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Vedas are a repository of knowledge dealing with physical, mental, spiritual aspects of Life and Cosmos. Vedas are eternal and are taught by the Supreme Being to creator Bramha at the beginning of each Kalpa made up of 1000 units of well known four Yuga cycle. Vedas are like the breath of the Supreme Being who regulates all universes. Vedas are received as sacred sounds in the form of Mantras by Rishis who are Mantra Drishtaras (Seers of Mantras). Thus a mantra is a vedic utterance which carries the divine energy and hence spiritually strengthens and protects the devotee who repeats and meditate on the deity along with chanting of the mantra.

Sruti (what is heard) also refer to the vedas and it its through the process of chanting and hearing that vedas are transferred from Guru (teacher) to Shishya (disciple). Hence, the sounds of the veda mantras are identified as the body of the deity referred in the mantras. The chanting of the veda mantras have three aspects namely: purity of mind, purity of intonation and purity of pronunciation.

Sound is the property or the descriptor of space, which is the subtlest among five elements. The order of five elements with decreasing subtlety is space, air, fire, water and earth. Although, sound can describe all the five elements, the space can only be described by sound. Thus the five means of perception corresponding to the five elements are hearing, touch, vision, taste and smell. Sound and Space are inseparably related to each other. The so-called sixth sense of perception is related to one's orientation in space, indicating that the sound is the signal to which one can respond easily.

Sounds of chants can carry the listeners to spiritual experiences. This is because the chanters due to the rigor, precision and devotion can alter the inherent intrinsic pitch difference found in common speech. The audible sound for humans is but a part of the vibration spectra manifested in the Cosmos. The sounds of the vedas are sacred because not only their physical characteristics have deeper phonetic influence but also due to their impact on the listeners' mind. The meaning of the vedas describe the Cosmos and its Creator. The deeper study of vedas can only be beneficial to the seeker.

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Sabda (sound) occupies a very important place in Sanatana Dharma (Vedic Hinduism). Understanding and realization of Sabda is said to be the goal of life itself. The Amrita Bindu Upanishat proclaim that,

द्वे ब्रह्मणि वेदितव्ये शब्द ब्रह्म परं च यत्

शब्द ब्रह्मणि निष्णातः परं ब्रह्माधिगच्छति ।

Dve bramhani veditavye sabda bramha param cha yat  
Sabda bramhani nisnataha param bramhadhi gachchhati

which means, "There are two bramhans to be realized, sabda and param bramhan; one who has realized and well versed in Sabda bramhan will realize Param Bramhan." Also it is noted by Lakshmana Deshikendra in Sarada Tilaka Tantra, that the essence of all beings is itself the Sabda bramhan.

चैतन्यं सर्वं भूतानां शब्द ब्रह्मेति मे मतिः

Chitanyam sarva bhutaanam sabda bramheti me matihi

Thus, the above statements from Hindu scriptures indicate that sabda is an integral part of our life. In Vedic literature, it is given that the sabda bramhan is omni-present through the sound of 'Om'. The philosophical analysis of this Om (अ A + उ U + म् M ) is dealt in several upanishads.

The modern scientific enquiry of sound which is also termed as acoustics has shown that sound plays an essential role virtually in all aspects such as earth sciences, engineering, life sciences and arts. Sound in modern scientific view refers to the audible range, with infra and ultra sound covering the inaudible molecular vibrations of the medium. Similarly, in Hindu scriptures, sabda originating from the vibratory cause is termed as ahata sabda. This article will only deal with this type of sabda (sound). In addition, Hindu scriptures also refer to self-sustaining sound, without vibratory cause, termed as anahata sabda which is experienced only in higher (deeper) states of Yoga.

Thus it is seen that sabda (sound) encompasses the life itself. Broadly we can categorize the role of sabda in spirituality, speech, music, and literature.

### **Sabda and Spirituality:**

In Hinduism or Sanatana Dharma, spirituality includes philosophy, yoga, tantra and agama. The source of all these branches of knowledge is the Vedas. Veda is also described as Sabda. The orthodox system of Hindu thoughts is based on the vedas as authority or sabda pramana. Here sabda refers to the spoken words as mantras. In the process of creation, the first element is space and this all-surrounding space can only be described by sabda. The scriptures say, 'sabdaikagunamakasa' which means "Only sound qualifies space." However, sound propagates through other elements, namely air, fire, water, and earth. The sound as only property of space can also be observed in terms of acoustical quality of space in rooms. It is known that the sound quality of a room space is described by the reverberation characteristics. Thus, it is seen that the sound plays a major role in the universe composed of five elements.

### **Sabda and Speech:**

Sabda as speech is extremely important for humans. Speech is regarded as a gift to human beings. The goddess Saraswati is the deity of speech. The infinitely large vedic literature in the form of mantras depict the spiritual effect of sound or sabda. The intonations termed as swaras bring out the sounding effect. The speech seed sounds are generated at various chakras located in the human spinal cord, namely Mooladhara, Swadhistana, Manipoora, Anahata, and Visuddhi. The seed sounds generated at the chakras take the form of vowels and consonants in the mouth with the help of the throat, tongue, jaws, teeth, and lips. The space variations in the mouth cavity with exhaling air will enable the production of words. Hence, word is also known as sabda. Sabda as the underlying energy in speech production plays an important role in human life.

The complete process of production of speech is mysterious. It is said in RigVeda that the process has four stages. These four stages are Para, Pashyanti, Madhyama, and Vaikhari. The first three are internal and yogic and can be experienced by yogis. The fourth stage of Vaikhari is the audible speech which is used by all human beings.

