural sciences.

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"India was the motherland of our race and Sanskrit, the mother of Europe's languages. India was the mother of our Philosophy, of much of our Mathematics, of the ideals embodied in Christianity…..of self-government and democracy. In many ways, Mother India is the mother of all". – ***Will Durant*, American Historian**

"Many of the advances in the sciences that we consider today to have been made in Europe were in fact made in India centuries ago". – ***Grant Duff*, British Indological Historian**

"In India, I found a race of mortals living upon the Earth, but not adhering to it; Inhabiting cities, but not being fixed to them, possessing everything but possessed by nothing". – ***Apollonius Tyanaeus*, Greek Thinker, Mathematician, Scholar, 1st Century A.D.**

Indians were technically skillful and crafty as well. Their engineering was highly enriched and was par excellence. The following verse from the *Yajurveda* provides a testimony to this claim: "O royal skilled engineer, construct sea-boats, propelled on water by our experts, and airplanes, moving and flying upward, after the clouds that reside in the mid-region, that fly as the boats that move on the sea, that fly high over and below the watery clouds. Be thou, thereby, prosperous in this world created by the Omnipresent God, and flier in both air and lightning." (*Yajurveda*, 10.19)

The ancient Indians were equally good at devising various astronomical instruments like *Gola, Bhagana, Chakra* (Height of a terrestrial object)*, Dhanus, Ghati* (Water Clocks)*, Shanku* (Compass-cum-Watch)*, Shakata, Kartari, Peetha, Kapala, Shalaaka* (Angular distance of a celestial object)*, Yashti* (Determining positions of heavenly bodies and terrestrial surveying) and many others. This list has been furnished by the famous Mathematician and Astronomer *Lalla*, in his '*Sishya-dhi-Vriddhaida*'.

The pyramidal structure of Temples also has a lot of science involved in it. This shape of the temple is intended to attract immense cosmic energy and amplify it manifold. This concentrated flow of cosmic energy is showered on all the devotees who visit that temple, bestowing physical and mental solace and bliss on them. Of late, extensive research has been directed towards the miraculous beneficial effects of pyramidal pattern, all round the world. Now-a-days, attempts are on to bring the shrouded mysteries of the Egyptian Pyramids to limelight.

Time is another concept that was given paramount importance by the ancient Indians. Besides dealing with unimaginable time scales, they were not estranged in determining the time zones in a given geographical region, say a country. The following instance elucidates this entitlement: *Ujjain* is a city in the state of Madhya Pradesh. The city of *Ujjain* (meaning 'one who conquers with pride') was once ruled by the legendary King *Vikramaaditya*. King *Vikramaaditya* was known for his valour and impeccable justice. His court was adorned by nine famous courtiers called *Navaratna* (nine gems), who were great scholars in different fields of knowledge. (*Kalidaasa* became one of the most brilliant of the `nine gems' at the court of *Vikramaaditya* of *Ujjain*) Despite extensive effort, *Vikramaaditya* cannot be identified with any known historical king. *Ujjain* is famous for the temple of *Mahakaala.* There is no temple in India, where *Mahakaala* is worshipped.

Is there a meaning behind the legend of *Vikramaaditya* and the worship of *Mahakaala*? The real meaning is revealed by considering the meaning of these words. *Vikramaditya* is made by joining prefix "*Vi*" to words "*Krama*" and "*Aaditya*". "*Krama*" means order, "*Aaditya*" means Sun and prefix "*Vi*" means deviation. Therefore, etymologically *Vikramaaditya* means 'the change in the course of the Sun'. What is significant is *Ujjain* is located on the Tropic of Cancer. Thus, sun comes to *Ujjain* during its northward journey, changes its course, and starts its southward journey. *Vikramaaditya* is Sun itself changing its journey at *Ujjain*. Nine gems in the court of *Vikramaaditya* are nine planets of Solar system.

