

### Principal Investigators

Prof. V. N. Giri  
Prof. Suhita Chopra Chatterjee  
Prof. Pallab Dasgupta  
Prof. Narayan C. Nayak  
Prof. Priyadarshi Patnaik  
Prof. Aurobindo Routray

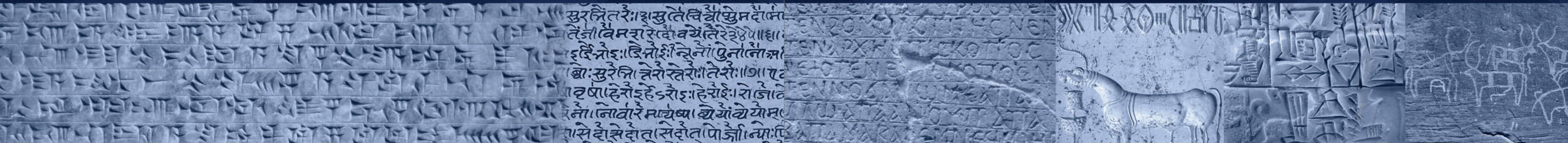
Prof. Arindam Basu  
Prof. William K. Mohanty  
Prof. Probal Sengupta  
Prof. Abhijit Mukherjee  
&  
Prof. Joy Sen



SANDHI

# A REFORMULATION OF THE INDO-EUROPEAN SYSTEM OF LANGUAGES AND A RECOVERY OF THE DEEP MORPHOLOGY OF VARNAMALA

(Project Codes AIP and OPP)



भारतीय प्रौद्योगिकी संस्थान खड़गपुर  
INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

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A synoptic collation of twin research by the SandHI Language Group  
INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

#### Patron-Advisor

**Ms. Amita Sharma**

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#### Monitoring Cell

**Prof. Sunando Dasgupta**

Dean, Sponsored Research and Consultancy Cell, IIT Kharagpur

**Prof. Pallab Dasgupta**

Associate Dean, Sponsored Research and Consultancy Cell, IIT Kharagpur

#### Principal Investigator (overall)

**Prof. Joy Sen**

Department of Architecture & Regional Planning, IIT Kharagpur  
Vide order no. F. NO. 4-26/2013-TS-1, Dt. 19-11-2013  
(36 months w.e.f 15-1-2014 and 1 additional year for outreach programs)

#### Professor-in-Charge

#### Documentation and Dissemination

**Prof. Priyadarshi Patnaik**

Department of Humanities & Social Sciences, IIT Kharagpur

#### Research Scholar Group (Coordinators)

Sunny Bansal, Vidhu Pandey, Prerna Mandal, Arpan Paul, Deepanjan Saha

#### Graphics Support

Tushar Kanti Saha, MS Student, Sandhi & Samiran Dhar, Sandhi Research Assistant, SRIC, IIT Kharagpur

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S A N D H I

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SandHI Language Group

**INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR**

# A TRIBUTE



The book attempts to pay a tribute to the historical entry of Swami Vivekananda on the world stage on the occasion of the Parliament of Religions in Chicago, on this day of September 11, 1893; taking over the universal mind and consciousness of humanity.

## SandHI, a Science and Heritage Initiative of IIT Kharagpur

(A mega-initiative sponsored by the MHRD, Government of India)

presents an Exhibition on

- Language Systems - Music and Cognition - Meditation and Therapy - Iconography  
History of Science and Technology & Science of Indian History (Myth and Truth)  
Geo-Exploration, Coastal Heritage, Urban Design and Engineering - Special Mega Project: Varanasi  
End-of-life Care - Generosity - Creative Economy and Regeneration -

September 11 - 13, 2015

at

**Indian Council of Cultural Relations (ICCR)**

9A, Ho Chi Minh Sarani, Kolkata



S A N D H I



“ The going forth of Vivekananda, marked out by the Master as the heroic soul destined to take the world between his two hands and change it, was the first visible sign to the world that India was awake not only to survive but to conquer. ”

Sri Aurobindo



“ It is probably true quite generally that in the history of human thinking the most fruitful developments frequently take place at those points where two different lines of thought meet. ”

Werner Heisenberg

## FOREWORD

The Department of Higher Education, Ministry of Human Resources Development, Government of India has steered a series of national and regional level workshops, for launching pilot projects, for creating centers of excellence based on a spirit of inter and intra-institutional convergence promoting research, development, innovation (RDI) initiatives. The idea is to pro-activate and augment a 'people-centric' course of India's future growth plans, strategies and development programs based on clusters of projects executed by IITs and other allied institutes.

Addressing the aforesaid course, the Indian Institute of Technology Kharagpur has made a distinctive and forerunning headway for creating and initiating a cluster of projects under the 'Science-Technology & Culture-Heritage Interface' schema of Government of India. Other IITs and Institutes have national importance have also followed.

The present report is one of many to represent the headway. As one of many, it represents the effort to forward the vision of IIT Kharagpur, which will serve both as an umbrella to plan, design and activate a 'people-centric' ground reality for a cluster of projects. The vision is based on the foundations of Indo-centric theme and an operational-cum-organizational structure of scientific exploration, at the same time. These projects represent inter and intra-institutional convergence of research, development, innovation (RDI) initiatives. The vision is called 'SANDHI'. 'SANDHI' literally means convergence and confluence. 'SandHI' is also the platform of inter-disciplinary and inter-institutional assimilation. SandHI is the acronym of 'Science-Heritage Initiative'. Under 'SANDHI', there are four levels of activity:

- First, a deeper level of philosophical research based on scientific exploration;
- Secondly, an outward recovery of Indian heritage systems based on the epistemological domain of Indian science and technological traditions;
- Thirdly, a re-positioning of traditional community planning and engineering systems based on the Indian ethos; leading to a fourth and demonstrative level, i.e., a pro-active resurrection of traditional knowledge systems of India based on creative economy regeneration and marketing in various corners of reality – concerning the people, their economy, their folk and the all-round livability in the surrounding they belong to.

### Exploration through cooperative inquiry

Constituting Level one, which is an agglomeration of Deep science and heritage interface based projects, there are:

1. Two language based projects
2. Two music projects and
3. Two iconography-shape grammar driven heritage and historical exploration projects

The present report initiates a research note on the two language projects:



## PROJECT ONE

Developing a scientific rationale for re-exploring and re-discovering a larger foundation of Indo-European Language System (IELS) in light of a range of approaches like cognitive matching of geo-spatial and ethnographic data based on iconography and syntax-semantics-semiotics driven genre-pool-mapping techniques which can be empirical-graphic to begin with.

## PROJECT TWO

Exploring and designing an etymologic/ articulation based foundation of Varnamala and a Signal processing driven exploration of features, which constitutes the hierarchy of vowels and consonants of Sanskrit and other parental languages in the Indo-European language system.

## THE TEAM

The present report is a wonderful work of a team of seven dedicated and brilliant minds:

**Dr. Partha Sarathi Bera**, Advisor (Project two) [Electrical Engineering], Kalyani Government Engineering College

**Apala Sarkar Ghosh** (Project one) [Linguistic and Historic research]

**Tushar Kanti Saha** (Project one) [Electronic Graphic support]

**Samiran Dhar** [Electronic Graphic support]

**Preeti Pal** (project one) [Textual research – Project one]

**Indira Chatterjee** (Project two) [Signal Processing]

**Tanaya Mukherjee Sarkar** (Project two) [Linguistic-syntactic research]

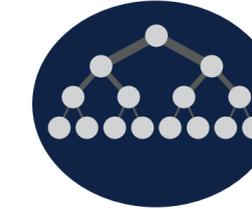
Ms. Apala Sarkar Ghosh and her team have worked incessantly and exhaustively towards the making of the first part of the report. Worth mentioning are the contributions of Tushar Kanti Saha and Samiran Dhar for their invaluable graphic supports.

Dr. Partha Sarathi Bera, Ms. Indira Chatterjee have contributed substantially to Project two. The two have worked in the backdrop producing a large pool of secondary data analyses, a small part of which has been exposed in the present report. Additionally, Tanaya Mukherjee Sarkar has contributed to the theoretical research on *Varnamala*.

The present note is an aggregation and a culmination of the tireless effort rendered by all seven of them. It marks the beginning of a research initiative that aims in reaching the deeper and the vaster foundations of the Indo-European Language system rooted in the origin of the most perfected – ‘*Sanskrit*’; and its deep syntax-semantics driven morphology, which is the mystery of *Varnamala*.

That mystery, which is essentially a deeper way of the life of the Aryan sages and not a philosophical or analytical research is forwarded in the END NOTE entitled ‘The Brain of India’.

**Joy Sen**  
Principal Investigator, SandHI  
September 11, 2015



*India of the ages is not dead nor has She spoken her last creative word; She lives and has still something to do for herself and the human peoples. And that which must seek now to awake is not an Anglicized oriental people, docile pupil of the West and doomed to repeat the cycle of the Occident's success and failure, but still the ancient immemorial Shakti recovering Her deepest self, lifting Her head higher toward the supreme source of light and strength and turning to discover the complete meaning and a vaster form of her Dharma.*



**Shri Aurobindo**  
*Arya: A Philosophical Review (January 1921)*  
*‘The Foundations of Indian culture’*



*It may be debatable whether material history is the expression of an original idea; but it is an indubitable fact that spiritual history is always so. ‘It is of the One existence that yearning hearts speak in diverse ways’ - has said a Vedic seer (RV: 1.164.46); and this is true not only in an abstract way, but in a concrete form also.*

*Like the mystic Asswatha tree of the Upanishad, [the Bodhi Tree] ‘with its roots above and the branches below’, the Vedic tradition, in a broad sense, it stands at the very source of almost all forms of spiritual cults. And the interpretation of this tradition can be attempted with best results if we do not place the Vedas on the isolated heights of the past, but with a total (complete) vision of the present retrace our steps to the roots discovering, with a penetrating insight, the links at every steps.*



**Sri Anirvan**  
*Vedic Exegesis*  
*‘The Cultural Heritage of India’, Volume one,*  
*RMIC, Kolkata (2001)*



ॐ तत् सत्

Om Namō Bhagavate Ramakrishnaya

नासतःसत्जायते — Existence cannot be produced by non-existence

Foreword: Historical Evolution of India

(Based on the works of Swami Vivekananda)

Joy Sen, Principal Investigator, SandHI



## GENESIS OF SANSKRIT IN THE ARYAN MIND

### The parable of the bricks in the sacrificial altar

*Non-existence can never be the cause of what exists. Something cannot come out of nothing. That the law of causation is omnipotent and knows no time or place when it did not exist is a doctrine as old as the Aryan race, sung by its ancient poet-seers, formulated by its philosophers, and made the corner-stone upon which the Hindu (Indian) man even of today builds his whole scheme of life.*

*There was an inquisitiveness in the race to start with, which very soon developed into bold analysis, and though, in the first attempt, the work turned out, might be like the attempts with shaky hands of the future master sculptor, it very soon gave way to strict science, bold attempts, and startling results.*

*Its boldness made these men search every brick of their sacrificial altars; scan, cement, and pulverise every word of their scriptures; arrange, re-arrange, doubt, deny, or explain the ceremonies. It turned their gods inside out, and assigned only a secondary place to their omnipotent, omniscient, omnipresent Creator of the universe, their ancestral Father-in-heaven; or threw Him altogether overboard as useless, and started a world-religion without Him with even now the largest following of any religion.*

#### The science of cosmic rhythms in time and space

*It evolved the science of geometry from the arrangements of bricks to build various altars, and startled the world with astronomical knowledge that arose from the attempts accurately to time their worship and oblations.*

#### The science of universal proportions and signals

*It made their contribution to the science of mathematics the largest of any race, ancient or modern, and to their knowledge of chemistry, of metallic compounds in medicine, their scale of musical notes, their invention of the bow-instruments — (all) of great service in the building of modern European civilisation.*

#### The science of literature building up the child-mind

*It led them to invent the science of building up the child-mind through shining fables, of which every child in every civilised country learns in a nursery or a school and carries an impress through life.*

#### Embracing the most perfected syntax, semantics, melody and the semiotics of number systems (Samkhya)

*Behind and before this analytical keenness, covering it as in a velvet sheath, was the other great mental peculiarity of the race — poetic insight. Its religion, its philosophy, its history, its ethics, its politics were all inlaid in a flower-bed of poetic imagery — the miracle of language which was called Sanskrit or "perfected", lending itself to expressing and manipulating them better than any other tongue.*

*The aid of melodious numbers was invoked even to express the hard facts of mathematics.*

#### SandHI of an analytical power and deeper poetic visions

*This analytical power and the boldness of poetical visions which urged it onward are the two great internal causes in the make-up of the Hindu (Indian) race. They together formed, as it were, the keynote to the national character. This combination is what is always making the race press onwards beyond the senses — the secret of those speculations which are like the steel blades the*

*artisans used to manufacture — cutting through bars of iron, yet pliable enough to be easily bent into a circle.*

*They wrought poetry in silver and gold; the symphony of jewels, the maze of marble wonders, the music of colours, the fine fabrics which belong more to the fairyland of dreams than to the real — have back of them thousands of years of working of this national trait.*

*Arts and sciences, even the realities of domestic life, are covered with a mass of poetical conceptions, which are pressed forward till the sensuous touches the super-sensuous and the real gets the rose-hue of the unreal.*

#### The earliest glimpse of the Aryan race

*The earliest glimpses we have of this race show it already in the possession of this characteristic, as an instrument of some use in its hands.*

*Many forms of religion and society must have been left behind in the onward march, before we find the race as depicted in the scriptures, the Vedas.....*

*Swami Vivekananda  
Historical Evolution of India*

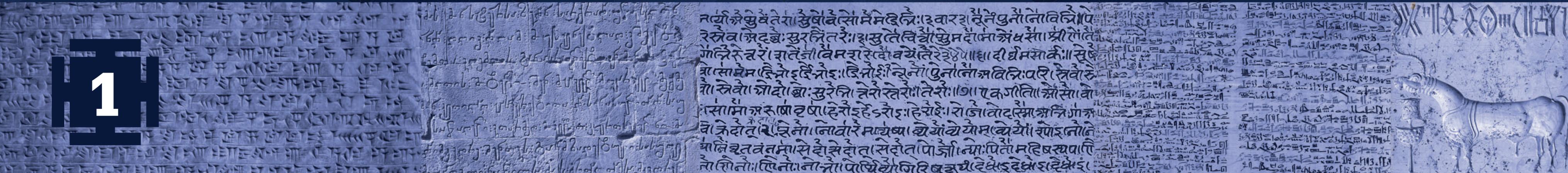
# PROJECT ONE

## Deep Science exploration of Language projects

– A Maslow-Aurobindo approach of integral inquiry

Developing a scientific rationale for re-exploring and re-discovering the Indo-European Language System (IELS) in light of a range of approaches like cognitive matching of geo-spatial and ethnographic data based on iconography and syntax-semantics-semiotics driven genre-pool-mapping techniques which are empirical-graphic to begin with.

The idea is based on the trans-personal edifice of 'Hierarchy of minds' and 'Hierarchy of needs' (Sri Aurobindo and Abraham Maslow, respectively)



## The Team

Apala Sarkar Ghosh (Project one) [Linguistic-semantics driven research]

Tushar Kanti Saha (Project one) [Electronic Graphic support]

Samiran Dhar (Project one) [Electronic Graphic support]

Preeti Pal (Project one) [Textual-syntax driven research]



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## PREFACE

To summarize the whole truth behind the foundation of Indo-European Language systems having Sanskrit either at the core or the apex of that very system, one may refer to the following words quoted from 'Hymns to Mystic Fire' P 1):

*'In ancient times Veda was revered as a sacred book of wisdom, a great mass of inspired poetry, the work of Rishis, seers and sages, who received in their illumined minds rather than mentally constructed a great universal eternal and impersonal Truth which they embodied in Mantras, revealed verses of power, not of an ordinary but of a divine inspiration and source. The name given to these sages was Kavi, which afterwards came to mean any poet, but at the time had the sense of a seer of Truth – the Veda itself describes them as 'Kavaya satyasrutah' or 'seers who are hearers of Truth' and the Veda itself was called shruti, a word which came to mean 'revealed scripture'...'*

Sri Aurobindo



### A research abstraction

The abstraction depicts a morphological upward evolution, which can be reciprocally structured to counter a downward evolution of language systems from deeper (core) to surface (peripheral) levels. The two-way ladder, in the form of a vertical tree-like structure is suggested on the basis of a three stepped enquiry. Sufficient work has been done till date to address:

1. Earmarking an evidence of an upper strata leading to a hierarchy of surface (temporal and personified) and deep (universal) structures

2. Assessing further inter-linkages of 'Shape Grammar' depicting response-stimulus exchanges based on iconography (templates)

Establishing morphological evolution of language systems based on hierarchy of response-stimulus exchanges through components: vowels, consonants, syllables etc (bases of varnamala in project two i.e. Code: OPP)



## INTRODUCTION

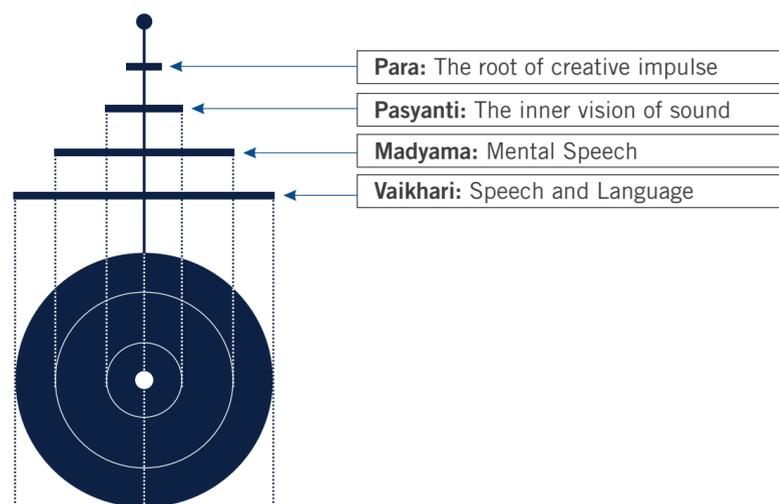
### 2.1. Origin of the Deep Science exploration of Language projects

The concept of SANDHI is based on the integration of four concerns that correspond to the realization of 'Vak', the sacred cosmic word as encoded in the Vedas, which stands for the cosmos and every level and variety in it. The fundamental understanding of the hierarchy of cosmic manifestation as perceived by the Vedic seer-wisdom has defined and regulated the social laws, administration, literature learning process and principals that guide ordinary human minds in Indian subcontinent. Just as a river in its turbulence washes away the fertile banks that sustains its inhabitants, in the same fashion the flow of time brought in serious aberrations that made Indians lose the pulsing tempo of their heart or deviate from the mainstream of wisdom and vision. Swami Vivekananda steadfastly reiterated the need to empower human minds with the silent, unperceived, yet omnipotence of Vedas and Upanishads.

The four levels of VAK and its manifestation provides the epistemic domain and the ontological network of science-heritage interface, required for the outlining of a future pedagogy. It is like a tree with the roots above and branches below (*urdhamulam addwa sakham*) which also is an inside-outside relationship (*antara-bahi* or micro-macro). Thus through a fundamental understanding of the hierarchy of cosmic manifestation, from the highest unmanifest to the gross manifest, the seer formulates the basis of a 'conjunction' or 'a unified recovery' of Science-Heritage interface. The thread or the interface of the two – the analytical (external) and intuitive (internal) worlds is the synthesis or SandHI, to understand the study of evolution and dissemination of the of Indo-European Language system (refer Figure 1).

### 2.2. The theme of the Language projects

The Study of Indo-European linguistics requires comparison of lexicon, grammar and texts of old and contemporary languages. A detailed analysis of etymology of language origin and dissemination of language families involve investigation into philology and comparative linguistics to reconstruct information about languages that are too old for any direct historical evidences to establish a chronology. In concurrence, the study of the interpretations of scriptures by philosophers, philologists, historians from different ages and



Involution of Language systems

Figure 1: Involution of Language Systems (top-down or inside-outside)

Source: Composed by the authors



Table 1: Levels of structures and Dimensions of cultural flow

Scientific / Normative	Dimensions of cultural flow: making of ideas and word formation				
	Numbers	Law	Measures	Ecology / Geography	Economics
<b>Meta structures</b>	Astral and cosmic sequence	Cosmic law; macro and micro causation	Anthropometric iconography; Mandala	Natural matrix of things (Gaia hypothesis); energy and grand unification	Economies of scale in the cosmic level
<b>Moral structures</b>	Numerology and good ethics	Social or community law and ethics	Codes and scale of rules	Ecological and environmental ethics	Ethics of trade and exchanges
<b>Material structures</b>	Concept of numbers and materialism	Individual rights	Anthropometry; ergonomics; universal design (barrier-free)	Environmental and space conservation and renewable energy paradigms	Demand and supply chains

comparison of morphological and semantic expression of the root sounds and word cognates open up the scope to locate the paucity/gap in research of the Indo-European Language Systems (IELS).