चत्वारि वाक् परिमिता पदानि तानि विदुर्ब्रह्मणा ये मनीषिणः

गुहा त्रीणि निहिता नेङ्गयन्ति तुरीयं वाचो मनुष्याः वदन्ति

Chatvari vakparimita padani tani vidurbramhana ye manisinaha

Guha trini nihita nengayantri turiyam vacho manusya vadanti

### **Sabda and Music:**

Music can be described as a universal language of emotions. Sabda in addition to the well known form of seed sound and words takes another important

form called nada. The nada refers to the flowing energy of sound which also refers to the expressions of chaitanya or consciousness. Saranga deva in Sangita Ratnakara says,

चैतन्यं सर्वभूतानां विवृतं जगदात्मना

नाद ब्रह्म तदानन्दं अद्वितीयम् उपास्महे ।

Chaitanyam sarvabhutaanam vivrutam jagadaatmanaa  
Nada bramha tadaanandam advitiiyam upaasmahe

which means, 'we worship Nada-Bramhan, that incomparable bliss, which is intrinsic in all the creatures as consciousness and is manifest in the phenomenon of this universe.' Thus, the nada and sabda direct to the same entity, which is consciousness.

However, nada relates the emotional expressions through music, whereas sabda as sound and word emphasizes the philosophical inquiry. In the process of describing origination of nada, Sangita Ratnakara gives:

नकारं प्राणानामानं दकारमनलं विदुः

जातः प्रणाग्निसंयोगात् तेन नादः अभिधीयते ।

Nakraram praananaamaanam dakaaramanalam viduhu  
Jaatah praanaagnisamyogat tena naadaha abhidiiyate

which means, "It is understood that the syllable 'na' represents the vital force and 'da' represents the fire. Thus being produced by the interaction of vital force and fire is called 'nada'.

This nada which manifests as seven notes becomes the vehicle of emotional expressions through the nine rasas in the form of music and dance. The nine rasas (sentiments) are love (erotic), heroic, pathetic, marvelous, comic, odious, terrible, furious, and peaceful. The words of a song denote the sabda (pada) while the singing tune denotes the expressing of nada. Thus it is seen that sabda and nada are connected by music. It is true that music and dance are integrally related.

### Sabda and literature:

A literary work is essentially a composition of words to express the inner experiences of the writer. In the Hindu view, the writer or Kavi, after experiencing the theme, expresses it through the proper assembly of Sanskrit words. This choice of words indicate the role of sabda. The premier poet Valmiki has demonstrated the effect of poetry and sabda in Ramayana. It is well known that the sanskrit has several unique effects of sound and sabda. The poems in

Sanskrit are easy to memorize due to the explicit sandhi (union of alphabets) effect. The large number of vowels and consonants as basic sounds make the language able to deal with many expressions. The metrical details in Sanskrit also bring the sound effect. The infinitely large literature in Sanskrit has been carried through generations by oral traditions not only because of its intrinsic values for life but also the joy of sound that it provides the reader and listener.

**Concluding Remarks:**

Thus, sabda undoubtedly plays a key role in all aspects of life including both scientific and spiritual. Sabda or sound encompasses life itself. As Saranga Deva in *Sarita Ratnakara* puts it,

नादेन व्यज्यते वर्णः पदं वर्णात् पदात् वचः

वचसो व्यवहारोऽयं नादाधीनमतो जगत्

Nadena vyajyate varnaha padam varnaat padaad vachaha

Vachaso vyavaharoyam nadadhinamato jagat

Which means, 'Nada manifests as letters, letters constitute the word, and words make a sentence; so the entire business of life is carried out through language; and therefore, the whole phenomenon (the world) is based on nada.

In the words of my SriRanga sadguru, (a Seer-Yogi, the founder of Ashtanga Yoga Vijnana Mandiram, Mysore, India), that two essential aspects of spiritual development is in realization of the identity between 'Spoken Word-Object' (Pada-Padartha) and the integral cause-effect relationship of 'Seed Sound-Word' (Bija-Vriksha).

A sequential ordering of five elements on their decreasing subtlety, namely space, air, fire, water and earth is stated by Nārāyaṇopaniṣat in Atharva Veda. This statement is examined from an acoustical point of view. The space as an element (bhūta) is qualified by sound as its descriptor (tanmātra). The relation between space and sound and their subtle nature in reference to senses of perception will be presented. The placement of space as the first element and sound as its only property will be discussed in a scientific perspective.

#### INTRODUCTION

The five elements and their properties are referred in various places in the Vedic literature. An element is the

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substance (dravya) which has an associated property (or qualities) termed as guṇa. The substance property (or dravya guṇa) relationship is very important in dealing with human perception and its nature through the five senses. Several upanishats and the darśana śāstras have dealt with the topic of substance-property relationship(see list of references at the end). The sequential ordering of the five elements is a fundamental issue when dealing with role of five elements and their properties in the cosmological evolution of the universe. At the same time the order of the properties of elements is also a fundamental issue when dealing with the perception of the universe through five senses. This paper focuses on the element-property( or dravya-guṇa) relation in reference to space as the element and sound as its property.

#### ORDERING OF ELEMENTS AND PROPERTIES

The mantra or key sentence on which the theme of this paper is based on is "Khamvāyurjyotirāpahprthiviviśvasya dhārini". The meaning of the sentence is given as "the universe is borne(supported) by space (Kham), air (vāyu), fire(jyoti), water(āpah) and earth (prithivi)". The significance of this statement is in the order in which the elements are enumerated. This same ordering of the elements is found in several vedic references. Also, an analysis of the significance of this ordering in connection with



corresponding properties is described in the darśana particularly in śāstras-Nyāya, Vaiśeṣika, samkhya and yoga sutras[1-8].

The order of increasing subtlety in five elements are based on the decreasing number of properties or qualities required to characterize that element and its substance. In vaiśeṣika sutras of Jaimini Rishi, it is given as[7]

Earth Possesses smell, taste, form and touch

Water possesses taste, form and touch

Fire possesses form and touch

Air possesses touch

The fifth element termed Ākāśa ( ether or space) cannot be qualified by these four qualities namely touch, form, taste and smell. This leads to the observation that the space only be characterized or qualified by sound. However, sound is an additional characteristic to qualify all the other four elements namely air, fire water and earth. In other words, sound as vibrations travel through all these four elements, and produce different effects which characterize the corresponding element.

This element-quality relationship is also referred in dealing with order of evolution of the universe. The

following statement from Muṇḍaka Upanishad of Atharva Veda reiterates the statement of Nārāyaṇopaniṣat referred above.