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Mahakaala is made by joining words, *Maha* (great) and *Kaala* (time). *Thus, Mahakaala means 'Time the great'. Ujjain* was known as *Ujjayini* in ancient times and was the capital of ancient empire *Avanti*. *Ujjayini* was the center of Indian civilization for several centuries and famous for its astronomical observatory. *Ujjayini* was equivalent of *Greenwich*, from where time was synchronized all over India and even abroad. New day commenced when it was 6 A.M. in *Ujjayini*. **When it is six in the morning in *Ujjain*, it is midnight in Britain. It is from this ancient system of changing date in the morning in *Ujjain* that changing date at midnight has been arrived at.**

As time was synchronized in a large part of the world according to *Ujjayini* standard time, it was only natural to designate the God of *Ujjain* as God of time himself, and therefore the name **Mahakaala, Time the great** (Source: Vedic Physics - by Dr. *Raja Ram Mohan Roy*, pp. 198-199).

However, this interpretation need not be considered a denial of the actual existence of *Vikramaaditya* and the *Nava Ratnas* of his court, in any way.

Further, the importance of the number **108** both physically and spiritually, has been explained by *Subhash Kak*, an eminent Indological researcher, as follows:

"The number 108 is very auspicious for *Hindus*. It is the number of beads of a rosary and of many other things in Indian cosmology. But why is this number considered to be holy?"

The answer to this mystery may lie in the fact that the ancient Indians took this to be the distance between the earth and the sun in sun-diameter units and the distance between the earth and the moon in moon-diameter units.

Two facts that any book on astronomy will verify:

Distance between earth and sun = 108 times the Sun-diameter
Distance between earth and moon = 108 times the Moon-diameter

Fig. 13: The Ten Incarnations of Lord Vishnu (Dashaavataaraas), indicating human evolution.

Indian thought takes the outer cosmology to be mirrored in the inner cosmology of the human. Therefore, the number 108 is also taken to represent the 'distance' from the body of the devotee to the God within. The chain of 108 'links' is held together by 107 joints, which is the number of *Marmaas*, or weak spots, of the body in *Ayurveda*.

We can understand that the 108 beads of the rosary must map the steps between the body and the inner Sun. The devotee, while saying beads, is making a symbolic journey from the physical body to the heavens.

108 is a number which resonates throughout the universe, as this shows. There are also several other numbers which are repeated throughout creation. The reason why we do our *Mantra Japa* 108 times is because it is a symbol of our journey towards our higher/spiritual self (Sun) from our material self (Earth).

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(Source: Shri 108 & Other Mysteries –by *Subhash Kak* Sulekha.com and http://www.cycleoftime.com/articles_view.php?codArtigo=58).

The peculiarity and uniqueness of Indian Scriptures as well as Texts and Treatises is that they present profound scientific truths in the form of nice stories, lively examples and aesthetic as well as metaphoric poetic expressions. It is science for an intellectual and a very well-narrated and a thoroughly fascinating as well as an entertaining fable or fairy tale for a lay man, set against the back-drop of a congenial genre. One such example is provided below:

Why do birds prefer to stay on treetops during the night? Why aren't they seen on the ground after nightfall? According to ancient Hindu Scriptures, birds possess special and sensitive powers of perception. At night, they `see' the surface of the Earth in flames. These flames reflect the intense energy trapped by the planet as a result of absorbing heat from the Sun's rays all day long. The *Vedas* are replete with such tidbits, encapsulating a heady mix of science, logic, deduction and belief, claim Vedic Scholars.

These 'flames' signify the out-going long-wave/terrestrial radiation, the wavelength of which lies in the infrared region of the spectrum. The radiation in the infrared region possesses 'heating' nature. Hence, the word 'flames' is of utmost prominence in this context.

(Source: Back to the Vedas: Gateway to Peace - by *Narayani Ganesh;* http://www.timesofindia.com/today/15edit5.htm).