The two dimensions, namely Science (S) represented by positive dimensions and Heritage (H) represented by normative dimensions will be induced with a set of elements that constitute various disciplines namely Numerology, Law and Social Science, Anthropometry, Eco-Geography and Economics and H will have a set of themes based on cosmology, mythology, history, language, art, aesthetics and so on. By and by, a systematic hierarchy of S and H will evolve into a two dimensional matrix, where each project or a batch of projects will contribute to fill the cells of the matrix, thus arriving at a self-evaluative analysis with least or almost no likelihood of ambiguity (Table 1).

The Computer Science technology and literary inquiry have been combined to understand the orthographic transformation rules, identify cognates and non-cognate words and refine the words on the basis of semantic similarities. The findings are to be plotted by inducing a set of themes based on scientific and normative scales to build temporal matrices. The next step involves comparison with other interpretative matrices from the fields of Phonology, Phonetics

and Retro-flexing to locate distinct cluster of language families and direction of flow (linkage) from one cluster to the other.

### 2.3. Literature Review: What and Why?

A thorough literature review on ancient philosophy and culture and rituals and their interpretations in historical and modern times is being conducted to refine research idea and questions into narrow topics. Next, the online internet library has been probed to study cognate words and compare sets of such data in various themes across ancient and contemporary languages with reference to proto-Indo-European language. To validate the authenticity of the above search procedure, a parallel and more elaborate time consuming search has been performed by referring to two or more Indo-European and Indo-Iranian dictionaries, of universal acceptance.

Application of the above word search has led to identify two sets of Eastern (Sanskrit/Hindi/Bengali) and Western (Latin/Greek/English) comparable list of words based themes (say, numerals) followed by their refinements into cognates and non-cognate words.

For this, two dimensions, Scientific and Normative have been identified. Within each of the dimensions, a set of themes is induced and compared in a Temporal Matrix by means of current approaches based on literature review as Shown in Table 1. The X axis of Table 1 compares the word cognates on the basis of scientific elements from the areas of laws of grammar (etymology, morphology, syntactic and phonetic rules of word formation), laws of mathematics and architecture (scales and measurements in nature and built environment), earth sciences of geology, geography and ecology and economic evaluations of exchange between cultures. The Y axis represents the normative aspects graded from tangible and concrete materialistic semantic outputs of language expression to less tangible and more contemplative intellectual codes and rules of ethics and principles of conduct with a perspective towards environmental consciousness and protection. The upper reaches of the X and Y axis synthesize and evolve into subtle expression of language of spiritual and cosmic understanding of the Universe where the lower cells in the matrix integrates and unifies into cooperative, humanistic and sustainable approaches of human evolution.



## A SANDHI APPROACH: AUROBINDO - MASLOW

Language is the surface expression of deeper domains of thought and psychic impressions that is reflected in the behavioral pattern of individuals, society and different cultures. Stimuli from immediate environmental backdrop modify and shape cultural traits over historical timeline. The study of such 'environment-behavioural' relationship is critical to facilitate understanding of the deeper or underlying causal factors that influence outward behavioural patterns as expressed in the articulated and written form of language families across the globe.

### 3.1. Experimental and humanistic approach of the West

The classical approach of natural science to explain the biological evolution builds around the arguments of Darwin that living things are engaged in a 'struggle for existence' and the features that evolved for their survival and reproductive ability are subject to continuous selective pressure. Freud (1923) explained the evolution of human mind through the dynamic interaction of *Id* (biological element), *ego* (socializing element) and *super ego* (dispenser of rewards and punishment) to generate diversified personalities that rationalizes outward expression. The aspiration of the reductionist school to analyze the mechanism of human behaviour, especially in the treatment of psycho-somatic disorders, attempts to explain the underlying cause and effect within the framework of physiology and neuroscience. Yet cognizance of human behaviour and remedy for behavioural anomalies remains partial or incomplete without a commitment towards a humanistic approach that include cognitive, social, cultural and environmental aspects holding onto Aristotle's principle that 'the whole is more than the sum of its parts'. The two movements in human psychology, one involving researches on

psychoanalysis by Freud and the other incorporating the science of behaviourism by B. F. Skinner (1838, 1853), and Ivan Pavlov (1902), evolved into the holistic approach in the form of humanistic psychology in the late 1950s. Works on analytical psychology by C. S. Jung (1956), humanistic and transpersonal psychology by Abraham Maslow (1968), spectrum of consciousness by Ken Wilber (1993) and spiritual transformation by Andrew Cohen (2011) are all directed towards individualistic human concerns of self, empathy, and self-actualization, thus nurturing a creative cultural environ worthy of sustainable humane biome.

### 3.2. Meditative and spiritual experiences of the East

The ancient foundation of Indian philosophy, the *Shruti*, shows a meditative pathway to reach the absolute knowledge, a road that foster ethics, values and goodwill for the long term environ friendly sustenance of humanity. Swami Vivekananda in his Raj Yoga (1893) elucidates that the mind responds to what the sense organs perceive from the external environment and our body reacts accordingly. The practice of yoga invokes tremendous will power by concentrating on

the breathing system, which is the highest manifestation of the vital force (called *élan vital* or the *prana*) in the human body. Through personal experience, yogis teach how to control the life force itself to arrive at the self that will lead to the supreme knowledge of the control of the life force of the universe as the self of the universe. They go on to say that when one returns to his own self he discovers that 'what is above is what is below'.

### 3.3. Fusion of oriental philosophy with occidental science

Modern science is beginning to acknowledge this interconnectedness. In a series of discourse of Swami Vivekananda with Nicola Tesla (1895), the inventor and electrical engineer, the Swami noted a significant conformity of interplay of Vedic *prana*, *akasha* and *kalpa* with the western concepts of force, matter and time respectively. The mathematically proved and tangibly demonstrated wireless transmission of electricity by Tesla showed a close resemblance with the power of mind (*will* or *icchashakti*) to liberate the life force (*kriyashakti* of *prana*) from the neural networking and directing it to ascend the hollow cavity of spinal cord and transcend

step-by-step high to higher psychic levels to aspire absolute knowledge (*gyana Shakti*).

### 3.4. Integral Yoga and Humanistic Alternative Education

The science of integral and spiritual evolution does not contradict the classical scientific approaches of bio-physical evolution. Rather, the humanistic behavioural process incorporates the quantitative analytical methods as preparatory stages in the hierarchy of psychological and behavioural maturity for achieving social learning and practices, ecological sustenance and spiritual fulfillment. The former section of Figure 2 gives a visual impress of the evolutionary progress from the lower order life forms to higher order brain development and refinement towards intellectual achievements. The scientific and mechanistic world of fragmenting and compartmentalizing earth science and ecology for critical analysis shows a stagnating era of evolution marked by competition, ego-centric war and degrading ecology. The late 20<sup>th</sup> Century, realizing the need for liberation from the evils of stark materialism has taken a turn towards an organic world view as represented by the concluding section of Figure 2.

Michel Murphy (1962), the founder of Esalen Institute, California was greatly inspired by Sri Aurobindo's interpretation of Integral Yoga-Supermind (Aurobindo, 1914-20), the evolution of mental and vital consciousness transcending the physical body to the subtle planes of creative force and perfect knowledge and back establishing

an all-pervading role of the infinite consciousness in the ladder of finite manifestation, from gross to subtle. The initiation to the ancient system of yogic meditative practice moved Murphy to establish humanistic alternative education by cultivating the individual human potential seen through the larger schema of evolutionary spirituality and its relationship with the universe. The binary relationship of the individual-universal within the matrix of the infinite-transcendental is the whole living idea of Sri Aurobindo's Supermind and its evolutionary transforming power (*Para Iccha Shakti*).

### 3.5. Optimum 'biological-cognitive' functioning to achieve cooperative 'environment-behavioural' relationship

Indic theologian Frederick Spiegelberg and philosopher Allen Watts reached out to Sri Aurobindo, who sent Haridas Chaudhuri, a pioneer in Eastern and Western philosophies, to spread the movement of evolutionary spiritualism to the West (1951). The ancient concept of ascent from physical to mental and into the deep realms of inner experiences of the East synthesized with the social interaction and contemporary western social and therapeutic psychological applications. Psychologist Abraham Maslow, the architect of Humanistic Psychology (1934), investigated the complexities and patterns of human behaviour concentrating on features such as

simplicity, order, justice, richness, wholeness and so on. Maslow's Hierarchy of Needs (1943) and motivation has been designed to develop a humanistic therapy that helps individuals to identify a healthy and holistic means and purpose towards self-realization. Maslow indicates that there exists in every healthy individual a desire to attain an inner completeness or 'self-actualization'. Yet, the path to achieve the inner enrichment can be activated only when the immediate and burning need of hunger, shelter and safety have been accomplished. The fulfillment of physical and basic psychological demands would motivate individuals to look beyond personal and competitive spheres and seek for cooperative and community oriented interpersonal relationships. Gradually, a commitment to human dignity, social justice and value systems gives a yearning to ascend the hierarchical peak that represents optimal biological and cognitive functioning in consonance with the integrated matrix of environment. It propels ego-centric, fear driven beings to scale up in the evolutionary pathway to build a world of harmony, cooperation and compassion.

This concept of biological and mental evolution have shaped the scientific and cultural progress in such a way that stimuli from the external environ influence the physiological (functional) and psychological (cognitive) responses. The evolution of language system can be understood by drawing inspiration from the reciprocal interaction of biological and environmental output which can be expressed as bio-physical or psycho-somatic preparedness.



Figure 2: The path of evolution from survival and competition to reductive logistics to social learning to reach spiritual fulfillment





### 3.6. The focus of research technique indicated by Sri Aurobindo

'There must always be these two elements, the structure of the language, its seeds, roots, formation and growth, and the psychology of the use of the structure'

Sri Aurobindo

Sri Aurobindo (1914-20), with these words, explained the significance of studying the nature of root-sound of words from the earliest languages such as Sanskrit. The root-sounds are those rigid parts of speech implying a specific idea or form that exhibit varied character and organization in speech and in writing. This variety is governed by complex and independent transformational thought process of human mind. In this way, the rigidity of the root-sound renders freedom to verbalize individual interpretation of ideas and feelings shaped by the cognitive perceptions. Hence, it is imperative that the study of Indo European origin essentially necessitate in understanding the following:

- (a) The laws that influence in attaching a specific idea or object to the root-sound or seed and
- (b) The freedom of individual cognitive process embedded in human mind responsible for evolving into sub-sets of the root-sounds that manifest in different world cultures.

### 3.7. The ancient science of phonetics with relevance to the exploration of linkages of Indo European word conjugates

In this regard, Sri Aurobindo expresses the complementarity of rigidity and flexibility of sound in word formation. Any root sound has a specific idea or form implanted within it which makes the root

sound a rigid part of speech. When this rigid core passes through the freedom of thought process, i.e. the cognitive perception, it imparts a flexibility that can be observed across semantic migration of words in languages. This line of investigation departs from the current trend in comparative linguistic analyses which are mostly concerned with measuring the nearness of sound transformation in words. But it needs to be remembered that change from the parental sound is in the very nature of word progression while the adherence of the meaning or form to the root sound is an inherent quality owing to the independence of mental will or mental power which freely chooses its own way and this method can be applied without the risk of aberration to stitch the missing links to establish the lineage of Indo-European language families. So, the scientific rationale for Indo-European language call for an in-depth understanding of the embryonic part of the word i.e. the root sound which will help to recognize the structural changes in cognate siblings which are an alteration, addition or modification of the root sound and carry the inherent idea or meaning as the cognates traverse the geo-spatial distance and time.

Table 2 describes the structural (phonological) and expressive (phonetic) aspects of word formation when an individual responds or reacts to the stimulus from the external environment. Here, the *Tantra* narrates how the vibration of air by the vital life force stimulates an intense urge through the cognitive domain to generate structural changes in words. The sonic structure of sound or *sabda* of the word outside is actually the vibration of structural waves or *spandan* created by the respondent. The outside, the surround, is the macrocosm while the inside, the cognitive framework is the microcosm. The Vedas deal with the psychological aspects of word formation and explains the creative impulse in the realm of precognition which is in fact the recognition of arrays of manifestation in the external environment. So the meaning or *artha* in the physical world is the vector of the soft structure of passion, emotion, intention and richness that together comprise the *bhab* or vibration of waves inside. So, what is inside is what is outside. When a wave of experience collapses in the seas of experiences outside, then

Table 2: Syntactic and semantic expression of response-stimulus interaction

Domain	Structural / Syntax Based ( <i>Tantriki</i> )	Normative / Semiotics Based Ideational ( <i>Vaidiki</i> )	Environmental Semantics (Iconography)
Large	<i>Sabda</i> : Part of <i>Spandan</i> (Soft)	<i>Artha</i> (Hard / Worth)	Name-Form Bliss ( <i>A-nandan / Vilasa</i> )
Small	<i>Spandan</i> : Part of the <i>Sabda</i>	<i>Bhab-Artha</i>	<i>Nandan</i>

both macrocosm and microcosm gets activated. This is what had been revealed to Swami Vivekananda through a deep meditation when he expressed that 'the microcosm and the macrocosm are built on the same plan'.

Thus the entire expression of shape and shape grammar and the vibration of waves constitute the whole paradigm of collapse of cosmos and resurgence of cosmos from the microcosmic point of view. And this is what modern science is looking for from the point of view of quantum physics and this is the fundamental basis of the science of mental perception and spiritualism of the orients, where the dissolution of the universal experience is called the *yoga* and its resurgence is the *Tantra*. So, both shape and shape grammar is imbedded in the complex sequence of waves of sound or *sabda* in itself.

The above discussions reveal a world view, a shared conviction of a 'surface appeal' of the deep structure that soon led people from unrelated fields (architecture, music, politics, and even ritual studies like religion and deep ecology or spiritual studies) to use the term to express various concepts in their own work. This appeal at the generic level argues some kind of pre-existence of an universal appeal or grammar that may pervade various genre or application of genre in language, which is the very basis of 'cognates'. In other words, recognition by a user or a perceiver can also be termed as a pre-planned pre-cognition established universally in some deeper embed of language systems.

### 3.8. Reconstructing the linkages based on the thoughts of Sri Aurobindo and Abraham Maslow

In the above context, Figure 3 explains the working principle to reconstruct the evolutionary sequence of Indo European language system that reflects Sri Aurobindo's elucidation of orthographic transformational process and pattern of root sound and Abraham Maslow's Hierarchy of Needs (1943). The ascendancy from the lower to higher order of need has been reorganized or modified into a three tier echelon of Shallow ecology, Ecology and Deep Ecology. In other words, the scheme of categorization scales up from ground centric concrete themes to cognitive (psychic) level of aesthetic and emotive themes to deep ecological aspects based on abstract and subtle values and norms.

The Hierarchy of Needs is a process of psychological enrichment as



an individual reaches the satiety for material possessions and escalates to the higher planes of subtle needs of belongingness, sympathy and apathy and lifts the psyche to the spiritual realm of realization of the eternal within the self. This journey from the external (tangibles) to the internal (deep-ecological) shows a marked variance in the oriental process of meditative yoga which is an absolute internal (mental) process that silently disassociates the mind from the environmental and social stimuli and guides the vital life force to the fine-drawn realizations of higher and pure consciousness. In spite of the separate ways followed by the two schools, both aim for the same goal of attaining the spiritual or deep-ecological limitless (macrocosm) within the limited self (microcosm).

For the purpose of comparative exploration and analysis, complementary pairs of words are identified from contemporary cultures of Europe and Asia (India) that bear both phonological (*sabda*) and phonetic (*artha*) resemblance. The individual words from each group are then explored to bring out the etymological origin (the root-sound) as well as its semantic variations. The words have been explored and analyzed to arrive at their etymology or root and their orthographic transformation process in the word forms as well as the iconographic expressions and usages for both the branches. The findings are categorized in two parallel trunks of ramification of words with iconographic representations arranged and organized on the basis of shared characteristics or structural sequence before placing them into appropriate classes of modified Hierarchy of Needs proposed by Abraham Maslow to arrive at a rational synthesis or a world view of global epistemology of language system.

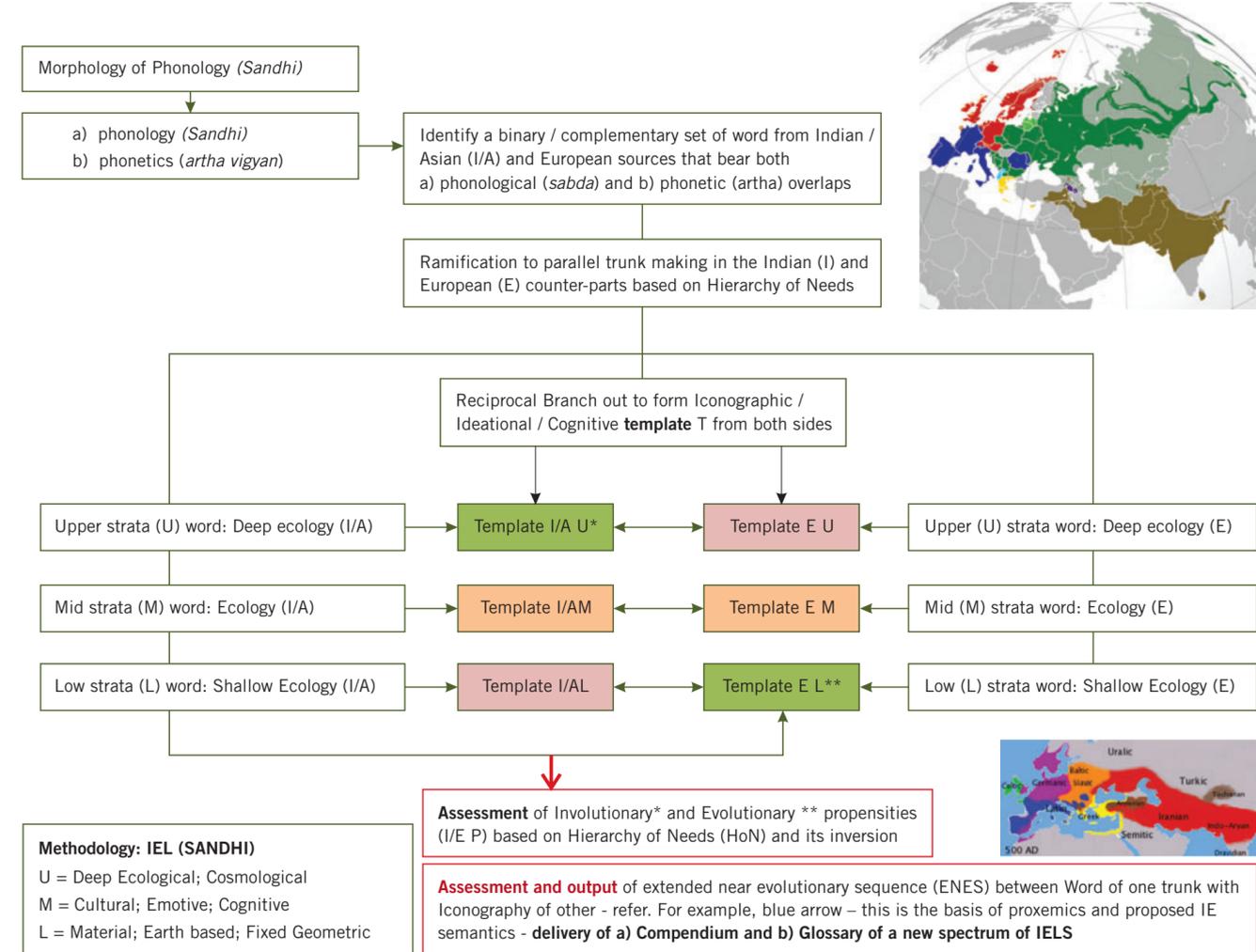


Figure 3: A Scientific Rationale of Indo-European Language Systems



## OVERVIEW OF THE TEMPLATES

The integrated approach for the study of the cognate word pairs of the east and the west has been conducted under the aegis Sri Aurobindo, the modern seer in the Indian subcontinent and Abraham Maslow, one of the pioneers of evolutionary spiritualism in the west. Sri Aurobindo elucidates the Vedic meditative and spiritual gateway to behold the cosmic consciousness within the individual consciousness and Abraham Maslow introduces the system of humanistic therapy that frees the mind from the concrete tangible need-based boundaries to the boundless bliss in the spiritual or deep-ecological level of existence.

The *Sabda (Sk.)*, the source of vibration of the sound waves or *Logos (Gk.)* the Word of God reveals through words and phrases to evolve languages and cultures and finds expression in art and architecture, philosophy and science, poetry and music over thousands of years. The present commentary based on the unified assemblage of the eastern and the western world view has been delivered through a seven stepped comparison and interpretation of cognate words to identify the incoherence that disrupts the natural flows and patterns of the evolution of world language families. The seven stepped execution involve in the weighing of the words from their point of origin to the on-going trends in dispositions and usage in the contemporary society.

Two languages, one archaic, that is, *Sanskrit* and another contemporary, that is, *Bengali* have been selected to represent the eastern or oriental group of languages. The western language group is represented by the *Proto Indo European (PIE)*, *Latin*, *Greek*, *Proto Germanic*, *Gothic*, *Old French* that

alternatively stands as the origin of most of the words of the world languages. The English language has been chosen as the modern language of the West, as the counterpart of Bengali in the east. PIE is the internationally accepted linguistic reconstruction of the origin of the world language families spoken by the proto Indo Europeans.