Etasmāt Jayate Prāṇomanahindriyani ca  
 Kham Vāyur Jyotirāpah Prithivi Viśvasya Dhāriṇi  
 Muṇḍaka (II.1.3)  
 Nārāyaṇāt Prāṇo Jāyate Manassarvendriyaṇi ca  
 Kham vāyurjyotirāpahprithiviviśvasya dhāriṇi  
 Nārāyaṇopaniṣat

The two statements are identical in their contents. Their meaning essentially is given as follows:

'From this, originates the vital force, mind and all the senses, space, air, fire, water and earth that support universe'

The evolutionary order of elements is also stated in more explicit way in Brahmānandavalli of Taittiriyaopaniṣat in Krishna Yajurveda in the following statements[9].

Tasmāt va Etasmāt Atmana Ākāśaha Sambhūtaha  
 Ākāśāt Vāyuhu, Vāyoragnihi, Agnerāpaha  
 Abhyah prithivi, Prithivyaosadhayaha  
 Osadhibhyonnam, Annāt Puruṣaha

The meaning of the statements is as follows: From that verily, from this self (Ātman)-is Ākāśa(ether) born; from ākāśa, the air; from air the fire; from fire the water; from water the earth; from earth the plants; from plants the food; from food the man,

It is given in the statements above that, the production of elements begins from the all pervading Atman (Bramhan). Then the first element Ākāśa is born, here ākāśa refers to absolute space (which is mistaken for vacuum). This most subtle element ākāśa is qualified by sound as its property or guna. Then from ākāśa, air comes into being with two properties or gunas namely touch which is its own and the sound property of ākāśa already evolved. Then from air, fire came into being having three properties composed of two preceding and property of form which is its own. Then from fire was born water with four properties, comprising its own property of taste and the three preceding one. Then from water, earth came into being with five properties namely smell, taste, form, touch and sound. Then from earth the herbs, the food and the man came into being. Although, it is noted above that vāyu(air) came from ākāśa (ether) and so on, but truly the vāyu is born from Ātman assuming the form of ākāśa as ākāśa is only an effect with Ātman as source and cause. The same is true in regard to birth of the other elements for which Ātman is the causal source[9]. Thus, the element property relationship can be written from subtle towards gross manifestation as below

<u>ELEMENT</u>	<u>PROPERTIES</u>
Ether or Absolute space (Akasa)...	Sound (śabda)
Air (vāyu)....	Sound and touch (Sparsā)
Fire (Agni)....	Sound, touch and form (rūpa)
Water (Āpah)....	Sound, touch, form and taste (rasa)
Earth (Prithivi).	Sound, touch, form, taste and smell (gandha)

It is seen from the above tabular representation that the most subtle and the first element namely ether or absolute space or ākāśa has only one guṇa or property, which is sound or sabda. The rest of the elements accumulate the previous properties with the most gross element namely earth or prithivi which has all the five properties which correspond to the five senses. The ākāśa having sabda (sound) as its only property is also referred in several literature. In reference [10], the information given in table above, is identically given in sutra form. The akasa-sabda relationship is given by 'śabdaikaguṇamākāśam'.

Thus, the statements referred above traces the evolution of the great elemental powers which have brought forth the external as well as the internal universes, that is the world that is outside man as well as the one that is within him. The world outside is referred from cosmological point of view, however, so far as the inner world is concerned, as per yoga, their evolution takes place in the chakras which are strung in the suṣumna, hence the saying

that the chakras are abode of the elemental powers. The Chakras namely Moolādhara, Swādhīṣṭana, Maṇipooraka, Anāhata and Viśuddhi correspond to abodes of five elemental powers Earth, Water, Fire, Air and Space respectively. It is noted that in human body the location of the chakras correspond to, the coccygeal triangle at the termination of spinal cord (Moolādhara), the source of genitals (Swādhīṣṭana), region of umbilicum (Maṇipooraka), cardiac region (Anāhata), and the cavity of the throat (Viśuddhi) [11].

The yoga maintains that if the mind could reach these chakras and pass from one to the other until it reaches the Ajna chakra, then the reverse process of involution will take place leading to the realization of Ātman[11]. This yoga based implications of elemental powers is only provided as an indication of the wealth of spiritual knowledge both practical and theoretical, which needs to be acquired by a serious spiritual aspirant under a genuine yogi as Sadguru[12]. In this paper, as the topic is sound-space relationship in external world, the yoga approach to acquire the knowledge of inner world of a human being is not dealt with in further details.

#### SOUND-ONLY PROPERTY OF SPACE

Absolute space should not be mistaken for vacuum, as vacuum means emptiness. However, on the contrary, absolute space or ether or akasa does not mean emptiness. The word

akasa does not mean emptiness. The word akasa refers to 'Avakāśasvarupa' which refers to the substance (ether) or element that is spread in all corporeal space meaning the space capable of containing other, elements and bodies[13,14].

It is important to note that the scriptures (śāstra) say that the sound is not the property of air, but air is a carrier of sound waves. In modern scientific view also, air is essential to carry sound waves. In other words a medium is essential for sound waves to propagate. It is said as an observation in Vakyapadīya by Bhartṛhari that when a letter is uttered, the sound (atom like) is propagated like ripples, when a piece of stone is dropped into a lake [15].

abhraṇiva pracīyante śabdakhyah paramānavaha

This is similar to wave motion as in vicitaranganyāya of Anṁbhata in Tarkasamgraha. Thus, the sound is propagated from source to listener through the air medium through the mechanism of touch. In other words, when a hard (material) surface vibrates, the vibrations of the surface are transferred to the adjoining air molecules which again transferred to next plane of air molecules and so on till the air molecules impinge on the eardrum and then through auditory nerves, the vibrations are recognized as sound. Both at the source and listener, the property of touch is

used to transfer sound energy as wave motion. This conforms that the air is the carrier of sound but not the substance for sound. This can be further explained using the well known bell-jar experiment, which is used to show that air is essential to carry or transmit the sound to the ear of listener. In the bell-jar experiment, when the air is taken out in the jar to create a vacuum, the listener does not hear the sound as its carrier 'air' is absent. However, the listener can see the ringing of the bell, which means that the bell surface is vibrating and that only the vibrations are not carried further because the air is absent. Changes in air such as turbulence, temperature variations etc. affects the sound waves propagated. This means that the air is the efficient cause of sound but not the material cause, because the efficient cause can destroy the property just as the potters wheel can influence the pot but not the clay[16].