Indians believed that this entire universe and the evolution of all the beings is an 'incident', which had a systematic plan and organisation behind it, while the science thought that this was an 'accident' and everything would end abruptly in chaos, with ever-increasing 'Entropy'. Even the Ten Incarnations of Lord *Vishnu* (*Dashaavataaraas*) (Fig. 13) described in *Hindu* Mythology are nothing but a 'theory of evolution'. The first incarnation is '*Matsya'* (Fish). This shows that the Indian seers were well aware that the first form of life originated in water. The next incarnation is *Koorma* (Tortoise), which is an amphibian (that lives both in water and on land and in water), followed by '*Varaaha'* (Wild Boar), which is an animal that lives only on land. This is succeeded by *Narasimha* (Half-Man and Half-Lion). This proves that Indians had knowledge about Genetic Engineering as well. After this, came the *Vaamana*, a short-yet complete human being, the first prototype of a human being. All the other incarnations that followed are complete human beings in form. The mention of a unique race called '*Vaanara'*, the 'Ape-Men' (Lord *Hanuman* is one among them as well (Fig. 14) in *Ramayana* holds some similarity to *Darwin's* theory of man's evolution from apes. But, Darwin's theory has many drawbacks and has not been granted the status of a 'Conclusive Proposition'. Indian texts too don't agree well with Darwin's theory. The co-existence of humans and *Vaanaras* in *Ramayana* points to this fact. This leads us to a notion that these 'Ape men' are some unique race and not the ancestral fore fathers of the modern say man. The presence of some tribal races resembling ape men exactly in some isolated islands of the Andaman and Nicobar, Pacific Rim, Amazon region and in Africa till today, fortifies this claim.

In Sanskrit, the term '*Vaanara'* is to be taken in the sense of '*Nara vaa*?, meaning 'Is it a man?' as '*Nara'* means 'Human Being' and '*Vaa'* is an interrogative expression 'Is it?'. Anyone who happens to see a *Vaanara* would be in a doubt whether he is a human being. So, Indian texts had everything in them concretely, long before the remaining world even started imagining such things in abstract.

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Fig. 14: Lord Hanuman who belongs to the race of Vaanaraas, the semi-human race.

Despite all the novel and path-breaking discoveries and inventions by numerous Indian Scholars, none of them was ill-treated, ostracized or had been awarded any sort of corporal punishments. They were rather honoured richly and they were gifted with lands, property and other riches. Arrangement was made to divert the revenue and other taxes from the villages, lands, temples, lakes, ponds, etc. to those distinguished Scholars. Prestigious titles were conferred on them by the emperor himself. Overnight, a poor scholar would turn into a millionaire. But, in the West, the situation was the most abhorrent and pitiable. Scholars like *Archimedes* have been beheaded. Those like *Socrates* have been killed by administering a poison called '*Hemlock'*. Galileo, Copernicus and others have been imprisoned and tortured before they passed away as prisoners. One would definitely experience goose bumps when he contemplates the extent of bestial treatment that had been meted out to those pioneer proponents of exceptional scientific theories in those 'Dark Ages'. Thankfully, exactly the diametrically opposite scenario was prevalent in India, right from the beginning. In India, there were conflicts over Religion and sects of Philosophy only, but in case of Science and innovations, there was unequivocal unison and unanimity.

When it comes to architecture, Indian architecture has no parallels anywhere. This is the reason why Dr. *Sarvepalli Radha Krishnan* has even gone to the extent of stating that if India were to give away its architectural assets to any country, then, that country's people would have to pay back by offering their entire nation in return. There are many sculptural marvels in Indian architecture like single-stone carvings, the pillars and statues that give out musical notes (*Sapta Swaras*), the pillars that are attached to the ceiling, but do not touch the floor (Sometimes, the gap between the pillar and the base floor is such that only a thin piece of paper could pass through), which are even difficult to imagine for the modern day architects and sculptors.

The Indian astronomers went even further, giving a physical reason for how the dual star or binary motion might allow the rise and fall of human consciousness to occur. They said that the Sun (with the Earth and other planets) traveled along its set orbital path with its companion start, it would cyclically move close to, then away from, a point in space referred to as *Vishnu Naabhi*, a supposed magnetic center or "grand center". They implied that being close to this region caused subtle changes in human consciousness that brought about the Golden Age, and conversely, our separation from it resulted in an age of great darkness, the *Kali Yuga* or Dark Age. When the Sun in its revolution around its dual comes to the place nearest to this grand center, ... (an event which takes place when the autumnal equinox comes to the first point of Aries), dharma, the mental virtue, becomes so much developed that man can easily comprehend all, even the mysteries of the Spirit."