The ancient languages of Asia namely, Sanskrit and Persian words are often recognized as related to the PIE root and the archaic versions of Latin and Greek words, but hardly one finds the occurrence of oriental words as the source of world languages. The present enquiry into the Indo European cognates makes an assessment of the different word pairs from varied and independent areas of application to understand the differences and similarities of the thought process prevalent in the two separated zones of the earth. Further, the study probes into the deeply embedded philosophy associated with the words if any. The seven layers of words represent the

three hierarchical words agglomerations conceived through Aurobindo's Integral Yoga and Maslow's Hierarchy of Needs. Each of the seven themes display words across the three tier evolutionary scale ranging from the concrete tangible expressions (*shallow ecology*), to the emotive and cognitive expressions (*ecology*) to the highest level of subtle and abstract expressions in the spiritual or cosmic sphere (*deep ecology*). The seven modules identified for the analysis of words deal with seven independent concepts. Each module contains two sections; the first is an overview of the evolution of the concept in the world cultural zones followed by the analysis of a cluster of word cognates in that study area. The analysis of each of the seven sections presents an illustration of words, their original sound and meaning and the gradual evolution into different languages supported by pictorial representations of the meanings and applications in the respective languages of the east and the west.



## THE SEVEN TEMPLATES

The illustrative demonstration is complemented by a vivid explanation of the graphic elements. The first cluster of cognates is based on the anthropometric words belonging to the different anatomical areas of the human body. The second module deals with words forming the medical terminologies of organs in the human body and the branches of treatment in the biological science. The third group of words is selected from the arena of physical science, particularly from the two fundamental concepts of physics and chemistry. The fourth layer constitutes of a single word pair and its ramification of applications and usages in different languages since pre-historic era. The word belongs to the interface of natural and built environment or architectural layout. The fifth category of cognates represents the elements of environment and earth science across the language families. The sixth collection of words demonstrates the way by which different languages, ancient and modern, perceive the significance and applicability of numbers and shapes in the fields of natural and material science. Finally the seventh module embodies the agglomeration of subtle thoughts and emancipations at the spiritual or deep ecological realm of cognizance experienced by the ethereal minds born in different language and cultural ambiances.

The discussion is complemented by a closure on a peculiar collection of mantras drawn from the Rig Vedic mandala. '*Apri Sukta*', normally a systematic embodiment of a hierarchy of 11 mantras, has been chosen to explain the step-by-step journey of human evolution from the shallow to deep ecology. With this closure, a presentation of visual results and textual interpretations in view of the seven templates culminate to the surge of subtle thoughts and realms of the human mind and needs. Thus, a discussion on the *Apri Sukta* can become a concluding note to the twin Aurobindo-Maslow hierarchy driven approach proposed by the SandHI language initiative.

## TEMPLATE I: ANTHROPOMETRICS

### Introduction

*'Man is the measure of all things; of what is, that it is; of what is not, that it is not'*

*Protagoras (480-411 BCE)*

This utterance of the pre-Socratic philosopher meant that the sense and perception of an individual is his interpretation of truth in all things. Plato however used both the anthropometric bias and the universal impersonal bias in his works viz. Timeus Republic, Phaedros

etc. However, a deeper connotation of this statement can be observed in the metaphysical world view of the Early Grecian philosophy in the western coast of Anatolia around 600 BCE. The Milesian philosophers advocated the evolution of universe with all its entities from an amorphous existence. They explained that the proportions and measures in all natural elements, especially human beings (*micros kosmos*) are in conformity with the rules of the universe (*macro kosmos*). In other words, human proportions as well as the entire cosmos are formed and functions on an ordered matrix. This notion of harmonious array in human and cosmic proportions known

as the Golden Section by the ancient Greeks is reflected in the architecture of Ionic temples designed on the basis of human body measures. **Samkhya Philosophy** Pythagoras observed certain patterns and numbers repeatedly appearing in nature and went on to explain the structure of the universe by numerical ratios and numbers. Euclid proved that the diagonals of a regular pentagon (The Pythagorean symbol) cut each other in 'extreme and mean ratio'. The ancients considered that this unique proportion imparted a perfect balance and aesthetic harmony between the creator and the creations and is commonly known as the Golden Ratio or the Golden





of Sanskrit हस्त (*hasta*) which has acquired its form from the root sound क्री (*kr*) meaning 'to do'. The Sanskrit *hasta* and *kar* are synonyms and evolve from the same root *kr*. The variations in the usages of *hand:hasta* can be observed in the examples *hand-writing* or हस्तलिपि (*hastalipi*) and *handicraft* or हस्तशिल्प (*hastashilpa*). The idiomatic expressions of *hand (Eng.)* such as 'to give a hand' (to assist) and 'a good hand at' (to create) express the functional or creative aspects of the **Sanskrit** root *kr* which means 'to do something with the hand'.

The word *hand* leads to another set of cognate words, the *anta (Sk.): anti (Eng.)*. The dropping of h in both the words indicates the sense of 'other side' or 'reaching the other extreme'. The new cognate pair retains the root verbal meaning of 'to do', which in this case refers 'to reaching out'.

## Foot

The English word *foot* has been described at the lower right hand side of the template, aligned with the left leg of David. **Foot** is the modern version of the old **Englishfot**. However, the origin can be traced to the **PIE** root **ped** that has been transferred as **pedis (Lat.)** and **podos (Gk.)**. The word **foot (Eng.)** exhibit a shift of consonant from **p** (as in *Lat.* and *Gk.*) to **f**. पद (**pada**) (*Sk.*) is used to mean both 'foot' and 'step'. **Foot (Eng.)** and **pada, (Sk.)** both stand for the unit of anthropometric linear measurement which equals to 12 inches. In *Sanskrit / Bengali* and *English* languages the words show a tendency to get prefixed with other words and implant the idea or form of **foot**

in the new word thus formed. **Pedapath** or **footpath** and **padatik** or **foot-soldier** have been put up as two examples in the figure. In the *Vedas pada* refers to the divine feet of Lord *Vishnu*. The word **pada** (lotus) is a derivative of **pada** and represents the 'seat or vehicle of Goddess *Lakshmi*'.

The semantic variation of foot has given shape to new words and forms such as *podium* that means 'a raised platform' or 'projecting base of a pedestal 'and *fathom* which means 'get to the bottom of', 'penetrate with the mind' and 'understand'.

## Navel

The word **navel** has been placed at the lower left hand side of the template aligned with the right leg of David. The **English** word **navel** is a derivative of the **PIE** word **nobh** and has been verbalized in other European languages as **nafa (Angl. Sax.)** and **nav (Dan.)**. The meanings of **navel** in these languages are shown in the figure as the 'central part or the hub of the wheel', 'the depression or scar in the centre of the abdomen (**umbilicus**) where the umbilical chord remains attached with the foetus. The word also refers to the central part of a basilica, extending from the narthex to the chancel and flanked by aisles'. The *Sanskrit* word नभ (*nabha*) and the *Bengali* নভি (*nabhi*) indicate the 'highest or the central point', the 'nave' and the 'navel'. It is a derivative of the root word नभ (*nabh*) which describes the *Vedic* concept of a celestial and heavenly origin and is often identified with the 'sky'. The word in the two language families represent the unique theme of the central or the supreme infinity or

the point of origin which is manifested as the central point of tangible elements on the earth. In the *tantric* tradition of the orients the **navel** is the third centre of the *Kulakundalini Chakra (Astral nervous system)* commonly known as the *Manipura* or the *solar plexus*. The *Navel* or the *manipura* or the *solar plexus* is the centre of vital life force or *prana*. The astral nervous system draws cosmic energy from this centre to nourish the vital functions of the physical and mental self.

**Nabha (SK): nobh (PIE)** - Both the words possess near identical phonetic elements and the embeds the idea of a central or highest point.

The four cognate words described in Template 1 are just a representation of the different parts of the anatomy or external organs in the human body that are almost similar in phonetic quality as well as the form or idea attached to the words in most of the Indo European languages. The four cognates mentioned above and many others such as *Dental:Danta, nose:nasa, heart:hardik* belonging to the human body epitomize the lost linkages between what is apparently understood as divergent language families. As the anthropometric tendency is an echo of the underlying uniformity that regulates the cosmic order, the uniformity of thought, idea and form embedded within the words of the widely separated languages unfolds the existence of a common ancestry or the Aryan origin of the sibling languages in the contemporary societies.

The next template (Template II) delves deeper into the anthropometric words through the scientific world of medical science that is concerned about the health of the human body.



# TEMPLATE II: BIO SCIENCES: THREE BRANCHES

## Introduction

The conception of the knowledge of human anatomy and the theory and practice of therapy or treatment to rehabilitate health and promote longevity can be tracked down to the archaic documentation in the scriptures of ancient Egypt, Greece, Babylonia, China and India. A large body of historians upholds in unison the Egyptian origin of the Greco-Roman era of classical medicine. The Egyptian medical science centres on the religious offering and prayers to *Imhotep*, the God of medicine and travelled via the *Minoan* culture of Crete and reached the shores of Greece. The temples of *Aspecius*, the God of healing marked the earliest centres of medical practice in ancient Greece and the first recorded School of Medicine is Cnidus in 700 BCE. The modern perspective of the Western schools of medicine owes much to the Greek physician Hippocrates (c.460 – c. 370 BCE). The *Hippocratic Oath*, revised and edited by the World Medical Association continues as the norms of medical ethics to the present day functioning of the medical health system. The contribution of the Greek physician Galen (129 – 217 CE) in the fields of brain and eye surgeries, the Roman design and development of surgical tools and access to public health are some of the milestones that laid the foundation of the modern method and rational practice of medical science in the West.

A parallel tradition of human health can be perceived in the East that incorporates the physical, mental and spiritual states of an individual. The oriental cognizance of anatomy and medical health has been widely dealt in the *Atharva Veda* and the *Rig Vedas*, the two most ancient and contemporary traditions around 7000 BCE and before. The hymns attest the existence of *Yoga* and *Ayurveda*, the two parallel systems for healthy life passed on to the Vedic sages as direct

revelations from the cosmic source of creation. The period from 800-600 BCE is deemed as the golden era when physician Charaka and Surgeon Sushruta compiled the sacred wealth of diagnosis, treatment and surgery in great detail. Charaka dedicated the *Charaka Samhita* to Sage Punarvasu Atreya, the father of *Ayurvedas*, who belonged to the clan of Sage *Atri*, one of the seven Sages (*Saptarshis*) from the *pre-Vedic* era. Sushruta in his book refers to Divodasa, the incarnation of Dhanvantari as the father of surgery. Patanjali's *Yogasutra* embodies the gift of *Shiva Shakti* – the integration of physical body with the cognitive faculties to attain the highest understanding of self-realization, a perfect equilibrium of body and mind. The continuity of the Vedic system can be observed in the Buddhist literary compendiums. The *Ashtanga Sangraha* is one such source that reflects a blend of traditional methods with the indigenous Tibetan ways of therapy and surgery. The trend of integrating the best of medical interpretations and practices continued. The pre and early colonial period witnessed the introduction of Indian medical system being introduced in the West by Dutch and Portuguese settlers in India and the waves of the Western medical education washing the eastern shores.

Today, the teachers and practitioners of health worldwide show a strong inclination for a holistic approach towards management and prevention of ailments that primarily focus at the general well-being of individuals. Individual health is viewed as a balance among the physical, psychological and spiritual realms as well as impacts received from the immediate environ or the society and not merely restricted to the absence of diseases. The rational techniques of organized health management have incorporated *ayurvedic* and *yogic* elements of the East that matures to become a holistic syncretic health system.

## Interpretation

The languages of the two medical traditions of the East and the West have been compared through a study of pairs of cognate words belonging to the two discreet parts of the globe. The phonetic resemblance and meaningfulness between Sanskrit/Bengali and Latin/English words portrays a shared heritage of the past that gradually dispersed yet preserved the words with their thoughts and forms across temporal and spatial dimensions.

**Template II** highlights the words that determine and distinguish the three branches of medical science, namely, **neurology**, **osteopathy** and **geriatrics**. All the three words are actually a combination of two concepts, '**neuro + logy**', '**osteo + pathy**' and, '**gere + iatric**'.

## Neurology

The upper part of the template illustrates the different words in the field of *neuro-science*. The words **nerve (Eng.)**, **neuro (Gk.)** and **nerf (OFr.)** have descended from the PIE root **neu** that stands for both 'nerve' and 'tendon'. In the field of scientific nomenclature, the **Greek** version of **neuro** has been accepted worldwide. **Neuro** has later evolved into many allied terminologies such as the **neuron**, **nerve** or the **nervous system**. The **Sanskrit** root of **astral nerve** is नड (**nada**) which means 'motion'. It is through these नडि (**nadi**) or subtle passages called *sushumna* that the vital force or *pranic* current flows. The English word **sinew** is synonymous to the word **nerve** and is a derivative of the **PIE** root **\*sey-** that means 'to connect'. There is also a synonym of **nadi** in Sanskrit called स्नायु (**snayu**) which resonates



with the **English** equivalent **sinew**. The diagram at the centre of the **neurology** section depicts the different parts of a **neuron**, that is, the **soma**, **axon** and **dendron**. The word **Soma** has been derived from **PIE** root **\*seu-** which means 'juice' and the derivative **soma** (*Gk.*) indicates the 'body'. The modern science defines **soma** as the 'cell body of a neuron which contains the nucleus and other structures floating in a fluid-like environment names cytosol'. These structures support the chemical processing of the neuron, the most important of which is the production of neurotransmitters. The Sanskrit word **सोम (soma)** is an intoxicating drink prepared from a plant and was used in *Vedic* rituals. The drinking of the elixir was believed to grant control over senses and attain the light of God. **Axon**, also called **nerve fibre** carries the nerve impulses away from the cell body. Originally **axon** is a Greek word which means 'the axis of the vertebrates' and has evolved from **the PIE** root **\*aks-** meaning 'axis'. The Sanskrit complement is **अक्ष (aksa)** and conveys the meaning of 'axis', 'pivot' or 'axle'.

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**Dendrons** are thread-like extensions of the cytoplasm of a neuron; they typically branch into tree-like processes and compose most of the receptive surface of a neuron. The **PIE** root **\*deru-** stands for the 'tree' and sometimes implies the 'oak tree'. **Dendro (Gk.)** and **Dendron (Gk.)** have semantically evolved from the **PIE** **\*deru-** and retain the root form of tree. The **Sanskrit** word **दारु (daru)** which also refers to a 'tree' replicates the **PIE** root sound. A **dendrogram** (from Greek **dendro** "tree" and **gramma** "drawing") is a tree diagram frequently used to illustrate the arrangement of the clusters to explain taxonomic relationships. **Dendrograms** are often used in computational biology to illustrate the clustering of genes or samples.

**nāli (Sk.): neuro (Gk.)** – The consonants **n** and **r** (or **ḍ, Sk.**) and their phonetic expressions dominate the idea and forms attached with the semantic variations of **nerve** in most of the Indo European languages. The pronunciation of **ḍ** and **r** are identical in **Sanskrit** and **Greek** languages respectively.

The term **logy** combines with **neuro** to form **neurology** which is the branch of medicine concerned with the study and treatment of disorders of the nervous system. The word **logy** is derived from the **PIE** root **leg** meaning 'to collect' or the **PIE** **legein** that means 'to speak'. The derivatives **logos (Gk.)** refers to 'the divine Word' and **logion (Gk.)** embodies the 'sayings of Christ' and 'the ancient source from which *Gospels* were compiled'. The word **logy** is the manifested output of the **Neo-Platonic** word **logion** meaning 'a discourse or speech on the subject of interest'. The **Sanskrit** word **लग्न (lagna)** is defined as the 'ascendant' by the *Vedanga Jyotisha*, one of the earliest known texts on astrology and astronomy. **Lagna** is the 'first moment of contact between the soul and its new life on earth'. This 'decisive moment or time for action' is directly related to the 'sayings' (as in **Logos** or **legein**) or '*shabda (Sk.)*' or the sound current of the farthest or the highest origin which is the source of all speech, discourse and logic. The nervous system is a complex, sophisticated system that regulates and coordinates body activities. It has two major divisions, namely, the Central nervous system consisting of the brain and spinal cord; and the Peripheral nervous system that includes the neural elements, such as eyes, ears, skin, and other sensory receptors. The ancient oriental tradition of the treatment of nerves is a self-renewal process of purification of the subtle nerves by activating the astral nervous system by means of *kulakundalini yoga*. Since the gross nerves and plexuses have a close relationship with the astral centres or *chakras*, the vibration produced in the physical centres have desired effects on the astral centres. *Naadi shodhanam* as illustrated by the yogic posture at the extreme right of the neurology section is one of the most commonly practiced techniques in yoga which literally means the cleansing of the subtle nervous system.

This practice of self-purification aims higher than mere restoration of a balanced healthy body. It is aimed at the awakening of the sleeping divinity within individuals in the form of a coiled serpentine (*kulakundalini, Sk.*) to transcend the gross or **stale** (**sthula**)

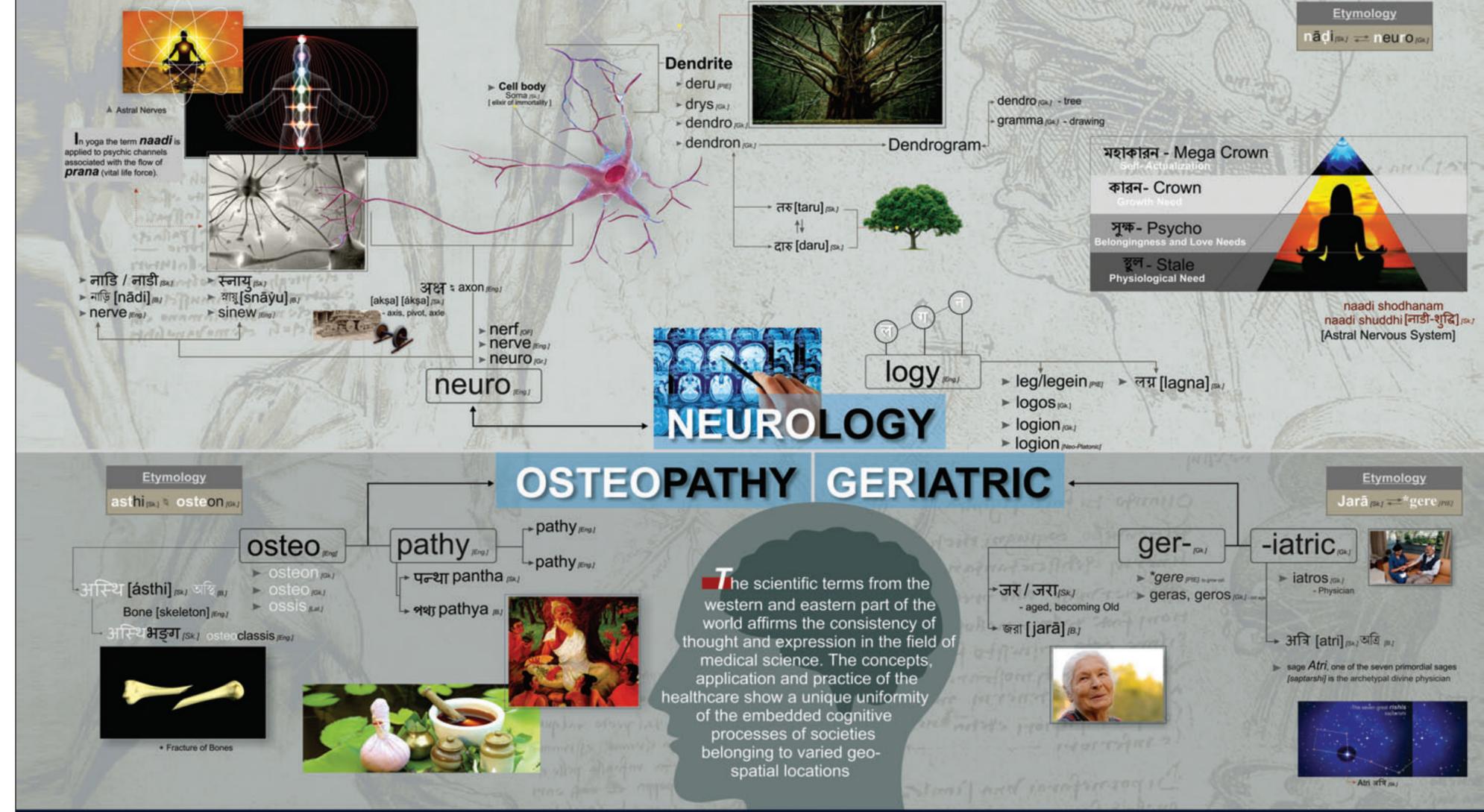
bondages of ego, possessiveness and concrete expressions through language and creativity in the mundane world and lift the mind to the **psychic** (**सूक्ष्म, suksha**) realm. This subtle cognitive plane of mind and intellect marks a transition between the senses of the physical and the astral body. The **crown** (**कारण, karana**) or the causal plane is the gateway to the higher collective consciousness and in this orbit sound acquires colour and form to culminate as the highest impulse of speech. Here, the divinized mind experiences the vision of the highest knowledge. Beyond this is the **megacrown** (**महाकारण, mahakarana**) or the level of the primary cause where the consciousness completely unites with the farthest and highest source of the primordial sound, the divine Unity. In the template, the yogic posture is set within the pyramidal diagrammatic representation of **Maslow's Hierarchy of Needs (HoN)** which is a motivational theory in psychology. Maslow argues that while people have met with the basic physiological needs, safety and security (corresponding with **stale** or **sthula**), they seek to aim for successively higher needs of belonging-ness, affiliations, esteem and recognition (**psychic** or **सूक्ष्म, suksha**). The fulfillment of these broad deficiencies leads an individual to the next level of fulfilling the growth needs (**crown** or **कारण, karana**). This is a psychic level where the mind explores and understands the true meaning of his/her existence and shows deep respect for ecology and a holistic way of life. Finally, at the highest point of the triangle a person truly enjoys the peak experience through self-fulfillment or **self-actualization** (**mega-crown** or **महाकारण, mahakarana**). This spiritual level of inner completeness takes the person beyond ego, competition and criticism and the individual embraces all elements (living and non-living) with the feeling of integration with the infinity.