Given that sound describes the space, this can be practically observed even for the physical space in the audible range. In an enclosed physical space such as a room, the sound characteristics namely decay rate of a impulsive sound (like clapping) depends not only on the hardness of the wall surface but also on the volume of the room which indicates a measure of the physical space. In acoustical terms, the reverberation time which indicates sound decay rate is directly proportional to the volume of the room. In other words, given the density of the air, room temperatures

and wall surface hardness unchanged but only the volume of the room is changed, then the reverberation time changes which means somehow the physical space is qualified by sound. It is also noted that the volume of air has changed due to the change in the room volume (space) which alters the damping characteristic in the room. However, the change in room volume (space) is qualified by the audible sound.

It is known that in cavities and resonators, the change in internal volume influences the spectral characteristics of the sound. It is a common experience that when a conch shell is blown, the fundamental frequency depends on its internal cavity size and shape. The smaller the size of conch shell, higher the fundamental frequency of sound. In physiological aspects, the production of sound and speech is also dependent on the equivalent cavity effects of the vocal tract. It is said in the process of speech production, the ākāsa (or space) along with air and heat elements are responsible for sound origination which depending on the details of space (articulation aspects) in the vocal cavity comes out as speech. The elaborate details of speech production process is dealt in Sanskrit language by great grammarians such as Paṇini Maḥarīṣhi [17 to 23]. Thus we can say that the space determined by boundary conditions influences the sound both in amplitude and spectral contents. In other words, "sound qualifies space".



## CONCLUDING REMARKS

This paper presents a brief study of the sequential ordering of elements as given in Upanishads of Vedas, namely space, air, fire, water and earth and their corresponding properties sound, touch, form, taste and smell. This ordering is not arbitrary, and it is based on the decreasing subtlety and increasing gross nature of elements. It is noted that the space is qualified by only sound although the remaining four elements can also be qualified by sound in addition to their respective properties.

The space-sound relationship has implications both in external physical world as well as inner physiological world. The external (physical) implications include the acoustical aspects such as reverberation characteristics of rooms, internal cavities in musical instruments and the noise from cavity flow interactions in machinery. The inner (physiological) implications deal with the nādayoga aspects which include the mind, breath, heat and interior space in production of audible sound which further evolves into speech, chants and music. This brief article indicates the depth and scope of sound with its relevance and importance to life and human life in particular.

## INTRODUCTION

We all know that any action to succeed requires relevant knowledge and devotion. In essence, knowledge in general is essential to human life. Where is all the knowledge? What is the source of all knowledge? How does one acquire knowledge? Given the complexities of life, there are so many types of knowledge and how to compare the various types of knowledge?... so on. Human beings around the world encounter such challenging questions in all ages. These questions deal with both scientific and spiritual domains. The rishis (seer scientists) of ancient India have addressed such questions and have provided shastras which are scriptural based treatises resulting from both scientific and spiritual insights. Shastras have high relevance to contemporary day to day life. Rishis have classified the body of knowledge into two categories namely Apara Vidya, which refers to arts, science, culture, etc... and Para Vidya refers to the causal or the spiritual inquiry.

Shastras generally refer to infinitely large literature (in Sanskrit language) with its roots in Vedas. There are four Vedas namely Rigveda, Yajurveda, Samaveda and Atharvaveda. There are other derived literature which are subvedas namely Ayurveda, Dhanurveda, Gandharvaveda and Arthaveda which deal with health, archery, fine-arts and economics respectively. The vedangas refer to Shiksha, Kalpa, Vyakarana, Nirukta, Chandas and Jyotisha which deal with phonetics, ritual procedures, grammar, vedic etymology, metre and astronomy respectively. The upangas refer to Nyaya, Vaisesika, Sankhya, Yoga, Mimansa and Vedanta. These six systems is referred as Darshanas which gives different studies of the same unitary truth established in the four main vedas. The four vedas were codified in the current form by Maharishi Vedavyasa around 3500 B.C However, the whole body of four main vedas cannot be traced to any human origin. These vedas perennially exist and are heard as mantras by rishis blessed by divinities. Then there are literature such as Bhagavadgita in Mahabharata, Ramayana, Smritis and Puranas etc.. Thus the infinitely large literature deals with all aspects of life. This article attempts to show how shastras provide integration of the scientific and spiritual aspects which form the basis of peace and joy in our human life.

## LIFE AND ITS VARIOUS ASPECTS

Shastras enumerate various types of life such as plant, animal and human. The shastras proclaim that life of any human being generally has four-fold objectives. They are Dharma, Artha, Kama and Moksha. The first and foremost is dharma which refers to the knowledge of perennial laws of life, nature and universe. It also includes an understanding of the long-term values. Artha refers to the wealth, possession and power. Kama refers to desires and ambitions. Moksha refers to the state of tranquillity and joy. The order of the above objectives is important. Given these objectives, an individual's life spans the physical, emotional and spiritual domains interacting with the surrounding and natural environments.

In this multi-faceted life, the search for joy and peace (not just survival) is the driving force of human life. The shastras deal with this complex task and provide a general plan based on the four-fold objectives. This general plan suggests that the human life can be divided into four stages namely Bramhacharya ( Student life), Grihastha (Married life), Vanaprastha (Contemplative life) and Sanyasa ( Spiritual life). The pursuit of understanding and application of dharma starts in student life and should accompany in all stages of life. The artha and kama objectives need to be fulfilled in married life. The pursuit of moksha will be the focus of contemplative years of life. Thus one can see the wisdom of shastras in matching the objectives and span of life. This has universal relevance. The shastras also have dealt with all possible situations of human life which deviate the general guidelines.