(Source: Lost Star of Myth and Time - By Walter Cruttenden)

The concept of infinity was a cordial one to the ancient Indian Scholar fraternity. **The actual**

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modern symbol of infinity ∞, which is called '*Leminiscate'*, was introduced by the English Mathematician *John Wallis* in the year 1655. *Hindu* iconography had already conceived this symbol of Infinity in the form of *Anantha*, which is another name for the Great Serpent *Aadi Sesha*. This *Anantha* is always coiled up in the form of horizontal '8' shape, which is nothing but the modern *Leminiscate* shape. This infinity is The Bed on which Lord *Narayana* (Fig. 15) reclines, it becomes His Sandals while He walks and it is His Throne while He sits. Hence, Lord *Vishnu* (Fig. 15) is The Supreme Being and the first as well as immediate complete Manifestation of the Unmanifested Self, who prevails everywhere, in and out of Infinity, sustaining it and which is not different from Him in any way. The '*Narayana Sooktam'* describes thus: "***Antar bahischa tatsarvam vyaapya Narayana Sthitaha***". This means 'In and out everywhere, *Narayana* is situated; as He is All-Pervading'. The Indian religion and philosophy believed in the concept of 'One Supreme Godhead' basically. The following tenets shine as nonnegotiable testimonials to the above assertion.

"Aakashaat Patitam Toyam Yathaa Gacchati Sagaram – Sarva Deva Namaskaaraha Kesavam Prati Gacchati", which 'means 'As all the waters falling from the sky (rain) are channelized into the ocean, all the salutations/prayers offered to any/all Gods reach Lord *Kesava* (i.e. The One Supreme Being) ultimately". The first text of the world *RigVeda* says:

"Ekam Sat Vipraaha Bahudhaa Vadanti" **(*RigVeda*, Book No.1, Hymn 164, Verse 46)**

This means 'The learned scholars (sages) call the 'One Truth' (The Almighty) by different names'. This shows that it was India that first conceived, taught and propagated the idea of 'Monotheism' to the world. Indian philosophy whatever exists and in whatever form, is nothing but the manifestation of the Supreme Soul Himself.

The *Garbha Upanishad* elucidates masterfully the various stages of formation, development and evolution of the foetus during the period of gestation/pregnancy.

The posture of *Nataraaja* (The King – Cosmic Dancer) of Lord *Shiva* (Fig. 12) is believed and proved to represent some intricate nuclear reactions. This is the very reason why, of late, this idol of *Nataraaja* stands majestically at the plaza of the '**European Organisation for Nuclear research', situated in Geneva.**

Recently, the Western Scientists have begun to come to terms with the Indian concept of 'Many Universes' existing simultaneously. Indian theory declares that whatever be the innumerable number of universes, all of them are sustained by one Single Supreme Power, because there is a pre-determined and a dictated rule and order in each and every atom of all these universes. Hence, the modern Astro Physics started taking this age-old Indian theory gradually. Therefore, it is clear that the noble and benevolent principle of 'Unity in Diversity', for which India stands as an irrefutable testimony, is the very basic and preliminary order

Fig. 15: Lord Narayana seated on Anantha, the 'Infinite Serpent'. Notice that the coils of the 'Great Serpent' resemble the 'Leminiscate' (The symbol of Infinity ∞)

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of the Universe (or Universes) itself. Most of the age-old Indian religious beliefs, customs, traditions and the so-called 'Superstitions' are actually disguised scientific principles**.** Highest scientific principles have been wrapped up in elegant and fabulous fables. On the consummate, India remains the cornucopia of wisdom that remains unsurpassed till date.

Utmost weightage was attributed to Atmospheric Science and study of rainfall because our learned forefathers knew that 'It is water that does matter for human survival'. They have observed, toiled and made strenuous postulations and calculations for thousands of years before they prepared texts, treatises and some invaluable manuscripts pertaining to meteorology and many other disciplines. But, due to many invasions and battles, a number of libraries which stood as the epitomes of wisdom were incinerated to ashes by religious fanatics. The libraries at *Nalanda*, *Takshasila*, *Vikramasila* and many others in India, the majestic Historical library at *Alexandria* in Egypt, etc. were ruthlessly torn asunder and torched. This cataclysmic concatenation of calamitous and chaotic catastrophes has been continuing unabated even today. A conspiracy seems to be in place to completely dislodge the Oriental, especially meritorious Sanskrit works preserved in libraries scattered across India, Nepal, etc. A colluded sabotagical *modus operandi* is being inducted gradually into India to make Indians completely alien to their glorious past and make them shy away from calling themselves *Hindus* (used in a geographical sense, as specified in the introduction and moreover, *Hinduism* is rather a *Dharma*; a Universal way of life, more than a religion) and also the 'descendants of those celebrated ancestors and rightful heirs of that intellectual heredity'. This is the premium paramount provident duty of the young generation to counteract this looming danger and repel the efforts of those gloomy goons and propel India to a bloomy destiny.