**Osteopathy**

The lower section at the left side of the template describes the term **osteopathy** which is a fusion of two different terms, **osteo** and **pathy**. **Osteopathy** is a branch of non-invasive manipulative therapeutic practice by the way of diagnosis and treatment of the musculo-skeletal system of the human body and aims to provide a balanced coordinated functioning of the body parts to render health and well

# BIO-SCIENCES :

3 BRANCHES





being. **Osteo-** is a modern **Greek** term that owes its origin to **osteon (Gk.)** and **ossis (Lat.)** suggesting bones. The **Sanskrit** अस्थ (astha) or अस्थन् (asthan) that indicates the base of weak cases has produced the words **Sanskrit** अस्थि (asthi) and **Bengali** word অস্থি (asthi), denoting bone or skeleton. **Osteo -** and **asthi** usually remains prefixed with verbs to form words related to bones and skeleton system. One such pair of words is **osteoclassis** and अस्थिमङ्ग (asthi-bhaṅga ) which defines the fracture of bones. The term **pathy** can be defined by a system of therapy to treat diseases and has derived from the **Greek** **patheia** and **Latin** **pathia**, both of which denote 'suffering', 'disorder' and 'disease'. The origin of **pathy** in the East can be traced in Sanskrit पन्था (**pantha**) or path or way (of treatment, in this respect). The **Sanskrit** word पथ्य (**pathya**) and the Bengali পথ্য (**pathya**) indicate a suitable diet for the sick and convalescent.

अस्थि (asthi): **osteon** (Gk.) – The pronunciation of **ast** (Sk.) and **ost** (Gk.) generate identical readings. The variations in **th** (Sk.) -**t**

(Gk.) and **'i** (Sk.) - **on** (Gr.) have occurred as a result of the semantic migration of the word. Both the words bear the form of bone or skeleton.

### Geriatric

The word **geriatric** located to the right of osteopathy is again a combined form of two terms, **ger-** and **-iatric**. **Geriatric** is a branch of medicine that is concerned with the health problems affecting the aged people and focuses on prevention and treatment of disease and disability and well-being of the old age. The **Greek** **geras** or **geros** is a derivative of the **PIE** root **\*gere-** that means 'to grow old'. जर (jara, Sk.) and জরা (jara, Beng.) also convey the idea of the process of aging, old age and senility in the east.

The term **iatric** has acquired from the **Greek** word **iatros** that carry the meaning of 'physician'. The term has a parallel in the ancient early **Vedic** hymns where sage **Atri** (अत्रि), one of the seven primordial sages

is the archetypal divine being and the preceptor of the clan of physicians.

**Jarā**(Sk.): **\*gere-** (PIE) – The **j** (Sk.) and **g** (PIE) take the same sound and thought and there is a shift in the vowel from **a** (Sk.) to **e** (PIE).

The scrutiny of the scientific words from the Western and Eastern parts of the world affirms the consistency of thought and expression in the field of medical science. The concepts, application and practice of the healthcare show a unique uniformity of the embedded cognitive processes of societies belonging to varied geo-spatial locations. The subsequent template (Template 3) will consolidate further on a deeper uniformity based on the two foundations of modern science.

Template III is accordingly devoted to the word cognates that constitute the components of these two domains, that is, physics and chemistry.



## TEMPLATE III: UNIVERSAL SCIENCES

*'The unity and continuity of Vedanta are reflected in the unity and continuity of wave mechanics. This is entirely consistent with the Vedanta concept of All in One'*

*Erwin Schrödinger*

*'When I read the Bhagavad Gita and reflect about how God created this universe everything else seems so superfluous'*

*Albert Einstein*

The discovery of the behaviour of gases by Robert Boyle in the 1600s opened the gateway of chemical science that soon pervaded the European scientific community towards profound scientific discoveries and inventions in the next few centuries and till this day serve the foundation of global interpretation of chemistry. Scientists such as Jacques Charles (Laws of Proportions, 1794), Lavoisier (Methods of Chemical nomenclature, 1789), Avogadro (Avogadro Number, 1811), Mendeleev (Periodic Tables of Elements 1869) belong to Europe's illustrious body of scientists whose contributions paves the world of chemistry as it is today.

The middle ages (600 – 1500 CE) was the golden age of chemistry in the Arab countries centred on Baghdad marked by the impressive growth of industrial chemistry. The Arab world was adept in extraction of metallic ores, crystal and glass making and preparation of dyes and manufacture of paper. But the highest contribution was in the field of *al-kimiya*, the transmutation of baser metals into gold. The knowledge embodied in textbooks and laboratory manuals travelled west through Islamic Spain and gave birth to Latin term alchemy and iatro-chemistry, the branch of alchemy dealing with medicinal chemistry. However, the origin of chemistry can be traced further back in ancient India and Egypt. Chemistry and medicine developed

conjointly from the profound knowledge of plants, herbs and metallic compounds used for preparing *Ayurvedic* medicines for treatment and longevity. The **Sanskrit** word *padartha* literally means 'meaning in steps' and indicates the stages of experimentation involved to produce the purified liquids or the *rasas* and slurries or *dravya*, the essentials of the *Rasa Vidya* that is the science of liquids. The treatises of the Buddhist physician Nagarjuna (150-250 CE) accounts for the detail application of Indian metallurgy and alchemy and the technology to produce precious metals from base metals. The rich tradition travelled west through the interactions with the old Persians, the Greek and Chinese travelogues and the adaption of *Ayurveda* and *Siddha* culture of India into the *Unani* (Ionanii) medicine of the Arabs, which is also Judeo-Grecian or Neo-Alexandrian.

### Interpretation

**Template III** exhibits the fundamental terminologies that form the foundation in the field of physical science. The flow of explanation commences from the extreme left with the word **matter** and elaborates **physics** with its two major wings, namely **statics** and **dynamics** in the top half of the diagram. The lower half of the figure describes **chemistry** and its classifications into **acid** and **base**.

### Matter

Most areas in the physical science can be discussed and explained in terms of *matter* or energy. In general, *physics* deals mostly with the motion and energy of matter while *chemistry* concentrates on the properties and behaviour of matter. The **PIE** root of matter is *mater* which means 'origin, source or mother'. Subsequently *materia* (Lat.) meaning 'substance from which something is made' has evolved from the **PIE** root and the words *matere* (Fr.) and *matter* (Eng.) are the

### Introduction

*Physics* and *chemistry* are the two foundational wings of *physical science* that encompass the entities of the organic and the inorganic world. The ancient worldview of physics is a unified nature of existence that manifests as interrelated occurrences and events in the physical world. The *Milesian* school of thought (590-530 BCE) conceived of a primeval amorphous state of existence and planted the seed of classical schools of physics and mathematics in the west. The *Milesian* philosophers were greatly influenced by the mysticism and spiritual experience of the cosmogony prevailing in *Babylonia*, *Egypt* and the *Far East*. In the *Vedic* India, the source of atomic energy was perceived as the *parmanu* (*param* meaning 'beyond' and *anu* meaning 'atom'), the indestructible eternal particle. The concept of atomic composition of matter and relativity (*sapekshavada*) has been deeply entrenched by the philosophers Kashyapa and Pakudha Katyayana in the 600 BCE. The metaphysical view of matter was opposed by Aristotle, Archimedes and Ptolemy who established mathematical theories, strict laws guided by experiments and finite deductions that paved the path for scientific revolution shepherded by Copernicus, Galileo, Descartes and Isaac Newton. The 20<sup>th</sup> century scientists recognized the potential of the weightless fluids like heat and electricity, discovered light as a form of electromagnetic radiation and evolved kinetic molecular existence of gases. These breakthroughs through physical and chemical analytical treatments culminated in the forms of modern quantum physics and the theory of relativity that for thousands of years remained shrouded in the cloaks of mysticism and black magic. Niels Bohr, Heisenberg and Einstein found unique consistency of their scientific research with the Vedic explanation of sub atomic particles, the cosmic egg or *Bramhanda* and the infinite cycles of expansion and total collapse of the cosmos.

Here are a few words of the great minds of the west who ushered the platform of unified thoughts of the east and the west:



happening semantic variations that convey the meaning of 'subject, substance or material'. The Sanskrit word मृत (mr̥tá) depict the 'dead or desiccated or stationary' form of मृत्तिका (mṛttikā) or 'the earth' and the word मात्र (mātra) means 'an element, elementary matter'. The Bengali derivative मात्र (mātrā) subsequently establishes the modern scientific perception of matter that is, 'dimension and mass'.

mr̥tá (Sk.): mater (PIE) – The conjugation of mṛ has been separated by placing r at the end after the vowel e to make the pronunciation simple.

### Physics

Physics is concerned with nature from a very large scale (the entire universe) down to a very small scale (subatomic particles). All natural (or man-made) phenomena that are measurable follow certain behavior that is in accordance with the most basic principles studied in physics. The western etymology of the word physics has been traced to Greek phusis denoting 'nature'. Later the words phusika (Gk.) meaning 'natural things' and physica (Lat.) or physic (Lat.) suggesting 'physical things' were the siblings of the old word phusis (Gk.). Physics, the current word in usage is the plural of obsolete physic (Lat.). In the eastern part of the world the Sanskrit root पृष् (pṛṣ) and the later derivatives पृषति (pṛṣati) and पुष्ट (puṣṭa) indicate the natural flow of incessant birth, growth, development. This concept of the bubbling flow of nature is reflected in the philosophy attached to phusis or the science of physics.

pṛṣ (Sk.) - Phusis (Gr.): The sequence of pṛ renders the primary sound in both the words. The addition of h after the consonant p forms the labio-dental sound ph (Gr.) and intensifies the gentle pronunciation of p (Sk.)

### Statics

Statics as a branch of physics (mechanics) is concerned with the equilibrium state of the bodies under the action of force. When a system of bodies is in static equilibrium, the system is either at rest or moving at constant velocity through its center of mass. It can be understood as the study of the forces affecting nonmoving objects. The PIE root \*sta- meaning 'to stand' matures to statikos (Gk.) and

Staticus (Lat.) and retains the idea of 'causing to stand and skilled in weighing'. The new Latin derivative static pertains to the science of weight and its mechanical effects. The parallel thought is found in the Sanskrit word स्थिति (sthiti) that forwards the essence of 'staying or remaining or being in any state or condition'. The Bengali equivalent স্থিতি (sthiti) conveys the idea of 'equilibrium or stability' and 'resistance to motion'. The word sthiti is the second state of the cosmic cycle of continued existence and maintenance of life preceded by utpatti or 'coming into existence' and followed laya or 'dissolution'.

sthiti (Sk.): \*sta- (PIE) – The words prefixed by st establishes the theme of stability and maintenance. The examples of such words are stall (a stand or booth), stage (platform), story (preservation of words and thoughts) and so on.

### Dynamics

Dynamics is the branch of physics (mechanics) which deals with the effect of force on the motion of bodies. It can also be understood as the study of the forces affecting moving objects. The origin of the word can be tracked down to Greek words dunamis and its derivative dunamikos meaning 'power' and 'powerful' respectively. The present form of dynamics is a relative of dynamique (Fr.) denoting 'force produced by motion'. The imagery of the lingual constructs and purpose of dynamics rests with the word दहन (Sk. dahana) that speaks of 'burning, scorching and consuming by fire' and दहन (Beng. dahana), the Sanskrit derivative specify the concept of combustion. The words directly indicate the Surya (sun) and Agni (fire). The sun is the Vedic symbol of vitality that infuses energy into all organic and inorganic elements and is a source of constant changes that maintain an integrated balance of nature and its forms. The hydrological cycle illustrated in the top right had side of the figure describe the unending transformation from evaporation, condensation, precipitation, infiltration and evapo-transpiration energized by the sun. Agni the God of fire is personified as the sacrificial media who purifies the offerings and carry oblations to the divinities. In a deeper sense, the meditative fire purifies the egos and desires to evolve into a universal being with pure awareness.

Diana, the Greek Goddess is the symbol of 'Fire and Fury' – the power of wind, the very basis of dynamism. Today, the movement of the

Sacred Feminine, the Wicca of the West (wizard / witchcraft in modern terms) is the extension of the ancient cult.

### Chemistry

Chemistry is concerned with the transformation of one kind of substance into another (chemical reactions). Explanations and predictions are related back to the underlying atomic structure, giving more emphasis on the methods for the identification of molecules and their mechanisms of transformation.

The western philosophers associate the origin of chemistry with the word alchemy, relevant with the medicinal and pharmaceutical practices of ancient Arab, Egypt and Greece. The Arabic word al-kimiya explains the 'transmutation of baser metals to gold'. The Egyptian khemia describe the 'transmutation of earth to crystals and metals' while the Greek word khymeia applied to pharmaceutical chemistry and the art of alloying metals. The Vedic concept of alchemy is implanted in the Sanskrit word क्षेम (kṣema) and its Bengali version ক্ষেম (kṣēma). Both the words convey the meaning of 'attainment or acquisition of unattained things and preservation of what is attained' and include a rich repository of the science of ayurvedic preparations and industrial applications of chemical compounds.

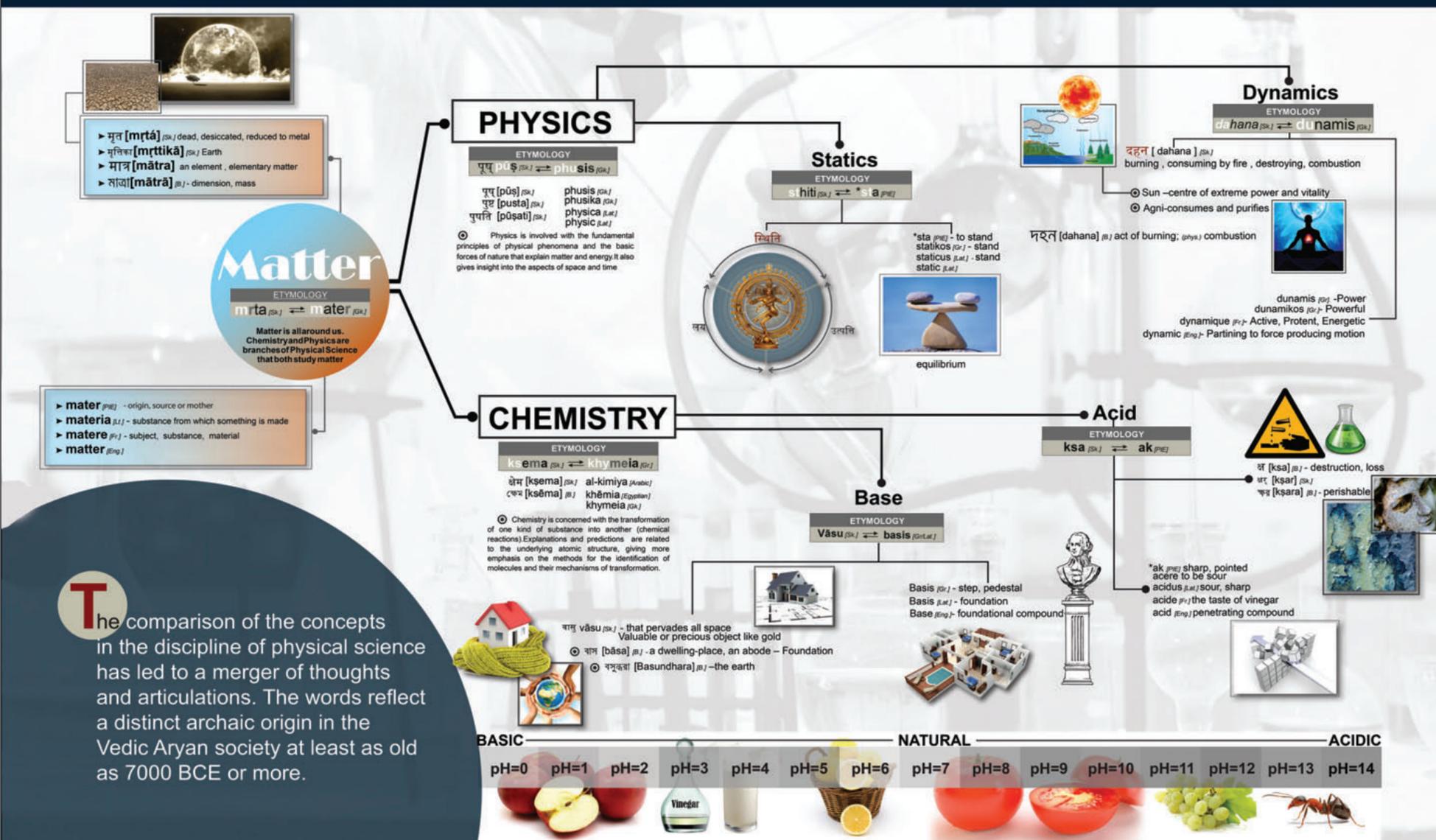
kṣema (Sk): khymeia (Gk.) - Both the words behold the root concept of ksh consistently evident in the semantic manifestation of the term chemistry from the prehistoric period to the present day. The letter क्ष (ksha) and च (ch) are both pronounced like the Bengali pronunciation of ক্ষ (kh). The words have been affixed with 'artist+-ry' or artistry meaning 'artistic ability' commonly used with chemistry, dentistry, palmistry and so on.

The words acid and base, the two common solutions with acidic and basic properties in chemistry have been highlighted in the bottom half of the figure.

### Acid

The word acid originates from the PIE root ak- which means 'sharp and pointed.' The complete words like acidus (Lat.) meaning 'sour and sharp' and acide (Fr.) meaning 'the taste of vinegar' carry the thought

# UNIVERSAL SCIENCES



The comparison of the concepts in the discipline of physical science has led to a merger of thoughts and articulations. The words reflect a distinct archaic origin in the Vedic Aryan society at least as old as 7000 BCE or more.



and forms of the *PIE* root sound. Today the word acid describes the 'penetrating compounds' and hence conveys all the attributes of its ancestors. The Oriental equivalent is the *Sanskrit* root sound ऋ (*kṣa*) bears the action of 'wasting away' suggesting 'having eroding or abrasive qualities'. The derivatives ऋर (*Sk.kṣar*) and ऋर (*Beng. kṣara*) define 'bitter, sharp and oozing acidic substances' have also represented in Sanskrit what is corrosive, decaying, transient, that is, properties and features of all the acids that the world knows. Even the ancient Upanishads classified Brahman as two –*Akshara* and *Kshara*, that is, permanent and transitory (Bhagavat Gita, Chapter 18).

## Base

The word *base* is a substance capable of reacting with an acid to form a salt and water, or (more broadly) of accepting or neutralizing hydrogen ions. It derives its origin from the *Greek* word *basis* denoting

'step or pedestal' and *Latin* word *basis* meaning 'foundation'. The *English* word *base* known as the 'foundational compound' in the field of chemistry is a derivative of *basis (Gk./Lat.)* The eastern complement of base is encapsulated within the *Sanskrit* word वासु (*vāsu*) which 'pervades all space'. The *Vedic* cosmic interpretation of 'the soul or the Supreme Being of the universe' has been personified in the form of God Vishnu in the later *Vedic* period. The word also means 'any valuable or precious object' suggesting the image of the supreme soul in the tangible precious elements of human possession. The Bengali বাস (*bāsa*) designates 'dwelling place, home, habitat' that is, the micro symbols of the 'earth, the most stable foundation' known to mankind. The *vāsu (Sk.)* has been used as a foundational compound since the oral traditions of the Vedic society while the coinage of the chemical sense of base in the western world is attributed to the French chemist Guillaume-François Rouelle in the year 1754.

**Vāsu (Sk.): basis (Gr/Lat.)** –The two words not only contain the phonetic elements '*bas*' (*Latin or Greek* pronunciation of '*b*' is '*v*' in *Sanskrit*) but also preserves the features of stability and permanence associated with the word 'foundations'.