## SCIENCE AND SPIRITUALITY

Shastras provide the required knowledge to achieve the joy and peace in our life based on the general plan. This systematic and multi-dimensional scientific knowledge dealing with nature and universe is referred in Sanskrit as 'Vijnana' and spiritual knowledge dealing with Self is referred in Sanskrit as 'Jnana'. The linking of Vijnana and Jnana is the chief objective of shastras. The shastras address seemingly diverse topics such as cosmology, elements of nature, human behavior, life after death, health etc... This comprehensive study is based on a key objective of human life that " to know and realize the Self and its relation to everything else".

Shastras in the background of eternal substratum describe the cyclical nature of creation, maintenance and dissolution. At the beginning of each cycle, from the all pervading Self, the (ethereal) space formed. Then the wind formed out of space. Then the fire formed out of wind. Then water formed out of fire. Then the solid earth formed out of water. Then the vegetation, plants and food and life energy formed out of earth and this process. This process indicates in a scientific way the subtleties of various elements and ubiquity of space and Self. The human body is microcosm of the element composed universe as macrocosm. In relating the elemental characteristics to human perception, shastras say that space can be qualified only by sound. The air can be qualified by touch and sound. The fire can be qualified by sight, touch and sound. The water can be qualified by taste, sight, touch and sound. The solid earth can be qualified by smell, taste, sight, touch and sound.

In Taittiriyaopanishat, the five sheaths of Bramhan (all pervading reality) which encompasses the life are presented. The first sheath represents the physical domain through food. The second sheath represents the life energy domain through breath and vital force. The third sheath represents the psychological domain through mental faculties. The fourth sheath represents scientific domain through intellectual abilities. The fifth sheath represents spiritual domain through joy and bliss. Shastras proclaim that the inherent nature and instinct of life is to be joyful. In human life it is possible for an individual to achieve and remain in this state of joy as described by the fifth sheath which is the subtlest.

In order to achieve this joyful and spiritual state, one needs to understand and live in harmony at all other sheath levels. The plant and vegetation is referred at food and vital domains. The animal kingdom is referred at food, vital and mental domains. The human life encompasses all the five sheaths. It is in the human life, the fourth and fifth sheaths namely scientific and spiritual inquiries can be fulfilled. It is true that Human beings need both science and spirituality. The current developments in science in all aspects of cosmology (Big-bang) to human behavior (fiber-diet and prayer) seem to follow the observations and recommendations of the shastras.

### SANSKRIT LANGUAGE

This infinitely large resource of knowledge of shastras which is relevant and beneficial to humanity is in Sanskrit language. Although

translation efforts are being carried out in large scale, still the original experience in the form of mantras, stotras and sutras depends on the learning of Sanskrit by seekers. The exclusive phonetic quality of Sanskrit is reflected in recitation of, poetry and ritualistic mantras. It is found that Sanskrit as a natural language is well suited for the knowledge representation. The language is essentially held by about 4000 sutras (rules) and about 1900 verbal roots. Sanskrit because of its compressed form is adaptable to represent knowledge in various aspects of life such as science, arts, music, dance, medicine, philosophy, architecture, spirituality etc. The language is intricate because of its wonderful ability to represent diversified knowledge. Due to its compactness it is well-suited for memory and recitation. Even a cursory knowledge of Sanskrit can bring the phonetic experience and profundity of the language and knowledge contained in it.

### CONCLUDING REMARKS

In this brief article, an attempt is made to show the relation between science and spirituality and also its relevance to us. It is possible to see the common spirit between seemingly different approaches of rishis and modern scientists. The rishis of *Sarvata Dharma* (Hinduism) proclaim "Vasudhaiva Kutumbakam" which means in Sanskrit, "the World is One family". If this realized saying is compared to an inspired saying of Apollo XVI astronaut Thomas K. Mattingly, "It's hard to take yourself too seriously when you look at the World from Outer space", one can see the common global view in these two statements coming from diverse sources. On the spiritual basis, one needs to be in harmony with not only self but with everything else. This harmony or union of diversities at the root level is Yoga (union). This yoga is referred not just for postures but the whole process of uniting the individual to the universal self. This process of Yoga is termed as Ashtanga Yoga (eight-limbed) formulated by the Maharishi Patanjali. This process deals with all five sheaths described above. I wish to remember the thoughts of my guru Sriranga who says that "the customs and habits, the dress and ornaments, the manners and etiquette, the concepts of right and wrong and of good and evil, the learning, literature and various arts like music, the political thoughts, views regarding action and consecratory ceremonies etc. of Hindus are all permeated like the warp and woof by Ashtanga Yoga".

Thus, it is said that in the path of spiritual realization, one needs three aspects namely, a preceptor, an understanding of the shastras and one's experiences. However, the concurrence of these three aspects is the essential culmination in one's spiritual path.

In the light of globalisation that we are experiencing, one can see that there is hope to synthesize the various cultural resources to complement one's understanding and achieve harmony both internal and external. Vedas say "Let noble thoughts come to us from every side".

I wish to conclude with my inspirational saying that " Learning has a beginning but no end; whereas, ignorance has no beginning but an end".

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## INTRODUCTION:

Indian scientific heritage can be referred as 'Vijnana'. Causal knowledge can be termed as 'Jnana'. Both of these words are in Sanskrit language, I wish to remember the words of my Sadguru Sriranga, a great yogi, "that 'Jnana' refers to the knowledge in the seed form which then has manifested in universal expansion as 'Vijnana'. The prefix 'Vi' refers to 'Vikasa' or 'expansion'. The Rishis or seer scientists of ancient India or 'Bharata' were 'Vijnanis' that they had realized both the manifested and causal knowledge, i.e. Vijnana and Jnana.

In this brief article, some of the great scientists of India and their contributions both from ancient and modern times are presented. All knowledge in Indian heritage in various fields such as science, arts, medicine, mathematics, astronomy, etc. have their origin in 'Vedas', which are eternal and infinite. The great Rishis originally blessed by divinities, heard and understood this knowledge in the form of mantras. Then, these original Rishis transferred to qualified and interested disciples. In the course of time, this process became diluted. However, the great ones with sincere effort attempted to recover through research and they are 'seer scientists'.