The Vedic Indians were true Philanthropists to the core of the sense. The munificent Vedic hymns like ***"Sarve Janaaha Sukhino bhavantu – Samastha Sanmangalaani santu"*** and ***"Sarve bhavantu sukhinaha – Sarve Santu Niraamayaaha – Sarve bhadraani paṣyantu – maa kaschit dukkha bhaagbhavet"***, present us with the true benevolent facet and the ultimate aim of Indian thought that each and every organism on the earth, whether it be humans, animals, birds, trees, herbs, the five elements and others, they desired peace and prosperity to all. Their all-encompassing benediction and benefaction is reflected in the hymns like '*Aapaha Shanthi* (Water), *Oshadhayaha Shanthi* (Herbs), *Vanaspatayaha Shanthi* (Trees), *Viswedevaaha Shanthi* (Universal Gods), etc. Their ultimate and supreme 'Cosmopolitan' attitude is demonstrated from the verse "….*Vasudhaiva kutumbakam*", where it was emphatically declared that 'All beings on this entire Earth (*Vasudha*) are one family'.

In those good-old golden days, all this knowledge of tech'know'logy and Arts, whatsoever, always emanated from passion and culminated in compassion. But, now-a-days it originates in quest and terminates in conquest. Nature always embraces a humble researcher and a meek seeker of truth, but never a defiant invader, who would cause the green and serene shades of nature to fade away. This is what the modern man is up to. Man should be a student of nature, but not a rodent that indiscriminately devours it, as the famous poet laureate William Worth preaches us thus: ***"Nature is my teacher".*** If we do not portray this particular feature on our hearts, then, there definitely is no future and it is not long before the man's very caricature vanishes from brochure of Mother Nature.

Before, there used to be War and Peace; now, it is War and Pieces. Previously it used to be turmoil and silence, now, it is turmoil and violence. Earlier, there were minstrel symphonies of violins, symbolizing non-violence; contrary to the current-day monstrous phony cacophonies of violence.

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Previously, one witnessed the pride-parades of prosperity, where 'the head was held high'. But, now, one can only see the desperate 'headless' dumb charades of bloodshed and poverty. The immortal utterances of ***Jawahar Lal Nehru*** **on the midnight of 15th of August, 1947**, should keep on reverberating constantly in the ears and hearts of each and every Indian:

"Long years ago, we made a tryst with Destiny… At the stroke of the Mid-night hour, when the World sleeps, India will awake to Life and Freedom……."

Indians, from times immemorial, stood for Satyam (Truth). All the artistic, architectural, scientific and spiritual quests of India were aimed at unraveling truth and nothing else. They believed in the Superlative Truth of **"*Satyameva Jayate…*"** housed in the *Mundaka Upanishad* of the *Vedas*, which means **'Truth Alone Triumphs'**.

This is not any statement of conservatism as truth itself is to be conserved. But, this should be prospected and sought-after in the light of ancient wisdom and the might of modern acumen, where the conservation and preservation of age-old knowledge and fusing it with the latest understanding for the prosperity of the posterity is the need of the hour. I end this article with these benign and genuine peace invocation hymns from the *Vedas*:

"***Sarve Janaaha Sukhino Bhavantu***
Samasta Sanmangalaani Santu
Lokaaha Samastaaha Sukhino Bhavantu
Sarva Jeeva Janthu Sukhino Bhavantu
AUM – Shaantihi Shaantihi Shaantihi"

(May all the people of this world be happy; May everything propitious and auspicious happen to them; May all worlds be happy; May all creatures be happy and may Peace, Peace and only Peace Prevail Eternally)

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