The comparison of the concepts in the discipline of physical science has led to a merger of thoughts and articulations among the languages and expressions in different ethnic and cultural communities. Moreover, the words reflect a distinct archaic origin in the Vedic Aryan society which is at least as old as 7000 BCE or more. Through the understanding of the physical and chemical property of elements, our knowledge of the surrounds, the environ grows.

The upcoming template (Template IV) is a treatment of Indo-European cognates through which a rendition of the elements of earth and environment critical for the sustenance of life on earth has been best portrayed.



# TEMPLATE IV: ECOLOGICAL CORRESPONDENCE

## Introduction

The ancient Indians viewed environment as the sacred space and a spiritual realm that maintain the elements of the universe – the land, water, light, air and ether in perfect coexistence. The *Atharva Veda* mentions the word '*chandamsi*' which embodies the three vital constituents, the water, air and plants that sustain mankind on the earth. The Rig Vedic seers explained *Prithvi* or the earth, *Dyau* or the heaven and *Antariksha* or the intermediate space between the former two as the three subtle levels of the universe. The *Prithvi Sukta* in the *Atharva Veda* is an invocation to the mother earth for endowing her children with the supporting systems to secure life and livelihood. The *Vedic* sages took the sacred vow to protect the mother against all infringements to the nature's law of equilibrium and accepted moral responsibility towards the conservation and sustainability of the sanctum.

A parallel philosophy in ancient China is the *yin* and *yang* concepts that preserve the natural rhythm of the environment. The *Yin* environment represents the dark, still, quiet and secluded physical features of nature and the *yang* environment is attributed with the warm, colourful, energetic functional qualities. These two complementary yet opposing forces account for the dual aspects of the same phenomena (for example the light and darkness) or two states of matter (the sky and the earth). The rise and fall or the advance and retreat of the two forces are reflected in the diurnal,

seasonal and annual changes that repeats in ever ending cyclical order.

A mirror image of the oriental co-evolving process of creation and dissolution can be observed in ancient Greece where the first divinity was identified as *Gaia*, the mother earth. The archetype deity evolved from the primordial chaos and created life from her sacred womb and in due course of time the creations returned to her. *Gaia*, the mother mature is a symbol of the ecosystem that actively nurtures life and health by integrating the life processes into a holistic balance.

The archaic philosophy of preserving the earth and her environment has gradually surfaced as a critical concern owing to the competitive war for success and achievements that regarded natural heritage as opportunities and possibilities for fulfilling tangible goals and desires. Centuries of extortion and consumption of organic and inorganic assets created a void and severe imbalance that poses fatal threats to life functions. In the face of the imminent danger looming ahead, the conscious minds have come together to organize movements of awareness for environmental protection and conservation. The Gaia Theory of James Lovelock (1960) recalls the values of earth- environment dynamics by saying that the functioning of the self-regulatory mechanism of nature is possible when and only when the organic and inorganic life processes have the unhindered access to co-exist and co-evolve through the process of interaction and integration. In other words, 'life maintains conditions suitable for

its own survival'. The Gaia Theory is an eye-opener to the world communities to withdraw unwanted intervention and to feel and blend with the rhythm of nature in all works of life.

In the 1900s, the world poet, Rabindranath Tagore, reiterated the Vedic call to protect and preserve the environment and emphasized on the reciprocity of human-nature relationship with an holistic approach of sustainable continuity of life on the earth. The poet's untiring efforts as an active environmentalist are expressed in the vast literary works that portrays his deep love and concern for nature. He regarded himself as an integral component with the leaves, flowers, rain and wet earth that together resonate the vital life force of the cosmic order. Earth conservation by the means planting of tree (*briksharopan*), tilling of land (*halakarshan*) and celebration of arrival of monsoon (*borshamongo*) are some of his initiatives to promote consciousness and responsibility towards the natural heritage. Tagore reached out to render his thoughts into action by creating an organic habitat of Shantiniketan amid the greenery of southern West Bengal (India). The place is a repository of the Vedic image of farmstead livelihood with traditional nature-based handicraft industry and *gurukul* method of learning and education in an eternal embrace of spiritual and meditative frame of mind and way of life. Today, the worldwide environmental programs and movements draw inspiration and motivation from the noble enterprise and vision of the sage poet.





(*Gk.*) meaning 'oak' and *drevo (Russ.)* meaning 'tree' and 'wood'. The *Old English* words *treo* and *treow* have rendered the present form of *tree*. The *Sanskrit* counterpart is the root sound द्रु (*dru*) meaning tree.

दरु (*daru, Sk.*), तरु (*taru, Sk.*) and तरु (*taru, Beng.*) are the derivatives of *dru*. The highest image of the tree in the *Vedic* hymns is the *kalpataru*. Shiva Shakti, the cosmic power beyond all manifestations, reveals His imperceptible yogic knowledge of truth in the form of a wishing tree or *kalpataru*. The tree of divine consciousness bears the fruits in the form of Archetypal divinities – the eternal *Kumaras*, to guide the limited minds of the world (*Jiva Tattva*) to achieve the Limitless (*Mahat Tattva*). The extreme lower left hand side corner displays the image of the *kalpataru*.

*dru (Sk.): \*deru(PIE)*: The combined phonetic reading of *dr (Sk.)* has become simplified in *deru (PIE)*, an orderly element of change observed between the Sanskrit and the mother languages of the west. The meanings of both the words indicate tree, wood or log.

The elements of the ecological system are inevitable for sustenance of life forms and see no east or west. Seeds, vegetables, trees and mountains are the reservoirs of natural heritage and life support device all over the world. So are the words that persistently indicate a common origin, sprouting from a seed and developing branches on every side laden with fruits. The new seeds from the fallen fruits adapt to the new environ and thrive as new generation hybrids through a continuous process of ramification without losing the roots.

The next template (Template V) lays emphasis on a single cognate pair which is an impression of nature in the man-made built environment and details the journey of the word from its source through the evolutions over wide time and space zones to its ramified features and occurrences in the present situation.



## আল :: AISLE [EASTERN AND WESTERN SEMANTICS]

*'Without symmetry and proportion there can be no principles in the design of any temple; that is, if there is no precise relation between its numbers, as in the case of those of a well-shaped man.'*

Marcus Vitruvius Pollio

### Introduction

The Roman architect Vitruvius, in his book 'de Architecture' (1624) declares that the role of proportions in the layout of spaces renders harmony or aesthetic symmetry in architectural design. Vitruvius believed that architecture is best represented when based on the proportions found in the shape of the human body. He reasoned out his viewpoint in the following lines:

*'Therefore, since nature has designed the human body so that its members are duly proportioned to the frame as a whole, it appears that the ancients had good reason for their rule, that in perfect buildings, the different members must be in exact symmetrical relations to the whole general scheme.'*

The mention of 'the ancients' perhaps goes back in times of the coexistence of a harmony that exists between the cosmic plane and the dualistic forms of nature expressed in the *ziggurats* (temples) of Mesopotamia and the *mastabas* (early tombs) and *pyramids* of Egypt. The knowledge of measurements in the design of the pyramids finds expressions in the geometric forms of the *Minoan* (2800-1100 BCE) and *Mycenaean* (600-1100 BCE) art, beehive tombs, palaces and lion gates (1500-1100 BCE). The shapes and proportions of the structural forms reached the coasts of the Aegean Sea and the formal imprint of *phi* and the *Golden mean* based on the mathematical proportions of ancient Egypt and Mesopotamia blossomed in the *Doric* and *Ionic* patterns and in the temple culture in ancient Greece

exemplified by the Parthenon. The universal harmony in nature is reiterated by the *Pythagorean School* which proclaims that the principle of numbers that forms the inaudible harmony within the celestial bodies is reflected as audible ratios of musical consonance and symmetry in the mathematical proportions in all natural elements. The use of harmonic proportions in the classical period of architecture of Greece and Rome exhibits perfect equilibrium in all parts of any one building with respect to one another. A recent study of Kapraff and McClain based on the research of Anne Bulcken (2001) explains the musical origin of the proportions inherent in the built-forms that corresponds with the Pythagorean Dorian scale.

The architectural harmony based on anthropometric rules takes history to the archaic cultures of the east. The documentation of the rules of architectural layouts in the *Sthapatya veda* has kept alive the oral tradition of transmission of knowledge in prevalence till around 4000BCE. The architectural science is based on the tenet that peaceful mind and well being of physical body are attained when the five basic elements (of earth, water, fire, air and space) that make up the universe and all its organic and inorganic tangible components are in perfect harmony with each other. In other words, the human functioning of the physiology and psyche (the microcosm) are the complements of the structural order and mind of the cosmic being (macrocosm). The buildings of temples and homes in accordance with the natural dynamics of the cosmos maintain the dwellers in their dwellings in eternal order with the cyclic evolving nature of the

universe. The *Puranas* (like *Skanda, Agni, Matsya, Narada* and others) narrates extensive instructions on the science of *Vastu*. The *Brihat Samhita* elaborates on the temple and residential planning of organic modules that harbours optimum energy of the five basic elements in the nature. The *Vastu* technology emphasizes on the functional organization of space that integrates the energies in the environment with that vibrating within the built environment.

Since archaic times, the designs of temples, *Buddhist Chaitya* halls, *Christian Basilicas* and particularly, *Gothic cathedrals*, medieval *mosques* and *mausoleums* in India are repositories of anthropometric measurements. Of late, in the 19<sup>th</sup> century, Le Corbusier, the Swiss architect, balanced the scale of architectural measurements based on human proportions as conceived by Vitruvius, Da Vinci and others. Corbusier relied unequivocally on the Golden Ratio and formulated the Modular System focused at improved utilization of space and lucidity in ground planning, elevation and interior structural design. Corbusier's modularity divides his famous man with a raised arm into red series (total height divided in golden section by the height of the navel) and blue series (height of the raised hand above the ground and above the groin). Documentation of archetypal anthropometric expression in built forms in the modern times can be spotted in the design of the National Gallery at the Trafalgar Square in London, the Sydney Opera House, the Taj Mahal and the Bharat Bhawan in Bhopal (India), to mention a few.



## Interpretation

The **Template V** describes the pair of cognate words— *aisle* and আল (āḷ) selected from the two contemporary world languages, English and Bengali respectively. The left side of the template depicts the oriental records of the origin of the word, the exposure of the word in different functional aspects and their symbolic representations through images. Similarly, the right side of the figure explains the western interpretations with regard to the etymology and usages of the word *aisle* along with its iconographic expressions.

The word *aisle* (Eng.) is a derivative of the Latin *ala* which relates to the 'wing of a bird or wing of an army' and the modern Latin expression of *ala* denotes the 'side of the ship'. The nearest derivative *ele* (Lat./Ofr.) conveys the meaning of the 'lateral division of a church, usually separated by a row of pillars'. Thus the old usage of the English word aisle has been attached to the architectural interiors of *Basilicas* or *Buddhist Chaitya halls* to denote the side division of the nave or other parts of the church/temple generally separated off by pillars. The modern representation of *aisle* can be found in the 'walkway or passage between the rows of seats of classrooms, theatres, aircrafts' and the 'passages between rows of stalls in shopping malls'. The semantic manifestation of *ala* (Lat.) leads to phonologically (by virtue of sound) and orthographically (by virtue of the idea conveyed) similar words such as *alley* that originally denotes the 'narrow passage between rows of buildings' and in recent times demonstrates the 'straight narrow path' of the *bowling alleys*. Among the other derivatives are *lee* which is a 'sheltered (leeward) side of hills and mountains' and *isle*, a term from geography that is often prefixed with words like 'land' or 'let' to form '*islands* or *islets* meaning the 'detached small islands separated by water/sea'. The word *islets* is also meant for a group of cells such as *Islets of Langerhans*, a group

of epithelial cells in the pancreas. The more recent expression of *islets* can be observed in the GIS matrix to explain the field of cells formed by the intersection of rows and columns in the grid.

In *Bengali* language āḷ (আল) is the derivative of the *Sanskritala* (अल) meaning 'prevention and preservation'. The functional usage of *ala* stands for the 'bank or fringe of rivers, dykes or embankment' of agricultural lands to restrict overflow or outflow of water or simply a 'ridge' of earth to separate adjacent agricultural fields. Thus the *Sanskrit* root *ala* which contains the meaning 'prevention and preservation' is easily recognized in its modern usages. The semantic exposition of the *Sanskrit* root is often used affixed or suffixed with new words. The cognate able:abali refer to 'an ability to run' and 'an ability to cover'. Hence, the much used suffixation *abali* (আবলি), with the induction of the consonant *b* (ব) forwards the meaning of a collection of similar rows as discerned from the words like *gitali* (গীতালী) meaning chain of songs, *chandrabali* (চন্দ্রাবলী), the aura running like a moonshine, 'Vajra-anga-abali', covering like a thunderbolt and so on. The words *albal* (আলবাল) and *abal* (আবাল) are related to the irrigation of land and plant roots by preserving water within the earthen ridges.

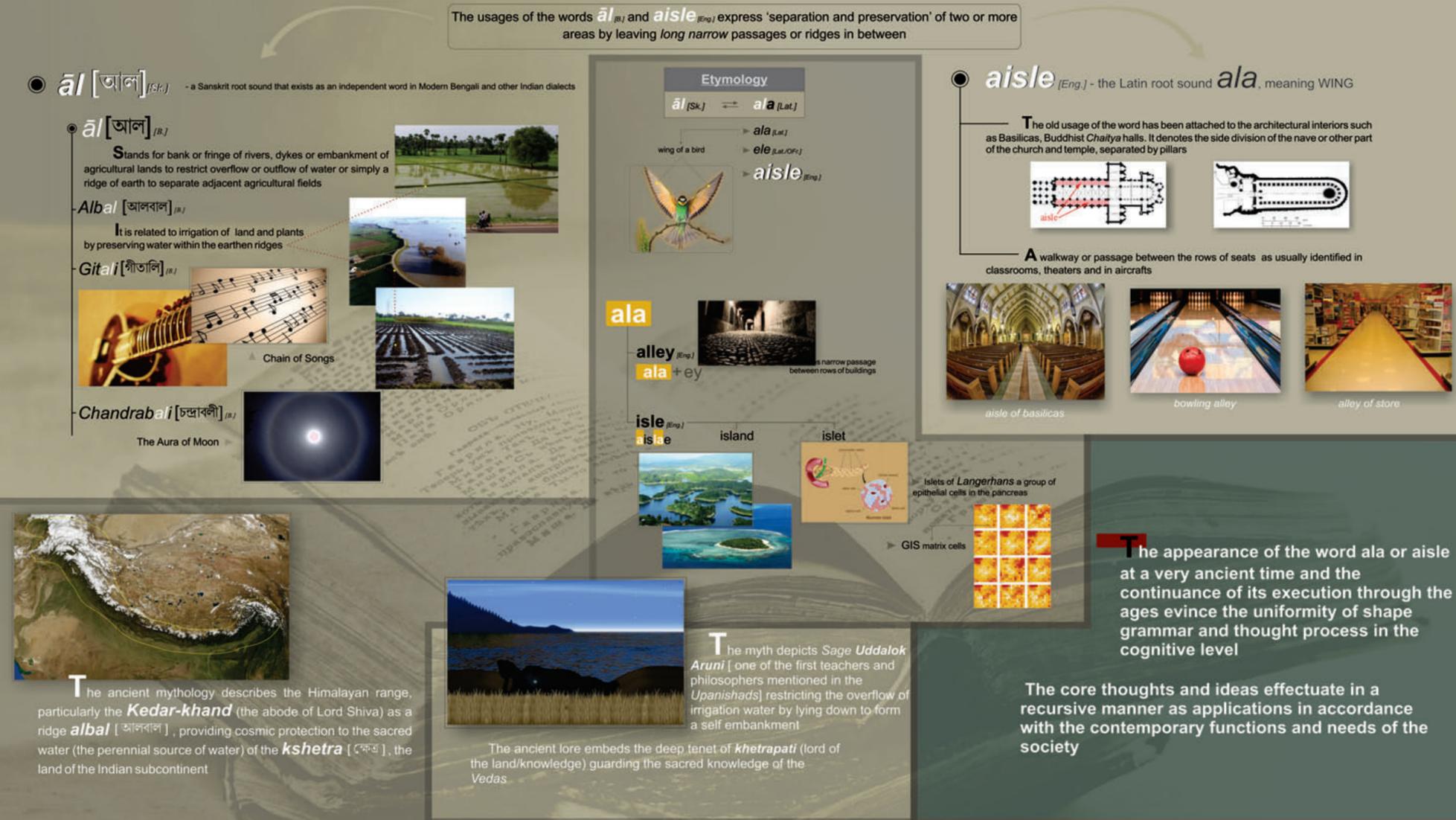
The lower left corner of the template depicts the archaic thoughts and usages of the Sanskrit āḷ. The ancient mythology describes the Himalayan range of *Kedar-khand* (the abode of Lord Shiva) as a *ridge* (আলবাল), providing cosmic protection to the sacred water (the perennial source of water) of the *kshetra* (ক্ষেত্র), land of the Indian subcontinent. The etymology of the *Sanskrit* root can be traced further back to *Uddalok Aruni*, one of the first teacher and philosophers mentioned in the *Upanishads*. The myth depicts *Sage Aruni* restricting the overflow of irrigation water by lying down to form

a self-embankment. The ancient lore embeds the deep tenet of *khetrapati* (lord of the land/knowledge) guarding the sacred knowledge and deep semiotics embedded in the *Vedas*.

A significant observation from the analysis of the cognate words show that the man-made functional applications of the Sanskrit *ala* are linked with the elements of natural environment rendering ecologically compatible form of earthen banks and ridges. The western counterpart, on the other hand, is chiefly associated with the concrete built environment. The appearance of the word at a very ancient time and the continuance of its application through the ages evince the uniformity of shape grammar and thought process in the cognitive level that in a recursive manner generates the core ideas to expressions applicable for the contemporary functions and needs of the society.

The root word has established its form wherever it has been attached to or fused with any new words. The analysis of cognate words thus lead to new sets of cognates that are interlinked with each other by the primordial idea, thought or form that keeps surfacing with the new waves of application or usage or icons for the new-fangled or state-of-the-art encounter with the external environment. For example, the phonetic and semantic treatment of the cognates *aisle-āḷ* (আল) can lead to another set of cognates—*wall* (Eng.)- *deyal* (দেয়াল, Beng.), both the words being used to denote elevated or high and concrete and opaque dividers or ridges to protect and separate the land areas, buildings or rows of rooms as in classrooms.

In the next template (Template VI), a group of cognate words that are assigned to the numbers or mathematical numerals and geometric shapes will help to explore the Indo European words and their interpretations in natural, scientific and cosmic echelons.





*This is the cosmic plan according to the Sankhya, and what is in the cosmos must also be microcosmic. Take an individual man. He has first a part of undifferentiated nature in him, and that material nature in him becomes changed into this Mahat, a small particle of this universal intelligence, and this particle of universal intelligence in him becomes changed into egoism, and then into the sense-organs and the fine particles of matter which combine and manufacture his body. I want this to be clear, because it is the stepping-stone to Sankhya, and it is absolutely necessary for you to understand it, because this is the basis of the philosophy of the whole world. There is no philosophy in the world that is not indebted to Kapila. Pythagoras came to India and studied this philosophy, and that was the beginning of the philosophy of the Greeks. Later, it formed the Alexandrian school, and still later, the Gnostic. It became divided into two; one part went to Europe and Alexandria, and the other remained in India; and out of this, the system of Vyasa was developed. The Sankhya philosophy of Kapila was the first rational system that the world ever saw. Every metaphysician in the world must pay homage to him. I want to impress on your mind that we are bound to listen to him as the great father of philosophy. This wonderful man, the most ancient of philosophers, is mentioned even in the Shruti: "O Lord, Thou who produced the sage Kapila in the Beginning." How wonderful his perceptions were, and if there aren't proof required of the extraordinary power of the perception of Yogis, such men are the proof. They had no microscopes or telescopes. Yet how fine their perception was, how perfect and wonderful their analysis of things!*



**Swami Vivekananda**  
A study of the Sankhya philosophy  
(Doctrine of Numbers)



## TEMPLATE VI: SHAPES AND NUMBER

### Introduction

The origin and development of mathematical interpretation of shapes and numbers have generally been open to arguments and difference of opinions. The worldwide acceptance of Greek origin of mathematics is in vogue for centuries endorsed by the intellectual academia of the West. However, an open-minded consideration will infallibly notice the deep-seated oriental history of mathematics in the Vedic grounds of the Asian subcontinent. The oral tradition (*Shruti*) of knowledge dissemination gave way to the written forms of hymns from around 4000BCE, before which the notions of measurements, arithmetic operations, geometry, algebra and trigonometry have been firmly established with very little tangible proofs (evidences of *Saraswati* civilization) owing to the *Gurukul* system of learning and practice. The Indologists further identify the tendency of the Vedic seers to preserve the core concepts (that underlay the rules that govern the universe) within the ambit of the most appropriate seer families. These circumstances delayed the free flow of research and application during the recorded period of the Indian history, not to speak of the destruction and plunder of texts in the post Vedic period, the Islamic drive in the 12<sup>th</sup> century to oust Buddhism from the Indian soil and the prejudices of the colonials to acknowledge the intellectual talents of the native Indians. The renowned French Mathematician and Physicist, Blaise Pascal acknowledged the Indian finesse in mathematics in the following words:

"The ingenious method of expressing every possible number using a set of ten symbols (each symbol having a place value and an absolute value) emerged in India. The idea seems so simple nowadays that its significance and profound importance is no longer appreciated. Its simplicity lies in the way it facilitated calculation and placed arithmetic foremost amongst useful inventions. The importance of this invention is more readily appreciated when one considers that it was beyond the two greatest men of Antiquity, Archimedes and Apollonius."