## INVERTED TREE OF KNOWLEDGE:

The scientific heritage is shown in the figure at the end as an inverted tree. This is to indicate that all kinds of knowledge such as science, philosophy, medicine, arts etc. descend from one Supreme source referred as 'Brahman'. In this context of scientific heritage, we particularly refer to the last six systems in sub-components or upanga. These six systems Nyaya, Vaiseshika, Sankhya, Yoga, Mimamsa and Vedanta were developed by great Rishis Gautama, Kanaada, Kapila, Patanjali, Jaimini and Vyaasa respectively. Among these, the Vaiseshika of Kanaada, Sankhya of Kapila and Yoga of Patanjali emphasize the physical sciences also in addition to the metaphysical and spiritual details.

## RISHIS AND SCIENTISTS OF ANCIENT INDIA (B.C.)

There have been innumerable number of Rishis and scientists. In his Vaiseshika philosophy Kanaada Rishi presented the smallest resolution unit referred as 'Anu' or 'Atom'. He developed the atomic basis of interpretation. The aim of Kanaada and other such Rishis is to provide understanding and methods to realize the nature and relations between God, Universe and Soul. In his Sankhya philosophy, Kapila Rishi presented a systematic approach to understand Cosmos and its manifestation. He categorized the various entities and hence 'Sankhya' or numbers. His approach is based on principles of energy conservation and transformations. The whole system is classified in twenty five categories and the cosmic being 'Purusha' is twenty fifth. Patanjali Rishi presented the Yoga which provides an experience based approach through the tools of mind and body to understand the life and cosmos. Astanga Yoga or eight limbed yoga system is based on Patanjali's Yoga systems. In my Sadguru Sriranga's view "the Ashtanga Yoga forms the scientific basis of all aspects of life, knowledge and culture of people of Bharata or India'.

In the field of medical science, some of the pioneers are Susruta and Charaka. It is well known that Susruta performed the surgical procedure, He had used about 100 surgical devices. The physician Charaka explained the imbalances in health is due to Vata, Pitta and Slesma.

Another major field of excellence in ancient India is astronomy and mathematics. Some of the pioneers are Aryabhata, Varahamihira, Brahmagupta and Bhaskara. It is well known that the discovery of zero which is the end of subtraction process on the positive side was made in ancient India. Brahmagupta presented various applications of Zero. Aryabhata presented earlier what is now known as "Pythagoras Theorem" and he also gave the value of pi as 3.1416. Varahamihira presented the treatise Brihatsamhita. Bhaskara presented the basis of integral calculus.

Nagarjuna provided the basis of chemical science. In the field of linguistics, one of the pioneers was 'Panini Rishi' who laid the foundations of grammar and

understanding of speech and language. In the field of music, the science and art was blended to excellence. The musical instruments such as Veena, Flute, Mridangam and Tabla are testimony to the great contributions of acoustical scientists of ancient India.

**SCIENTIFIC HERITAGE OF MODERN INDIA (A.D.)**

The scientific heritage rooted in strong foundation has developed into the modern age. There were many Kings who were scientists and researchers. Some of them are Jahangir who had deep knowledge of birds and animals. Immadi Savai Jaisingh is known for his expertise in astronomy. He was responsible for the development of observatories such as Jantnar-Manthar in New Delhi.

Then there have been several major contributors such as Sir C. V. Raman in field of optics and acoustics. S. K. Mitra in the field of Ionosphere research, M. N. Saha in the field Physics with the development of Ionization formula at the age of 25. S. N. Bose has been recognized for his contributions to Physics. Bosons are named after him. In area of Thermionics contributions of K. S. Krishnan are recognized. In the field of Physics, there have been several leading scientists such as H. Bhabha, V. V. Sarabhai, Raja Ramanna, M. G. K. Menon and J. Narlikar.

In the various fields of life sciences, some of the pioneers are J. C. Bose, Birbal Sahni, J. B. S. Haldane, Salim Ali, P. Maheswari, B. P. Pal, M. S. Swaminathan, A. Payental.

In the various scientific fields there have been several leading contributors such as P. C. Ray, D. N. Wadia, S. Ramanujan, P. C. Mahalanobis, S. Bhatnagar, T. R. Seshadri, D.R. Kaprekar, C.R. Rao, G.N. Ramachandran, Devendra Lal and C.N.R. Rao. Several scientists of Indian heritage have settled in countries outside India have done major contributions. Some of them are R.C. Bose, S.Chandrasekhar, H.G.Khorana, K.K.Pande, Govindji, A.M. Chakravarthi and C.KN.Patel.

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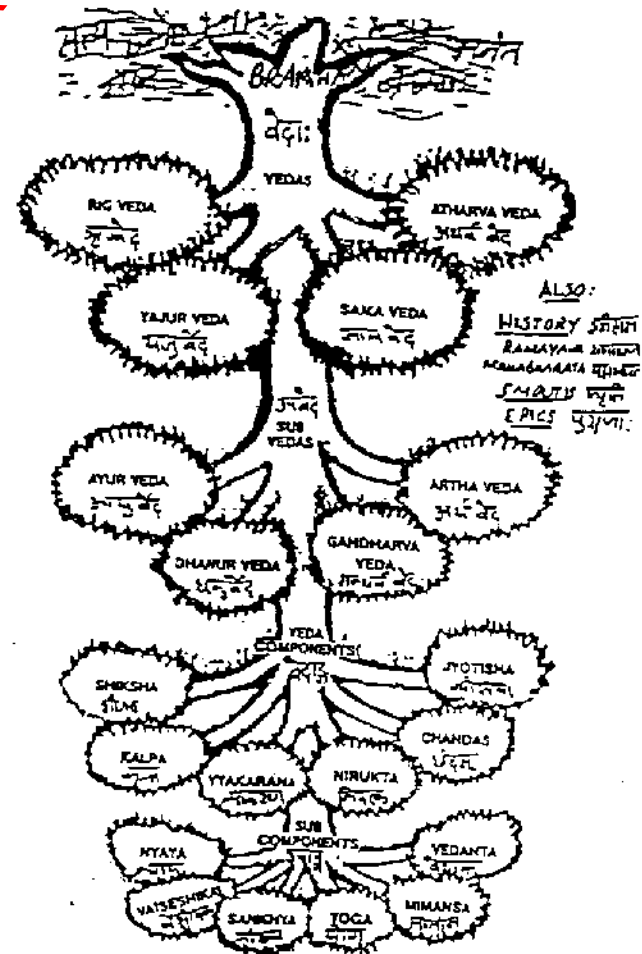
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DR. RUPNATHUJI DR. RUPAK NATH





Sounds of traditional vedic chanting produce vibrations which have beneficial spiritual effects both on chanters and listeners. Vedic chants are also part of Hindu religious worship. The precision in phonetic aspects of vedic chanting have been transferred orally from Guru (Teacher) to Shishya (Student). Thus, vedas are also termed as Shruti meaning 'heard', by the great Rishis and taught orally to students.