The metaphysical abstraction in mathematics experienced by the Vedic intuitive minds were displayed thousands of years later in the *Mycenian* symbols as perfect geometric concentric spirals and in the early Greek *Ionian* pillars. The Pythagorean philosophical approach of mathematical foundation in the cosmic order can be perceived from his acquaintance with the knowledge of Upanishads and his Indian connections. The Pythagorean Triplet in 600 BCE declares the knowledge of Geometry documented in Baudhayana's *Sulbha Sutras* which also set out the operations of arithmetic and geometry (*rekhaganit*). Interestingly the *Sulbha sutras* (800 BCE), *Apastambas's sutras* (600 BCE) and The *Narada Vishnu Purana* dedicated to *Ved Vyas* were the then new generation texts that endorsed the *Saraswati* Valley scales with decimal divisions used for layout of towns and construction of houses.

Sanskrit Grammarian and Mathematician, Panini in his *Ashtadhyayi* (6 BCE) shows that uniform laws of arithmetic operations govern the construction of compound words and formation and classification of verses in Sanskrit language. Ingerman in his research paper titled *Panini – Backus form* noticed the image of Panini's mathematical constructs in the formal syntax of computer programming language, *Backhus Normal Form (BNF)* developed by scientist John Backus (1958).

The concept of *zero* is the basic premise of Vedic cosmogony. *Shunya* or zero is the primordial symbol of Brahma, the infinite source of creation of the cosmic order. In Vedic metaphysical explanation zero is the real balance between the two conflicting yet, complementary forces of creation and dissolution. Later the formal introduction of zero has been identified in the works of Brahmagupta (7CE). Persian Mathematician Al Khwarizm (c.800 CE) narrates the journey of zero to Baghdad and from there to Europe (13CE) by the Jewish scholars stationed in Spain.

The unique aspect of the history of mathematics lies not in locating its place of origin only, but also in the universal acceptance of the wisdom and cooperative continuity of its application across the temporal and spatial dimensions of the globe as testified in the famous treatises of Einstein, D. Hilbert, Ramanujan, K. Godel and G. H. Hardy to name a few.





The Indian mathematical text *Surya Prajnapti* (c. 400 BC) classifies all numbers into three sets: enumerable, innumerable, and infinite. The **Bengali** derivative **কোন** (*lina*) also convey the fusion with the highest and farthest that includes everything. The derivatives of the concept of infinite line are the measurable or finitelengths of **लिख** (*likha, Sk.*) and **लिखन** (*likhana, Sk.*) that refer to the 'act of scratching, furrowing and writing'.

**Lina (Sk.):lin (Lat.)** –The identical words in both the languages reflects the image of a line. The **Sanskrit** word stretches the 'darkened finite consciousness' to the illumined infinite' or 'pure consciousness'.

## Circle

The word **circle** is located in the lower section of the figure between the words, line and angle. The **PIE** root **kirk** which means 'to bend' is the western seed of the word circle. The nearest relative of the **PIE** root can be discerned in the **Greek** word **kirkos** meaning the geometric figure of 'circle'. The other derivatives **circulus (Lat.)** denoting 'circular figure' and **cercle (Ofr.)** meaning 'circle, hoop or ring' are marked by the replacement of the **PIE k** with **c**. The direct usage of the PIE word and its thought can be observed in the **Scottish** word **kirk** that refers to the 'church', a place where people 'bend down' as an act of complete submission to the Supreme Infinite. In another sense, the church is a circle around which the community evolves all norms, associations and activities. The oriental concept of circle is sowed in the **Sanskrit** letter **च (ca)** that stands for 'moving to and fro'.

The words that have emanated from the letter reflect the seed thought of the circular motion and shape in varied usages and expressions ranging from the cosmic to the Cartesian plane. The

**Sanskrit** words **चक्र** (*cakra*) and **चकार** (*cakāra*) refer to the 'wheel' which is applied to an array of forms like **potter's wheel, carriage wheel**, the **planetary bodies** and the imaginary geographic circles of latitudes. The phraseology in the field of physics describes the laws of motion. The concept of wheel transcends to the metaphysical realm of space and time in the *Vedic kala-chakra* or the **wheel of time**. The **Chakrapani** is the personified *Vedic* Lord of the Universe holding the wheel of time. The European expressions of circle also confirm the oriental usages in the different strata from mathematics, physics to quantum physics and deep ecological thoughts.

## Angle

The word angle is explained in the block located to the right side of circle and below the number seven. The European origin of the word can be traced to the **PIE \*ang-/\*ank-** meaning 'to bend'. The words **angul (OHGer.)**, **angulus (Lat)** and **angli (Lat.)** all refer to the mathematical angle or organic and inorganic elements in the nature having angular shapes. The origin of angle in the east recalls the **Sanskrit** word **अङ्ग** (*aṅg*) meaning 'go'. The **Sanskrit** word **अङ्ग** (*aṅga*) and **Bengali** **অঙ্গ** (*aṅga*) meaning 'limb' signify the human body or the limbs or organs of the body, joined together in different angular measurements. Hence, the ancient Vedic word **Angirasa**, which means the essence of physical growth.

Both **angle** and **aṅguli** refer to the geometrical proportions measured through the anthropometric distances between fingers or angular distances between the limbs. The anthropometric scales and angles are the mother of all applications in measurements. The English word **ankle** is a direct anthropometric term derived from the pie root **ank** which is an angle formed by the joint connecting the foot with the leg.

The anthropometric proportions put forward by Leonardo da Vinci in his '**Vitruvian Man**' (located to the upper right side of the block) is one of the highest cited illustrations of definite angular measurements of the human body and their applicability in mathematics, physics and architecture. A parallel is observed in the *Sthapatyaveda*, wherein the **Vastu Shastra** (located below the image of angular measurement of fingers) is based on the alignment of the anthropometric angles with the geographical cardinal directions. **Angul** or **Öngull**, is the **old Nordic** name of the region (located below the Vitruvian Man) once resided by the Teutonic tribes (present day Schleswig-Holstein area in Northern Germany and Denmark). The name of the region was called **Angul** because the place has a 'hook like angular' shape and exhibits a clear image of **Sanskrit aṅg** and **aṅguli** that refer to angular anthropometric shape. In nature, we often come across angular forms or shapes as in starfish, leaf blades, palm leaves, forking of branches and so on. The **starfish** and the **mapleleaf** at the bottom of the block display the angles in the organic forms of nature. The image of the '**angle of incidence**' shows the application of angular measurement in the calculation of reflection of rays of light in the field of physics.

**aṅg (Sk.): \*ang-/\*ank- (PIE)**–Besides the identical semantic features and phonetic readings explained above, the initial thought of the two root words display the verb or the action performed by the limbs like arm and legs in stretching or extending (**go, Sk.**) and bending or embracing (**to bend, PIE**).

The river of language that once flowed from underneath the glacial mass and spread across by the natural turns of its tributaries encountered sharp fissures and faults to be delinked from its source. The concepts and applications of the numbers and shapes are significant in correlating and matching the fallen or lost linkages of the interfaces of the world language families.



# TEMPLATE VII: SANDHI OF THE EVOLUTES AND THE INVOLUTES

## Introduction

The analysis of words of the East and the West converges into a central thought that cuts across the thematic boundaries of the six preceding templates. The discussion based on the Indo-European cognate word pairs across six different self determining dimensions reveals a common fundamental law or mathematical rule that underlies the stability and uniformity of the order and organization in all organic and inorganic elements of creation. **Template VII** is devoted to this central axis that can be viewed as the guiding principle of the thought processes and their interpretations around the globe. Thus, the concluding template deals mostly on the mental concepts that constitutes the building blocks of spoken and written words and expressions.

The unique proportions secure and restore harmony and balance when implemented in the man-created organization of forms ranging from the subtle arrangements of the musical notes to the shapes and features of the architectural designs and operating utilities of everyday life. The search and research for implementing the universal measurement of the cosmic scale in manmade devices rose in triumph in the present century with the discovery of the Modular Man, depicted in the template as a white silhouette of a man with a raised arm. The Modular is Le Corbusier's symbol of the cosmic order grafted in the organization of the built forms. The Modular system is based on the measurement of a six feet (183cm) man with his arms upraised to the height of 226cm. The height of the man is segmented according to the Golden Ratio which is approximately 1.16. Thus, the ratio of the height of the man (183cm) to the height of his navel (113cm) is 1.16. The proportioning system incorporates the features of the Fibonacci series (1-1-2-3-5-8-13...) which is also the closest

approximation in whole numbers to the Golden Mean. Unlike the static series of fixed standard of proportions of the Renaissance system, Corbusier developed a flexible linear scale that can be adjusted and manipulated to any combinations from measurable units to infinity. Corbusier developed two parallel syncopated dimensions – the **red series** and the **blue series**. The unit 113 (navel) corresponds with the golden mean 70 which is the starting point of the **red series** (4-6-10-16-27-43-70-113-183-296...). The unit 226 known as the double unit (2x113=226) corresponds with the golden mean 140-86 that starts off the second series called the **blue series**. The sequence of the **red series** is such that each of its segments is the arithmetic mean of the successive lengths of the blue series that shares its segments with the **red series** as evident from the vertical linear scale of red and blue combination in the template. The working principles of proportions in the cosmos that intrigued Pythagoras, Vitruvius and Da Vinci culminated in the reflection of the divine proportions in architecture, city planning, mechanic and ergonomic models that allow maximum productivity with minimum stress and fatigue.

The balanced state of organizations that restores human body and mind in harmony with nature recalls the words *psycho*, Greek (shuksha, Sanskrit) meaning 'subtle body, mind or soul' and *soma* (Greek and Sanskrit) meaning the nectar or body fluid. The modern day alternative medicine is actively researching into the psycho-somatic features for the diagnosis and treatment of the physical manifestations triggered by the mental factors such as stress and anxiety. The efforts of philosophers, scientists and psychologists, today, focus at minimizing or eliminating the disproportionate

influence in social (mental) and material (physical) orders to provide a psycho-somatic composure within and between individuals.

The pre-designed arithmetic progression in balance and harmony reminds of the oriental metaphysical principle of *Samkhya* philosophy of sage Kapila embodied in the *Shvetasvatara Upanishad*. The ancient dogma furnishes a higher level of organization of human mind that liberates the soul from the psychological affinities to possessions and self-identity –the source of all paradox in human-human and human-nature paradigm. The word *samkhya* or *sankhya* literally means 'numbers'. Originating as the philosophical system for analysing manifestation of elements from the primordial source, it delineates twenty four material truths (of *prakriti*) and the twenty-fifth entity is assigned to the pure consciousness (*purusha*). The *Samkhya* system elucidates the process of lifting the individual from the bondage of the worldly complexities that multiply through the interaction of external perceptions (sound, touch, sight, taste, smell) with the sensory receptors (ear, skin, eye tongue, nose). The complete control of mind over the gross expressions such as lust, greed and obsessions (*tamas*) help to break free the soul from the disorganized features like suffering and illusion. The soul ascends the ladder of the subtle astral body where the illumined mind (*sattva*) leave the shackles of ego and forges ahead to the state of complete liberation or pure knowledge (*moksha*).

*'The Supreme Good is moksha which consists in the permanent impossibility of the incidence of pain...in the realization of self as Self pure and simple'*

*Samkhya karika 1.3*



The attainment of pure consciousness through the union of *purusha* and *pakriti* renders the human psyche a state of perfection, where the cosmic proportions (macrocosm) resonate within the physical mind (microcosm). The seat of the absolute within the mortal self is built on the understanding and foundation of the system of *yoga*, a contemplative procedure for uniting the human spirit with the Supreme Consciousness (*pranava*). The systematic procedures of *yoga* are essential for disassociating from the differentiations or manifestations of *prakriti* and scale up in the evolutionary path to unite with the Infinite unmanifested consciousness. Sage *Patanjali* formally documents the traditions of the *Saraswati* civilization in the *Yoga Sutra*. The *Raj Yoga* is a continuous spiritual effort through deep meditation to awaken and arouse the divinity sleeping within the soul in the form of a coiled snake (*kulakundalin*). The *yogi* lights the *astral nervous system* with the fire (*agni*) of vital life force (*prana*) to invigorate the power in slumber from its residence in the *mooladhra chakra* (lower sacral or coccygeal plexus) to *swadishthana chakra* (upper sacral or prostatic plexus). As the coiled serpentine reaches the *manipura chakra* (solar plexus), the *yogi* feels the close proximity of the Supreme Consciousness. The *manipura chakra* located on the *navel* corresponds with the starting of the *red series* in Le Corbusier's Modulor Man.

*Agni*, the symbol of material source of heat and light is the basis of the cosmic power that detoxifies, purifies and transforms the soul to achieve higher and subtle consciousness and. The ascending *red series* of Corbusier reflects the *agni* or *igneous* principle which is the essential fuel to levitate the soul towards pure knowledge. The offering of the inner soul as the highest sacrifice is symbolized by the killing and destroying of the dark powers of demons by the Gods to impel the latent spirit soar high and seek the lost sun (*surya* or *sol*). The next higher level of astral chakra, the *anahata* (dorsal or cardiac plexus) corresponds with the location of human heart of the Modular Man. Here, the *yogi* experiences the first contact with the Infinite within the self. The *yogis* concentrate on the energetic components of breath or *vayu* (*vayu>biom*) to deepen the flames of awareness towards the state of enlightened Samadhi. At the *vishuddha chakra* (cervical or laryngeal plexus) located at the base of the throat the individual thought becomes one with the Universal Thought and as the fire further continues to transmute the soul, the transformed essence or *soma* intersect the *ajna chakra* (pineal gland driven basal ganglia or thalamic cavernous plexus), housed within the eyebrows and sours up to the *sahasrara* (upper pineal gland to fontanelle) to finally merge with the Infinity symbolized by the highest tip of the finger of the modular Man. There is no distinction between the soul and the Supreme Soul as both becomes One. The *yogi* attains the

**Table 1: Positioning *Apri Sukta* in the Rig Veda**

No.	Mandala: sutra	Rishi parampara
1	1.13	<i>Kanvas</i> ( <i>Angirasa</i> tradition)
2	1.142	<i>Angirasas</i>
3	1.188	<i>Agystas</i>
4	2.3	<i>Gritsamadas</i> ( <i>Bhargabi</i> tradition)
5	3.4	<i>Viswamithras</i> ( <i>Koushiki</i> tradition)
6	No <i>Aprisukta</i> in 4 <sup>th</sup> Mandala	
7	5.5	<i>Atris</i> ( <i>Atreya</i> tradition)
8	No <i>Aprisukta</i> in 6 <sup>th</sup> Mandala	
9	7.2	<i>Vasisthas</i>
10	No <i>Aprisukta</i> in <i>Madhyandin</i> tradition of <i>Sukla yadgur Veda</i> (in 8th Mandala)	
11	9.5	<i>Kasyapas</i>
12	10.70	<i>Bharatas</i>
13	10.110	<i>Bhrigus</i>

*Ritam*, the divine truth that Sri Aurobindo interprets as the 'spiritual or inner truth' that 'brings its light into our thoughts, building up in us the truth, an inner knowledge'. The thoughts illumined by the rays of the sun ('go' or the herds of the sun, Vedas) lights up the heart and the enlightened heart sees all dualism as the essence of the eternal vastness.

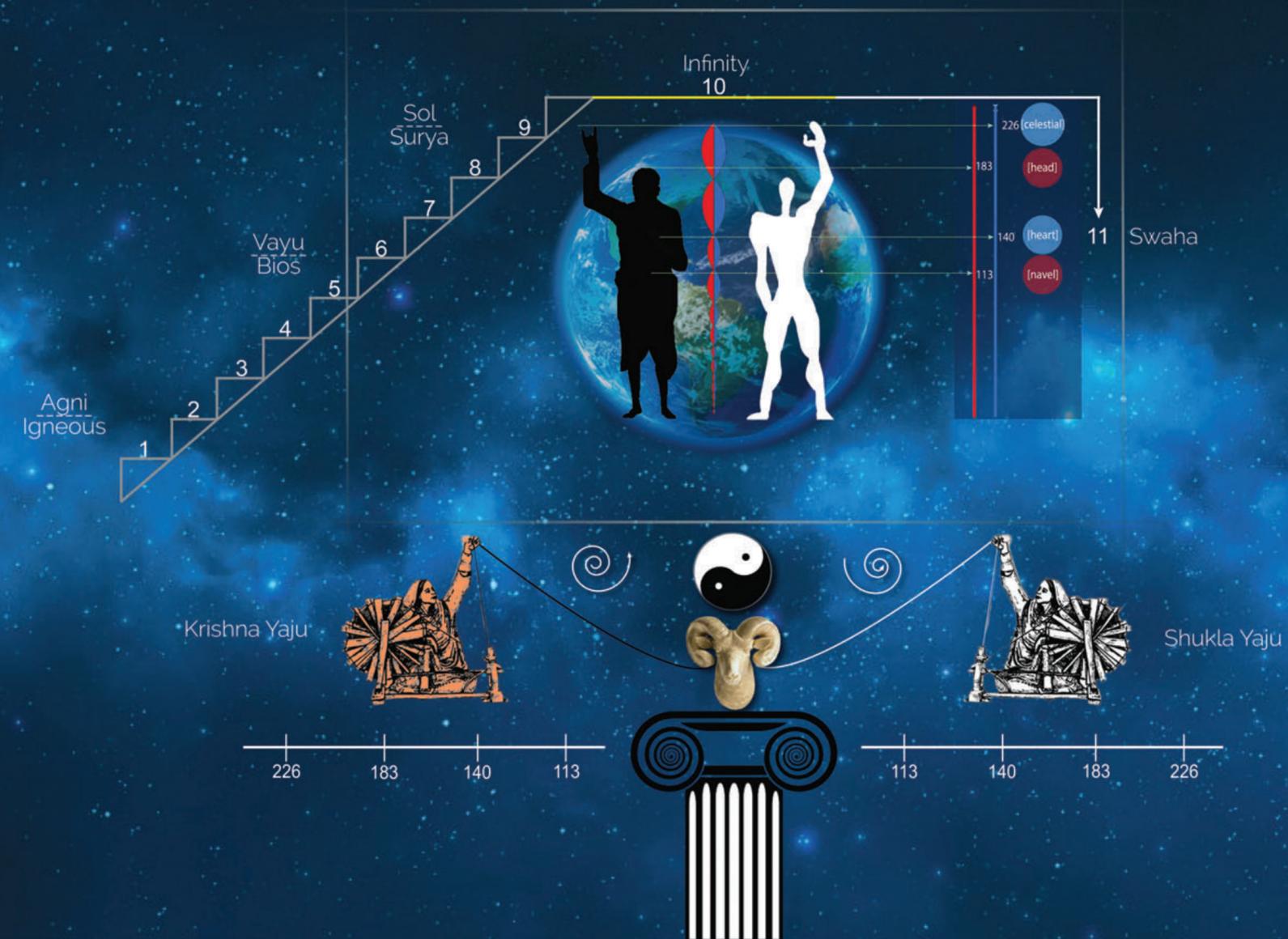
The *soma*, the *nectar* or *amrita* exudes out of the fountain head of the highest spiritual or deep-ecological experience in the form of bliss or *ananda* and descends to the seat in the heart which is also the base of the *blue series* of Corbusier. The ripened mellow of descending *soma* reflects the *blue series* that empowers the soul with eternal nourishment of delight and completeness. *Soma* or *blue series* is the counterpart of ascending *agni*, the fire of consciousness or the *red series*. The *Vedic schools* relate *soma* to the receptive and contemplative calmness of the moon, which corresponds with the *blue series* of Corbusier.

The contour of the dark serene personality opposite the Modulor Man in Template 7 represents those beings who the West reveres as the 'incarnations of God' and the East gives the esteem of the 'avatars'. In

the Sanskrit language, the term *avatar* means 'descent' or 'coming down from far away'. These divine beings take the highest challenge of hardship and pain to transcend the illusions or *maya* of the mundane world ignited by the flames of yogic fire to venture for the highest path of evolution. The fully liberated (*param purusha*) transmuted souls descends or involutes from the unmanifested to the world of manifestations to transmit the essence of pure consciousness or *soma* to the humanity. Sri Aurobindo calls this 'a process of divinization and bringing down of great and luminous riches, treasures won from the Gods by the inner work of sacrifice'. 'The desire-less desire' to help mankind ascend the inner evolutionary path have drawn the divinized minds like Rama, Krishna, Buddha, Jesus and Muhammad onto this earth from time immemorial.