In Taittiriyoanishat, the principles of correct articulation and pronunciation are summarized in the first canto. Six basic aspects of phonetics which are important to vedic chanting are given. They are: Varna( वर्णः ), Svāra( स्वरः ), Matra( मात्रा ), Balam( बलम् ), Sama( साम् ) and Santana( संतानम् ).

Varna( वर्णः ) refers to the speech-sounds of letters which include vowels and consonants. The consonants further include soft and hard aspirants, nasals and semi-vowels. The correct pronunciation of various letters is emphasized.

Svāra( स्वरः ) refers to the accents or tones. There are five svaras referred namely, Udatta, Anudatta, Svarita, Prachaya and Nighata. However, the first three are major. Udatta refers to acute accent, Anudatta refers to grave accent and svarita refers to circumflex accent. Prachaya and Nighata refer to extended acute and grave accents. This svāra aspect emphasizes the correct intonation which makes mantras different from shlokas.

Matra( मात्रा ) refers to the measure or length required to pronounce letters. One prosodial instant refers to short (hrisva), and long (deergha) and prolated (pluta) refer to two and three prosodial instants respectively. This aspect emphasizes the chanting mantras compared to singing music.

Balam( बलम् ) refers to the strength or effort required in pronunciation of various letters and compound letters.

Sama( साम् ) refers to the voice level required for the medium level which is comfortable throughout chanting.

Santana( संतानम् ) refers to successive flow of chanting to maintain the continuity of words which include juxtaposed vocalic sounds.

All these six aspects are inter-related in chanting and together generate the spiritual vibrations through sound.

In describing various ornaments for a person, a verse in Sanskrit says that the best ornament is the speech of the person which bears culture.

*Vaṇeykā Samalamkaroti Puruṣam Yā Saṃskrutā Dhāryate*

वाण्यैका समलं करोति पुरुषं या संस्कृता धार्यते

Incidentally, the meaning of the word Samskruta in Sanskrit language also means 'cultured' or 'well done'.

It is well known that Sanskrit is one of oldest languages and is at the root of many Indo-Germanic languages. However, there is a general opinion that Sanskrit is so called 'dead' language as it being not used as a day to day spoken language. In reality, Sanskrit is at the root of most of the languages of India and some European languages. Also, it is well known that the cultural, scientific, technological and philosophical literature given by Rishis of ancient India are in Sanskrit. The all-encompassing nature of Sanskrit language indicates that the language is formulated as a system which can be applied to any subject matter. In recent times, the use of Sanskrit as natural language in the area of artificial intelligence for knowledge representation is under study. Some of the characteristic features of this great language are briefly presented below.

The grammar of Sanskrit is well structured and is presented by Sri Panini Maharishi in his treatise 'Ashtadhyayi'. The grammar is presented in the form of 'sutras' (like a rule, a formula etc.) There are about 4000 sutras placed in a systematic order. A large number of words (including proper nouns) in Sanskrit are derivable from 'Dhatus'. A 'Dhatu' is essentially a 'root' which indicates an action. For example, root 'vid' means 'to know'. The word 'Vidwan' (scholar) is derived from root 'vid'. There are about 1900 different roots from which majority of the words are derived. Also, with the use of 22 'upasargas' (prefixes) words and meanings are modified. There are many examples in which derived words carry the sound quality of the root. The root 'vid' gives rise to many words such as 'veda', 'vidwan', 'vidya', 'vaidika', 'vidwat', etc. The meaning of a sentence in Sanskrit does not depend on the placement of the constituent words. This is mainly because of the declension of the words into various cases. In Sanskrit many single letters would carry meaning (for ex: 'ja' would mean 'born') in the context of the development of words. Also, many words have a common meaning as well as a meaning in vedic (philosophy) context for ex: the word 'purusha' commonly means 'man', but in vedic context, it would mean 'Soul'. It is easier to memorize texts (poetry or prose) in Sanskrit possibly because of the rhythmic structure which is helpful in effective oral communication (Shruti). The process of 'roots' evolving into 'words' facilitates formulation of new words making the vocabulary expandable.

Some features of Sanskrit noted above are only an indication of the brevity of packing information such that the language in a compressed form in the basics can be adapted to communication of knowledge in various aspects of Life, such as arts, music, dance, science, philosophy, medicine, literature, religion, technology etc. Thus it can be said that the spirit of Sanskrit is still vibrant as seen in the art and religion, with its direct use is not being made in the day to day communication and activities. However, it can be said that even a cursory knowledge of Sanskrit can only help a person in obtaining a feeling of its greatness as a language and profundity of the thoughts communicated through it.

Sri Tyagaraja has demonstrated that the path of pure classical music is not only joyful but also a means of spiritual realization of the Self (God). The spiritual aspects of this path which has acoustical basis can be referred as *nada yoga*. The term *yoga* means union in the spiritual sense. *Nada* is of two types, viz., *aahata* and *anahata*. The *aahata nada* is produced and expressed through vibrations where as *anahata nada* is beyond expression. In this article, the *aahata nada* is referred to all sounds which are produced physiologically and physically.

Although *nada* refers to vibrations of any frequency audible or not, we in the context of music refer to the audible sound produced by human body and instruments. This *nada* is like the clay which can be formed into a specific shape of a pot. Similarly, in dealing with *nada yoga*, the sound energy produced in human in the formless stage shaped into a specific phonetic form, i.e., an alphabet, which further evolves into a musical rendering as a *keertana*. This is true of an instrument also, such as *mridangam*, which produces a pleasing rhythmic sound as compared to that produced by a panel of wood. Thus, one can clearly see from these examples that effort, knowledge, and devotion which are interrelated, and are essential for achieving the goal from raw material, namely, a pot from clay, a musical rendering (*keertana*) from sound, and a *mridangam* from a wooden panel.

#### Sri Tyagaraja's Kritis

Amongst large number of kritis, there are about 24 which deal with *nada yoga* and its various technical aspects in music. We will briefly discuss one kriti dealing with *nada*. In 'Mokshamu galada' kriti in *Saramati* raga, Sri Tyagaraja brings out, in the form of questions, the essence of *nada yoga*.

Is it possible for those souls who are not realized to attain salvation? Is it possible for those who do not have 'our (God's) vision and not have devotion and knowledge of music to attain salvation? Oh! Lord of Tyagaraja, Is it possible for those 'who do not know (and experience) that the union of the vital force (*prana*) and fire (heat) produces the (primordial) sound and seven notes (*svaras*) having their origin in the *veena* which is always being blissfully played by Lord Shiva for devotees', to attain salvation?

In this kriti, in addition to the knowledge of music and devotion through music, the spiritual experiences through the means of sound are given.

The purport of the kriti given above can be further expressed briefly as follows: The production of sound as energy in the human body occurs at the *Mooladhara* center placed in the coccygeal triangle where the spinal cord terminates. The components which unite to produce the sound are *prana* and *anala*. The *prana* refers to the vital force that activates the inhaling and exhaling breaths which are essential in human sound production. The *anala* refers to fire element which could represent the heat generated at the beginning of sound production. The mind as an agent brings about the

union of the vital force and heat which then as energy comes up through navel, heart, throat and mouth and becomes sound which is audible. The generation and release of energy as audible sound occurs during the process of breathing. In particular, the audible sounds are released during exhaling. All sounds including the seven *svaras* and resulting music in the seed form or primordial form is considered as the Cosmic sound of *Om* (*Aum*). The sound of *Om* signifies the universal name and form of the Supreme Being. In addition to the acoustical significance, the *pranava* or *Om* has philosophical and spiritual significance. The *Garbhopanishat* says that an infant in womb, in its eighth month contemplates the imperishable syllable *Om*. Then, Sri Tyagaraja refers to the seven notes from the *veena*. The *veena*, the musical instrument, has its origin in the human spinal cord. The seven notes have their origin at the various *chakras* or energy centers along the spinal column. It is for this reason the musical recital from the *veena* has very close resemblance to vocal music. Thus, it can be summarized that the pure mind as an agent, with the human body in pure condition as an instrument, should bring out the music which provides both joy for senses and spiritual bliss. Such is the path of music demonstrated and adored by great souls like Tyagaraja for spiritual seekers.

#### Concluding Remarks

There are several kritis of Sri Tyagaraja, such as *Nada tanamanisham ...*, *shobilla saptasvara...*, *Sangita Jnanamu ...*, *Raga sudharasa ...*, *Svara raga sudha rasa ...*, etc., that deal with various aspects of *nada yoga* and the spiritual aspects of music. The sound being one of the basic means of human expression can be effectively used by devoted and spiritual seekers in the form of music, bhajans, chanting and japa to achieve and spread pure spiritual joy. I offer this humble article with remembrances of my Sadguru Sriranga and Sri Tyagaraja to Lord Shankara and Lord Sri Rama on the occasion of the 10th Anniversary of Tyagaraja Aradhana. *Endaro Mahanubhavulu Andariki Vandanamu*. "As many souls with Divine experiences are, salutations to them all."

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## Oh! SOUND...

You surround everything around.  
 You are everywhere to be heard.  
 You are outside but also inside.  
 You are produced ever in nature.  
 You come from humans and machines.  
 You are with motions and patterns.

As an annoying noise, you displease someone.  
 As a diagnostic tool, you are useful to someone.  
 As a painful noise, you can hurt anyone.  
 As a soothing music, you comfort everyone.  
 It isn't easy to place you as music or noise.  
 either wanted or unwanted, you are always sound.

M. G. Prasad.

## Sh... SILENCE

Where can you be found?  
 Are you the absence of sound?  
 Are you the one you can't hear?  
 As things move, are you there?

While we think, you are with us.  
 While we work, you can be with us.  
 As speech begins to flow, you run away.  
 As machine start to run, you get away.

It isn't easy to be with you always,  
 but you help to subdue aggravations.  
 You nurture quietness and calmness,  
 And one with you, feels the peace.

## DANCE

Dance, Dance, Dance...everywhere we glance.  
Patterns of motions surround us as dance.

As rains pour and rivers flow,  
As sun shines and snow melts,  
As flowers bloom and wind blows,  
Such dances in nature enchant us.

Dance, an art of human expressions,  
Moods and motions are its contents,  
Music and rhythm are its components,  
Together, dance, an art of creation.

What describes the quality of dance?  
Is it the harmony of its movements?  
Or is it the melody of its music?  
Or is it the vibrations of its rhythms?  
Or is it the emotions of its theme?  
Or is it the feelings of the dancer?

Dancer, you have a powerful expression,  
As you can reach one and all with ease.  
As you can excite and provoke the senses,  
You also can bring serenity and calmness.

Dancer, you as a pure instrument of dance,  
Bring the message of harmony and joy to all.

## MUSIC

Ah! Music, are you the flow of sound?  
Or in silence, the feelings of mind?  
Can you be described as frequencies?  
Or as thoughts through sound waves?

From speech how do you differ?  
How do you cross language barrier?  
What makes you bad or good?  
As you influence listener's mood.

What makes you so powerful?  
Although you are invisible.  
Various emotions come through you.  
Dancing patterns depend on you.

Is your secret harmony?  
Or is your strength melody?  
Or is it the lyric with memory?  
Or the rhythm in which you vary?

What you are, it is hard to say.  
What ever you are, give us Peace and Joy.

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