The lower half of the Template exhibits the proportions and harmony along a very wide scale from measurable units to immeasurable expanse. The nature's expressions of the Divine Proportion are exhibited in the logarithmic spirals of the horns of the ram. The Ionic column presents the golden mean in its volutes that reflects the

# SANDHI OF THE EVOLUTES AND THE INVOLUTES



**Table 2: *Apri Sukta* in its inner hierarchy (ladder of consciousness)**

Levels	The elemental form of Agni as	Principle (ascending)
1	<i>Samidh</i>	Fuel or the individual Body (Flesh) (microcosm)
2	<i>Narasamsa / Tanunpat</i>	Born of Fuel or Body
3	<i>Illliata</i>	Initiated
4	<i>Deha-bahir</i>	Impulse from outside; or from inside to outside (inverting the vision)
5	<i>Devi-dwara</i>	The knot of the inner goddess (perhaps the rise of <i>Kundalini</i> )
6	Double and reciprocities 1. <i>Usha</i> evolutes and 2. <i>Nakta</i> involutes	Circles and iterations (like a weft of a weaving wheel)
7	Double and complementarities 1. <i>A Devata</i> from outside 2. <i>A Devata</i> from inside	The instructing Guide and the inner responding Guide
8	Triple ramifications: <i>Illa, Bharati, Saraswati</i>	Convergence of the triple currents ( <i>Triveni</i> or Tribunal / tribes)  Each pattern leads to one tribe and hence diversity in <i>Chhanda</i> and <i>parampara</i>
9	<i>Twastha</i> – the fashioner, the sculptor, the Icon-maker	Formatting the transformed body
10	<i>Vanaspati</i> (from evolution to understanding involution)	The universal body – the Cosmic Tree (macrocosm)
11	<i>Swaha</i>	Exuding the highest fire Macrocosm = Microcosm

*'But he who sees everywhere the Self in all existences and all existences in the Self, shrinks not thereafter from aught'.*

*Isha Upanishad*

### ***Apri Sukta*: the parable of the First Fruits**

Rig Veda can be seen as an aggregate of temporal compositions. The ancient compendium is both a system and a dynamics of realization comprising of arrays of truth-realization, by different Sages in different aeons and ages. For example, as evident in the Rig Veda, in

nature's volutes in the horns of the ram. These tangible expressions are the symbols of the subtle evolutionary (outward) progression of thought to reach the absolute truth and complementary downward involutory (inward) spiral that brings back the light of truth to enlighten the world of dualism. The yin-yang principles of Taoism are the natural opposite and complementary forces that fit together in perfect harmony. The white area contains a dark spot and the dark area has a spot of light and the two together are wound within the infinite circle. Tao, the essential energy or order of life that flows through everything, fills the microcosm (physical body) which is only a scaled down version of the macrocosm (the universe).

The images of the two ladies, one dark and one light spinning the yarn reminds of the 2.3.6 hymn of the Rig Vedas:

*'Milch cows, good milkers, pouring out on us may Night and Dawn, the eternal and equal sisters, coming like weaving women full of gladness, weaving out the weft that is spun, the weft of our perfected works into a shape of sacrifice'.*

The night (nokto) and dawn (usha) are the two eternal aspects of consciousness - ignorance and knowledge. The sisters, one in the light of consciousness and the other absorbed in static existence together weaves the perfect cloth for the highest sacrifice in agni, the 'luminous guardian of the truth shining out in his home'.

Sri Aurobindo elucidates the symbolic sisters of dawn and night in his book 'Hymns to the Mystic Fire':

*'Our normal life and consciousness are a dark or at best a starlit Night. Dawn comes by the arising of the Sun of that higher Truth and with Dawn there comes the effective sacrifice. By the sacrifice the Dawn itself and the lost Sun are constantly conquered out of the returning Night and the luminous herds rescued from the darkling cave of the Panis; by the sacrifice the rain of the abundance of heaven is poured out for us and the sevenfold waters of the higher existence descend impetuously upon our earth because the coils of the obscuring Python, the all-enfolding and all-withholding Vritra, have been cloven asunder by the God-Mind's flashing lightnings; in the sacrifice the Soma-wine is distilled and uplifts us on the stream of its immortalising ecstasy to the highest heavens'.*

*'He who knows That as both in one, the knowledge and ignorance, by ignorance crosses beyond death and by the knowledge enjoys immortality'.*

*Isha Upanishad*

*'Just as a body, though one, has many parts, but all its many parts form one body, so it is with Christ'.*

*1 Corinthians 12*



Embedding on a series of truth-foundation, the first and the last *Mandalas* of the Rig Veda have ample evidences. They are also the starting and terminating *Mandalas*, which have no fixed lineage of sages. It is like experiencing the art-work in the Ajanta and the Karli caves, bearing no testimony of its creator, but upholding only the impersonal intention of creativity itself. This is the Aryan way. It cannot be an import from foreign lands and any alien corpus where a personal approach to copyright are normally preached.

### **Variations and unity in Rig Veda – why?**

*Mandalas* two to eight are dedicated to specific *paramparas* or lineages explaining an inheritance driven pattern of initiating an inner fire, the driving force behind the *tapas*. It is the microcosmic or the self-automated *Agni* of an individual often seen as an inborn or *Jataveda Agni*. The initiation is followed by expansion of *Agni* itself to its higher and more engulfing forms, signifying the higher movement of *Prana Shakti* i.e., *Vayu*. The culmination proceeds to a surge and a concentration into self-luminous hubs of light-and-consciousness, which are called the *Adityas*. In the Vedas, *Adityas* are twelve covering the *Sana* or the time circle or an aeon—and their movements are signified by some of them, *Indra, Varuna, Paryana*, to the highest, *parampadam*, the *Vishnu* to end with, and also, in the making of the *Viswadevas*, who are the godheads, the Universal macrocosmic beings.

The ninth *Mandala* is specifically dedicated to different Rishis again, all claiming an access to Soma, the elixir of immortality. In the upward journey, of which the ninth Mandala is a higher achievement, explains the beginning of a climax. The tenth mandala is the climax, the ultimate, where different *Rishi paramparas* finally step beyond the universal truth and transcend the space-time horizon. Instances are 'The *Hiranyagarbha Sukta*' (10:121) or the formation of the cosmic egg; 'The *Vak Sutra*' (10: 125) or the Creative word, and 'The *Nasadiya Sukta*' (10: 129), which are like a three phased sequence of transcendental hymns of which again, the first implies the universal (*Mahat*) transcending the individual (*Aham*) – which is the impersonal seat of *Isha*, the Lord; secondly, the universal Shakti conceiving the Lord and therefore transcending the creative Matrix or the Hiranya-Garbha itself, offering her son, the Lord, the primordial vibration – the *Vak* or the Word itself. It is similar to the conception by the Holy Spirit, evident in the New Testament. Finally, comes the merger of that *Shakti* unto that vast, the absolute, by going beyond that and also by coming back, reciprocally, explained by the Hymn of creation, the *Nasadiya sukta*.

In the sequence of 10 *Mandalas*, the exceptions are *Mandalas* four and six, which belongs to Sage Vamadeva and Sage Bharadwaja and their lineages, respectively. The two *Mandalas* initiate various parables explaining an access to 'wisdom', like the farmer has an access to the fruits of agriculture, pursuing an inner science of tilling, known only to the aspirant – to him or to her. It is like a preparation before the seed is sown in the field. Parables of agriculture, common to all Ancient Near Eastern religions are based on a chthonian 'dying' and 'resurrecting' god, and it may owe its origin to the Vedas. *Mandalas* four and five almost stand as mid-points and also as reference points. The two explain the rest of the *Mandalas* as the inner semiotics of agriculture itself, i.e., an inner urge, a process conceiving and delivering the 'First Fruits' – the seed, the Word of the Supreme. It happens in steps, like a ladder, as delineated in the last Template.

*Apri sukta* is a significant hymn representing a making of the Cosmic Tree (*Vanaspati*), a requirement prior to the yield or the fruit. It is evident in all *Mandalas* except the fourth, sixth and also the eight, which is the *Madhyanindan* (Noon or White-sun tide) foundation of *Vajsenahi Sukla yadjur Veda*. It is comparable to the Pentecost of the Semitic faiths. Table 1 on *Apri Sukta* positions and explains the contrast. The Tree is the basis of *Aranayak*, the forest, and its spread in the vast is the *Vrihad-Aranyak* – the parable of the great forest in the making. But the sacrifice has to begin somewhere. That somewhere is forwarded by the hymn of fruition – *A-fruti* or *Apri Sukta*.

### **An inner hierarchy of *Apri Sukta***

*Apri* is the continuity of fulfilment, and of satisfaction. *Priti / Preeti* or the propensity of satisfaction is feature of the working Godheads by virtue of the sacrifice of the aspirant. The connection between the two is the key. *Tripti* or *Preeti* are reciprocally seen as the same coin – at the receiver's end and at the deliverer's end. It guarantees the turning of the tide, from evolution to involution or from involution to evolution. It symbolizes both the transfers - from the disciple to the Guide (Guru), in terms of the fruits of sacrifice; or from the Guru to the surging disciple, in terms of the grace, in re-turn. The turning can be seen as the *tripi*/the *tropics* and the transfer of energy is something what we know as the *Trophic* level in ecological sciences. From an astral perspective, the dynamism is an *ayana* (ionic) movement, the *Mandala* itself – leading to the upward surges in the *Uttarayana* or the reverses in the *Dakshinayana*. In the turning of the tide, there are steps; there are movements, like the Jacob's ladder, moving cyclically as made evident in the 7<sup>th</sup> Template. The steps compose the inner hierarchy. It is both linear and non-linear.

*Apri Sukta* therefore has an inner hierarchy. It is normally a culmination of Agni, the life-principle representing a *dahana*, the burning within an inner urge, emanating from the Fuel (called *Samidh* or the wood). The gradual making of the source or the fuel is another vast and perennial mass of wood, which is the *Vanaspati* or the Tree evolving and maturing marking the summit of the ladder. Thus the journey takes place in 10+1 i.e., 11 steps (*ekadasam*). The journey enfolds both evolution 1 to 10 (decem: दशम) and beyond 10, which is the beginning of the involution or the descent.

It is again in the 1: 139 sutra of the Rig Veda, that **the thrice** is emulated. The 'Gospel of the 11<sup>th</sup>' is found in the triple foundations of the cosmos, i.e., in the earth consciousness (*Prithvi-chetana*); in the inner or link consciousness (*Antariskha*); and in the higher or celestial consciousness (*Dyava*). Sutra 1.139.11 of the Rig Veda re-establishes the eternal truth i.e., the 11 principles in *Prithvi*, the next 11 principles in link consciousness (*Antariskha*) and the final 11 godheads in the higher or celestial consciousness (*Dyava*). The total is 33 and everything else is a derivative (*koti*) of the 33 driven matrix. Hence, the term *33-koti.*, which a matter of deep understanding. Now, the inner hierarchy of the *Aprisukta* is explained in Table 2.

### ***Apri Sukta* and *Swaha* – retracing the lost connections: *Kumar Sambhava***

In Mahabharata, Sage Markandeya advices Yudhishtira on the varied divine stories of the past that is staged in the secret of the woodlands signified as *Vanaparva*. Chapters 224 to 232 of *Vanaparva* cover the story of *Skanda*.

It is evident that *Swaha Devi*, daughter of Daksha Prajapati, was in love with Agni. Once she noted that Agni came under the sway of lust after seeing the wives of the great *Saptarishis* in a *yagna*. In order to lure *Agni, Swaha Devi* took the forms of the wives of six of the *Saptarishis* (*Krittikas*), and one by one in a *sara-bhuja* or sextuplet way joined *Agni*. She could not adopt the form of Arundhati, wife of Vasishtha, owing to her unparalleled chastity. *Swaha Devi* dropped *Agni's virya* in a golden pond in *Swetaparvata. Skanda* with six heads was born in the pond. He is *Kumara* or *Subrahmanyam Swami*. Finally, *Brahmarishi Scanda* imparts the legendary knowledge to *Deva-Rishi Narada*, which is a part of *sruti* itself.

Finally, the 6 *Krittikas* brings him up. They are the consorts of the 6 among the 7 esteemed sages (The Septuplet Matrix or Chord of Sages called the *Sapta-Rishis*). At the behest of *Indra*, they later became



stars in heaven by the grace of *Skanda* and filled the gap left by *Abhijit*, who had gone for *tapas* in the forest. Viswamitra performed *jatakarma* of the baby and praised *Skanda* as Siva himself. *Swaha* Devi became Agni's consort. Later, Seer Skanda and Sage Agysta establishes another Varanasi in the Dravida belt – which is Kanchheepuram. It marks an ancient beginning of the Tamil Sangam literature, which is the tradition of Dravida Veda of the Deccan. Sutra one, *Mandala* three, of the Rig Veda provides a deeper description of the '*Kumar Sambhava*'. It belongs to the Kaushiki Rishis, of which Viswamitra is the patron saint. Before Kalidas writes his final lines, the descriptions are also evident in *Adi Kanda, Rama-ayana*.

In this parable, *Swaha* is Shakti herself i.e., *Parama-Prakriti*. And, Agni is Shiva himself. i.e., *Param-Purusha*. When the two are in eternal union (*Arghanarishwara*), by virtue of their androgyny transcending all differences, the form becomes *Kumara*. Hence, the myth of '*Kumara-sambhava*' – the story which explains the making of the first fruit, the first born, by the Word becoming blood-red flesh (*Pallash*) or the Son of God. In that sense, *Swaha* is the eternal Virgin (*Kumari*) and the *virya* of Agni is placed in the Golden pond or in the eternal flux or Ganga / *Alakananda*. Stages 6 to 8 of the *Apri Sukta* represent the deep mystery of the double and the triple wisdoms.

### Apri Sukta – universal foundations

The story has deep and timeless significance. The story represents a typical 'Marine' flow representing the 'birth of a son' and the role of 'deep waters'. Therefore, a deeper connection is established between 'Mari', the *Shakti* and her child. The connection can also be carefully derived from the ancient parable. *Kumara*, as a result is always First-Born, called '*Sadya-jata*'. In the universal sense, all *Mahayogis* are the bases of the birth of another '*Kumara*' (*Kumar-sambhava*). The seven sages are the divine architects – the fashioner, the fosterer, the holders of the spirit of *Takshana*. Hence, it is '*Twastha*', as the *Apri Sukta* hails at its 9<sup>th</sup> level.

Every great *Mahayogin* is therefore the very representative of the Bride (*parama-prakriti*), who is in divine conjunction with the Bridegroom, the *Parama-purusha*. Every time in history, when such a great realization is born, the first fruit (fruition) = the '*Priti*' is also born. Every time the androgyny or the unity of opposites or the SandHI of complementarities is established, that one and only impersonal universal truth is re-discovered once again. Thus Vedas are not books or mere commentaries. But they are a living chronology

of a perennial embodiment of the impersonal truth foundation, which can be accessed universally by all Great *Yogins*, in all ages and from all races or tribes. *Apri Sukta* is therefore a basis of the universal and impersonal foundation called the '*Sanatana*' dharma.

*Apri Sukta* is also the twin foundation of the synthesis of *Vaidiki* (the sematic and the ontological) and *Tantriki* (the syntactic and the epistemological) traditions of India; and it is also a lost link to retrace the origin of the *Gathas* of Prophet Zarathusthra and the closely inter-related Semitic foundations, later born on the very banks of River *Euphrates*, where the tribes of *Afridi* in an ancient city called 'Mari' had started a new approach of moderating their older form of religion.

Later the tribe came to be known as the '*Ibri*' and their new religion formed on the land between the two rivers paved new stories further and further west up to lands they had reached, like '*Iberia* and *Hebrides*. It can be a matter of fresh exploration, which may lead to a re-casted Story of Civilization, retracing 'the Oriental heritage' of the West. The exploration is beyond the scope of the present note. Now, to go back to the thought where we had begun, let us resonate with the following words:



*Non-existence can never be the cause of what exists. Something cannot come out of nothing. That the law of causation is omnipotent and knows no time or place when it did not exist is a doctrine as old as the Aryan race, sung by its ancient poet-seers, formulated by its philosophers, and made the corner-stone upon which the Hindu '(Indian) man even of today builds his whole scheme of life.*

*There was an inquisitiveness in the race to start with, which very soon developed into bold analysis, and though, in the first attempt, the work turned out might be like the attempts with shaky hands of the future master-sculptor, it very soon gave way to strict science, bold attempts, and startling results.*

*Its boldness made these men search every brick of their sacrificial altars; scan, cement, and pulverise every word of their scriptures; arrange, re-arrange, doubt, deny, or explain the ceremonies. It turned their gods inside out, and assigned only a secondary place to their omnipotent, omniscient, omnipresent Creator of the universe, their ancestral Father-in-heaven; or threw Him altogether overboard as useless, and started a world-religion without Him with even now the largest following of any religion.*

Swami Vivekananda  
Historical Evolution of India



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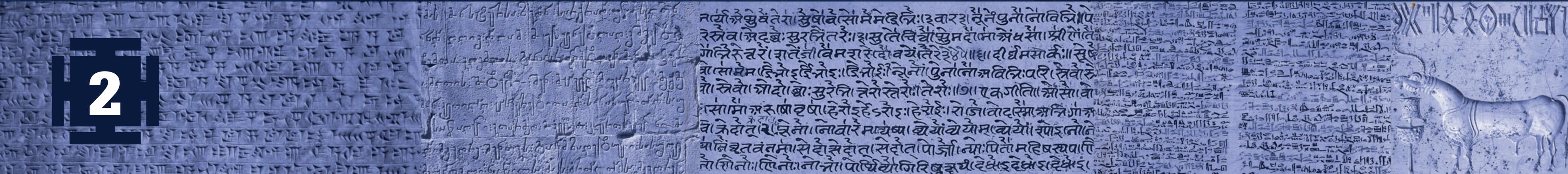
# PROJECT TWO: PART A

## *Varnamala* and its thermodynamic hierarchy and human evolution

Exploring and designing an etymologic / articulation based foundation of *Varnamala* and a Signal processing driven exploration of features of Music / Songs, which constitutes the hierarchy of vowels and consonants of Sanskrit and other parental languages in the Indo-European language system.

The ideas have been developed from the deep ecological works of Sir Arthur Avalon (John Woodruff) and the contemporary constructs of Signal Processing sciences and technology.

# 2



### The Team

Dr. Partha Sarathi Bera, Advisor (Project two) [Electrical Engineering]

Indira Chatterjee (Project two) [Signal Processing]

Tanaya Mukherjee Sarkar (Project two) [Linguistic-syntax driven research]



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## INTRODUCTION

Language is the system of communication used by a particular community. All living beings express them through language. Meaningful words (semantics) make a sentence and clusters of letter make a word. The letter which we called 'VARNA' is the syntax, which emerged through our '*vakyantra*' or larynx. *Varna* is the smallest unit of language and it is the most important thing to understand in a deeper way. The present note is an effort to initiate the understanding.

It may be said that *Varnamala* is the basic element of the living world. On the other hand '*Varna*' or sound is regarded as the basic source of energy and motion in the universe. The existence of the cosmic world has originated from the infinite bang of sound. Word is created from an actual physical vibration. In our daily life we generally come across with two types of sound – one is audible (*vyakta*) and another is non- audible (*avyakta*). According to modern physics theory, the ultra and supersonic forms are non- audible. The sound frequency range between 20 - 20000 cps are audible. The cosmos consists of the sound waves of all frequency range beyond the grasp of our audio senses and even beyond the limits of our imagination.



### 1.1. Research area

In Vedas every mantra has been linked with an emblem that symbolizes an eternal energy of specific flow of cosmic consciousness. Self-existing cosmic vibration of the subtle sound of '*OMKARA*' is considered to be the eternal source of energy and motion. Sound also creates the power of heat and other basic stream of power existing in the universe. It is indeed the source of the omnipresent manifestation of the supreme consciousness – the '*para Brahman*'. Therefore sound is regarded as the reflection of '*Brahman*'. So it may be said that sound (*Sabda*) is the connector of '*Brahman*' and the material world. A set of questions can be accordingly raised

- What are the scientific and spiritual aspects of *Varnamala*? And, what are its relationship with variety and experience of the environment around and the larger cosmos?
- How *Varnamala* can be re-explored as an inner basis of human evolution?

- Is there a deep science behind the evolution? And, what are the role and applicability of *Varnamala*?
- Can the science be a basis of Environment – behavior analyses in the contemporary world of communication sciences? Then what is its relevance in the context of contemporary human life?

### 1.2. Objectives

The present note attempts to bring together two viewpoints:

- 1.0 a pattern hierarchy based explanation of the evolution of universe which is further providing a thermodynamic hierarchy of the creation of *Varnamala* and
- 2.0 A complementary view point which may be extracted from the works of Fourier series spectra on heat flow and its measurement as a property of discrete wavelets, which are otherwise auditory

The note is forwarded in two parts. A pattern hierarchy based on explanation of universe is discussed in the first part of the paper. Similarly the second part contains the thermodynamic property and heat waves and 'Fourier Spectrum'. It may be said that the present paper contains both the scientific view and the mythological or spiritual view of the creation of *Varnamala*. So the objective of the paper is to establish the solution of the above questions through theoretical concept and technical way. The two parts are:

- One, a view point 1 based on a pattern hierarchy explanation of the universe;
- A subsequent view point 2 explaining the thermodynamic property of heat waves and 'Fourier Spectrum'



## VIEW POINT - 1 A PATTERN HIERARCHY BASED ON EXPLANATION OF UNIVERSE

### 2.1. Bases of the pattern hierarchy

Language is the carrier of all things in the conscious living world. Total living world can able to prove its presence only by language. We use language to express our thoughts, wants, emotions and needs. This language is made of some meaningful words and the word is made of some clusters of letter. The letter which we called 'VARNA' is the 'pratik' (symbol) which emerged through our 'vakyanttra' (larynx). Varna or letter is the smallest unit of language but it is the most important thing. Without letter we cannot make any word. Varna is the seed from which word and language evolved. It is both a syntactic (Sabda) or morphological and a semantic (Artha) or directional etymon.

Varnamala or letters are power which is formed by the all elements of this world. On the other hand human being is also formed by the elements of the world. There is a deep relation between human being and the micro and macro elements of this world. Therefore there is a connection between Varnamala and human being. Actually inner thoughts, needs and wants of human being reproduce the Varnamala or letter. So, it is to be said that Varnamala is the reflection of the desires of human being. Varnamala is the sound or power which flows out from the different body parts of human being. In others, the Macrocosm and the Microcosm are interwoven through Varnamala and its thermodynamic properties through which the whole flux of responses to stimuli and counter responses called Karma are generated and the samskara or subtle genetic impressions are carried forward (PurvaPragna: Vrihad-Aranyak Upanishad) through transmigration of Avidya (crossing death: Isha Upanishad) and finally bringing down in some very advanced reincarnated life, the gift of

universal knowledge, which is immortality by Vidya (bringing THAT: Isha Upanishad).

It is suggested that an inner or deeper hierarchy of a 'thermodynamic' evolution of structural or compositional part of language system is operational. It is the 'Varnamala' (Garland of letters) through which the ideas of primordial vibration, creation within and without are best forwarded in the following descriptions (Swami Vivekananda – essays on Macrocosm; Samkya and Vedanta; Cosmology):

“There is in the Rig-Veda, the oldest human writing in existence, a beautiful passage describing creation, and it is most poetical – “When there was neither aught nor naught, when darkness was rolling over darkness, what existed?” and the answer is given, “ It then existed without vibration”. Vibration had stopped. Then when the kalpa begins, after an immense interval, the Anidavatam (unvibrating atom) commences to vibrate and blow after blow is given by Prana to Akasha.

The atoms become condensed, and as they are condensed different elements are formed. The Akasha, acted upon by the repeated blows of Prana, produces Vayu or vibrations. This Vayu vibrates, and the vibrations growing more and more rapid result in friction giving rise to heat, Tejas. Then this heat ends in liquefaction, Apah. Then that liquid becomes solid. We had ether, and motion, and then came heat, then it became liquefied, and then it condensed into gross matter; and it goes back in exactly the reverse way. The solid will be liquefied and will then be converted into a mass of heat, and that will slowly get back into motion; that motion will stop, and this Kalpa will be destroyed. Then, again it will come back and again dissolve into ether.”

### 2.2. Definition and meaning of Varnamala

It has been said before that Varnamala is the smallest unit of language. Literary Varna means colour, but basically it is the shade of the sound (sabda). The material world is originated from the cosmic impulse, the infinite bang of sounds. Varnamala is produced by the variety in vibration of the cosmic impulse within the human neuro-physiological framework. So, it may be said that there is an inseparable relation between Varna and sound.

Syntactically Varna is divided into two parts, namely Swaravarna and Byanjanvarna (it is also called vowel and consonant in English). Swaravarna is the basic Varna and Byanjanvarna is formed through Swaravarna. Without Swaravarna Byanjanvarna cannot exist.

Syntactically, Varnamalas are the letters by which word can be formed. Besides this, each Varna has individual meaning which reveals the mystery of the creation of the cosmos and its quality. The meaning of the Byanjanvarna is furnished herewith in view of a particular syntax and semantics that it inherently constitutes by virtue of its Artha embedded in the Sabda:

**Ka:** First Byanjan Varna of Bengali is ka. According to Vedas ka means 'Adi', 'Brahma'. The lord of creation. The great poet 'Valmiki' also said that the first poem (kAbya) was started by the word 'ka' (kimidam)

**Kha:** This Varna refers to the sky (AkAsha). Here sky means not only a natural thing, it refers also to the sense of expansion (by Apti).

**Ga:** 'SamgIta' or music is created by this Varna. Here music refers only to song. It is a very interesting matter that poem (kabya) made by



the letter ka becomes spread into the sky and then it (kAbya) gets lyrics and song (samgIta) is created.

**Gha:** Gha means announcement (ghoShoanA). It means that the song which is flared up from 'ga', can be uttered by the letter 'gha' and spread into the whole world.

**Cha:** Cha is the emblem of motion (charoibeti). Motion is the most important quality of life. Life cannot exist without motion (gati). It may be said that motion is life and life is motion.

**Chha:** Chha refers to shelter (chhatr). All things in this world cannot exist without shelter (AdhAr). So it may be said that 'chha' is the receptacle of the cosmos.

**Ja:** Ja means life (jibana). The supreme power creates life (jlbana) to keep up the beauty and wealth of the world.

**Jha:** Jha interprets the impulse (spandana) of life. Without it life is dull, at the same time melody (samgIta) also rhythm less without it.

**Ta, Tha, Da, Dha:** These four letters refer to different types of musical instruments and their sound. 'Ta' means the sound of bow (tamkAra). 'Tha' means one type of music (thumri). 'Da' and 'Dha' refer to the musical instrument 'dhAka' and 'dhola' (different types of drum).

**Ta:** Ta means heat (tAp). It is said that by the power of heat the Earth is created. The power of heat is responsible behind all the creations.

**Tha:** It refers to 'sthirata' (immobility)

**Da:** 'Giving' (dAna) is originated by this Varna. Besides this the word 'dahana' (burning) is also formed by this letter.

**Dha:** The words 'dharitri' (earth) and 'dhl' (patience) are come out from this letter.

**Na:** 'na' means 'nadl' (river) and 'nad' (sound). Here river not only indicates the flow of water, but also the flow of consciousness.

**Pa:** The words 'pabana' (air) and 'patha' (way) are created by this letter.

**Pha:** Pha refers to 'phula' (flower) and 'phala' (fruit), these two things are the wealth of nature.

**Ba:** 'bAk' (word) can be got by this Varna.

**Bha:** It means past (bhUta). A sensation of time is acquired from this letter.

**Ma:** From 'ma' the words 'mana' (mind) 'mAnaba' (human) are formed. It means 'mana' (mind) and its receptacle 'mAnaba' (human) are formed by the same morpheme.

**Ra:** 'ra' means beauty (ramya), (rati), . 'ratha' (chariot) is also formed by this letter which indicates progress.

**La:** 'La' means time (laba). Actually it indicates subtle time.

**Sha:** The words 'shaba' (dead body) and 'shiba' (Lord Shiva) are created from this letter. 'shaba' indicates eternal truth and 'shiba' is the supreme power of the world.

**Shha:** The Varna 'sha' refers to 'shoras' (six). It introduces the number system. On the other hand it refers to 'sharaj', the musical note.

**Sa:** From this letter 'sohama' is created which means the intellection of self.

**Ha:** 'ha' creates 'haYa' (horse). Horse is the emblem of mobility.

Among the thirty nine Byanjan Varna (consonant) last five Varnas (Ya, t, anuswar, bisargo and chandrabindu) are not independent. These Varna are attached with other Varna and they cannot make individual words.

### 2.3. Evolution of Varnamala, the Thermodynamic Hierarchy and their Deeper Presence within the Six Chakras

An approach to understand the evolution of Varnamala based on thermodynamic property of macrocosmic involution. It is known that self-existing cosmic vibration of the subtle sound of "OMKARA" are considered to be the eternal source of energy and motion and hence the creation of the existence of nature.

Sabda manifested in the cosmic energy and Sabda, as a soft impulse also gives rise to the energies of heat, light and other basic streams of powers existing in the universe bringing forth the hard facts or Artha i.e., worth. According to the view of 'Rig-Veda' (Sutra 164, First Mandala on the four Vaks; and NasadiyaSukta, Tenth Mandala) after beginning of 'Kalpa', the non-vibrating atom became condensed and different type of elements are formed.

At first the by the power of heat and the infinite bang of sound the great empty place which we called 'Akasha' produces 'Vayu'.

After vibration of 'Vayu' heat rises and the atom becomes heated, as a result the third element of world 'Tejas' is produced.

The power of 'Tejas' leads to all things that are liquefied and finally, 'Apah' are eventually produced. After an interval when this liquid

becomes solid and the fifth element 'Kshiti' is produced. In this way the subtle element turns into gross element and gross element turns into subtle element. Thus a descendant thermodynamic hierarchy of devolution is evident. The basis is composed of the twins of rarefaction (Arya) and condensation (Dravida). Ascent of the human soul by heat (Agni or the Igneous principle), by Tapas is the Aryan way and it returns, by Dravibhuta (Drip/ drop) or liquefaction of the Amrita (Soma) is way of the Dravida. It is essentially, the Agni-Soma reciprocities, the ancient Psycho-somatic tradition of the Vedas that need to be recovered.

The Samkhya Darshana defines it as the equilibrium of three forces, one of which is called sattava, another Rajas and the third one is Tamas.

- Tamas is the lowest force, which is of attraction, determining the gross world and 'Time';
- A little higher is Rajas, that repulsion, keeping the activities and diversities from the gross thereby rendering a kinetic impulse to the primary potential inertia;
- And the highest is the balance of two, Sattava; so that when these two forces, attraction and repulsion are held in perfect control by sattava there is no creation, no movement in the world.

As soon as this equilibrium is lost the balance is disturbed and one of these forces gets stronger than the other, motion sets in, and creation begins. This state of things goes on cyclically, periodically. In one cycle of cosmos it is a 'Kalpa'. Varna is raised up by the subtle sound of 'OMKARA'. The first Varna is 'a' which came out at first from 'OMKARA', therefore 'a' is called Varnadi. After explosion of heat when the atom became condensed and the five elements are formed then different types of Varna are raised up. Figure 1 explains the hierarchy.

### Six chakras and the distribution of Varnamala

The ancient Indian Sages have realized and in a simple way they have described clearly how Varnamala came out from human body. It is the basis of the Anthropocentric-evolution. It is the basis of Yoga (evolution and convergence of the Garland of Letters or Varna as the primordial sound) and Tantra (involution and the divergence/embeddedness of the garland back in the human body awaiting evolution). Thus, Tantra precedes Yoga and forms the foundation of

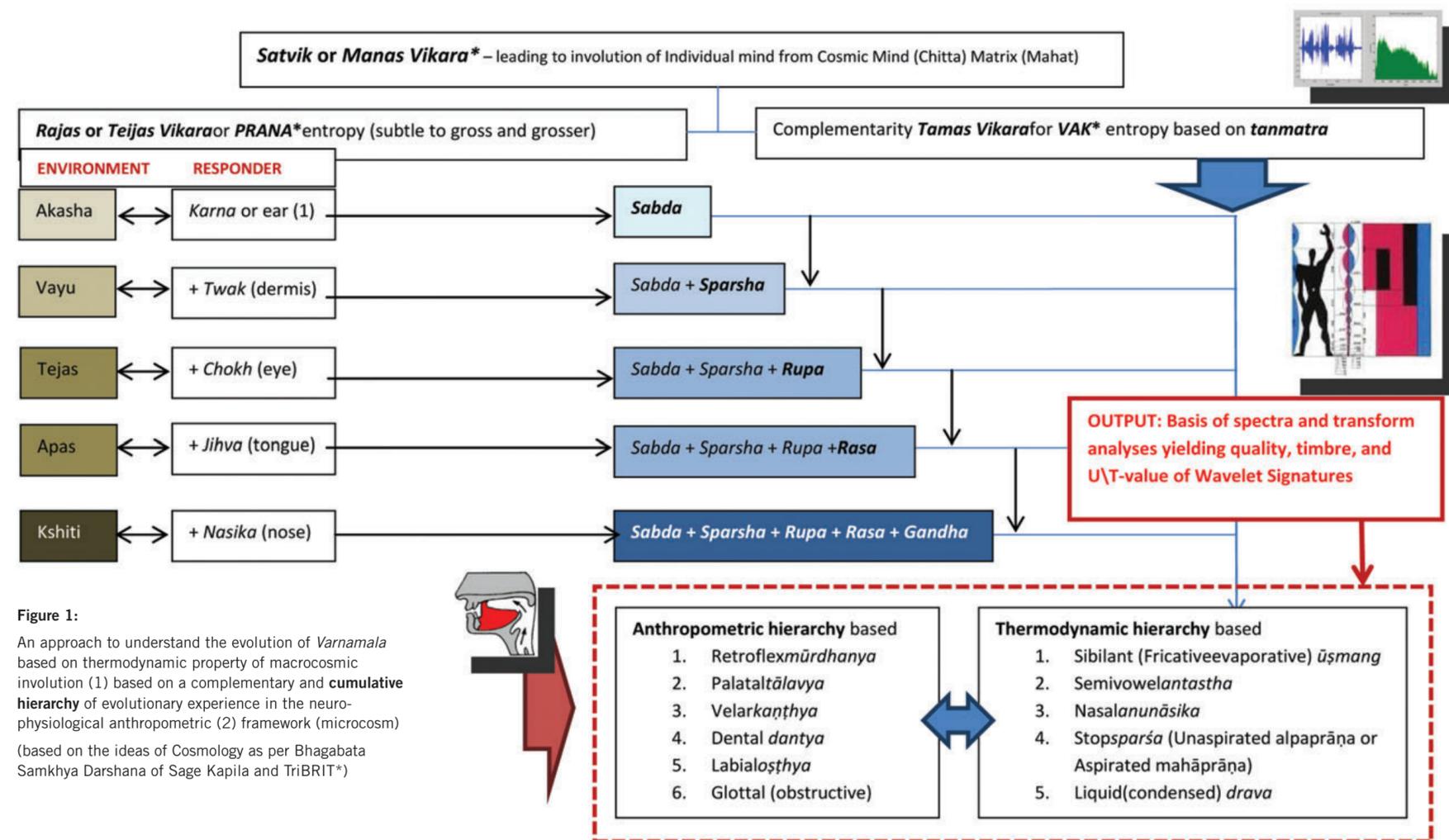


Figure 1:

An approach to understand the evolution of *Varnamala* based on thermodynamic property of macrocosmic involution (1) based on a complementary and **cumulative hierarchy** of evolutionary experience in the neuro-physiological anthropometric (2) framework (microcosm) (based on the ideas of Cosmology as per Bhagabata Samkhya Darshana of Sage Kapila and TriBRIT\*)

The Sankhyas define it as the equilibrium of three forces, one of which is called Sattva, another Rajas, and the third Tamas. Tamas, the lowest force, is that of attraction; a little higher is Rajas, that of repulsion; and the highest is the balance of these two, Sattva; so that when these two forces, attraction and repulsion, are held in perfect control by the Sattva there is no creation, no movement in the world. As soon as this equilibrium is lost, the balance is disturbed, and one of these forces gets stronger than the other, motion sets in, and creation begins. This state of things goes on cyclically, periodically. In one cycle of cosmos it is a Kalpa.



the Vedic epistemology (domain. i.e., root and branches of cosmic variety) and ontology (being and becoming). It is the deeper idea of the latent *elanvital* or the sum of all Prana called the coiled up i.e., *Kundalini Chitshakti*, which has been compared to the 'Sovereign of the Serpentine power-goddess' (*Sarpa-ragni*) in the Vedas. Sir John Woodruff has work exhaustively in this deep and hidden area of realization and systems later to a description of the same, evident in the 'Raj Yoga' by Swami Vivekananda.

The Vedas have conceived of a column of consciousness, whose foundations are that of a serpentine growth in the nether world (*Ahir-budhna*) and whose full blooming beyond the celestial is like a divine rhythm (*Ritasya Budhna*). These polarities (*Samavartana* in Hiranyagarbha sutra, Rig Veda, Tenth Mandala) pave the world's first scientific depiction of evolution, growth and purpose of life in the cosmos. In the microcosm, the pillar is the cerebral spine, whose hollow canal deep within holds the scope of that return to the Truth in the Vast and the Rhythm Divine (*Satyam RitamVrihat*). It is the neural circuit within which the circles or circuits of *Varnamala* are engrafted and the spiral is the upward or downward journey of the *ChitShakti*, cutting the planes or circles.

The Chakras or 'Neural circuits' are defined within the physical body as the place of power, here power means energy of self-consciousness. According to their view in human body there are six chakras. These chakras are compared with a lotus. The chakras are 'muladhara', 'swadhisthan', 'manipura', 'anahata', 'bishudha', 'agnya', and the 'sahasra'. The neuro-physiological locations are coccygeal, sacral, naval or solar plexus-based, dorsal or ganglia based, cervical or neck nerves based, pineal/ thalamus or basal ganglia based and crown fontanelle based in the apex-peri-carp, respectively. A brief definition and characterization of chakras are described below:

- **Muladhara chakra:** According to the esoteric foundations of the Vedas, called the Tantras, muladhara chakra is situated in the gonad gland of human body. It is the seat of the latent *elanvital* or the sum of all Prana called the coiled up i.e., Kundalini Chitshakti. Sri Aurobindo said the Shakti as 'coiled energy', which needs to be uncoiled through morality, ethics, devotion, right action and finally, yoga. The ancient Sages said that in this chakra the colour of power is golden, like four petaled golden lotus. 'ba', 'sa' and 'sha'- these Varnas rose up from this chakra.
- **Swadhisthan chakra:** The adrenal gland of human body is the place of this chakra. It looks like a six petal lotus which is orange in colour. It is the origin place of six Varna, like- 'ba', 'bha', 'ma', 'ya', 'ra', 'la'.

- **Manipura chakra:** The navel of human body is called manipura chakra. It compared to a ten petaled lotus. 'D', 'Dh', 'N', 'ta', 'tha', 'da', 'dha', 'na', 'pa', 'pha' – these Varnas came out from this chakra.

- **Anahata chakra:** Anahata chakra is situated, in the heart of human body. Here the lotus contains twelve petals and it is white in colour. 'ka', 'kha', 'ga', 'gha', 'ng', 'cha', 'chha', 'ja', 'jha', 'NG', 'Ta', 'Tha' these Varnas are originated from this chakra.

- **Bishudha chakra:** This chakra is the vocal cord. In this chakra the lotus has sixteen petals. Sixteen Varnas that rose up from this chakra. The varnas are 'a', 'A', 'i', 'I', 'u', 'U', 'ri', 'li', 'e', 'oi', 'o', 'ou'.

- **Agnya chakra:** This chakra is situated between the two eyebrows. Here the lotus is white and contains two petals. The two Varnas 'ha' and 'ksha' came out from here. This is the seat of Hiranyagarbha, the seed, or the vija, i.e., Iswara Tatva (place of Hamsa or Siddha Vidya).

- **Sahasra chakra:** This chakra is situated on the crown of the head. It is also known as the thousand petaled lotus. The radiance of all the chakras fade before the incomparable radiance of the sahasra chakra. The sahasra chakra possesses no special colour or quality. Its light contains all chakras that flow together here, just as the water of a thousand rivers come together in the sea. The element of the sahasra chakra is 'ADI ANADI TATTVA', or 'PARAM-ISHVAR TATTVA'. It is the source of creation, the pure light and one reality - GOD. This tattva is 'AdiAnadi'. 'Adi' means 'without beginning', 'Anadi' means 'without end'- therefore infinite. As soon as this tattva unites with a quality (guna) or it is bound and therefore limited - just as pure water has no taste of its own, but is modified by and takes taste of whatever is added to it. In this cosmos there are diverse manifestations of this one tattva with various qualities and functions such as fire, water, air and earth but the basis is always the same, the pure essence. This is the ultimate seat of Param-Hamsa or Maha-Siddha Vidya.

It may be noted that between the sixth and the seventh Chakras, there are subtle planes of existence holding in them journey of the *Mahat* (the Cosmic Hiranyagarbha) and its devolution and involution beyond the event horizon of a single universe. The journey from the first to the sixth chakra represents only the initial journey of the *Aham* up to *Mahat*. i.e., it is the journey from the individual to the universal consciousnesses (*Hamsah Vidya*). The journey over the pineal gland i.e., the sixth chakra is the journey to the state of *Param-Hamsah Vidya*.

Hence, we have a classification by *Yoga* and *Mahayoga*.

Thus *Samkhya darshana* becomes the living exponent, at least logically, of the system of *Tantras* and its thermodynamic hierarchy of evolution and involution of *varnas* based on experience of *tanmatras* (*Rupa* to *Shabda*) [refer diagram].

## 2.4. The Garland of Letters

According to John Woodruff's view Varna or letter is the subtle form of gross speech. It is a well known fact that sound is regarded as the basic source of energy and motion existing in the universe. The material world is originated from the infinite bang of sounds. Human being are awakened from the 'cosmic dreaming' stage from the effect of these sounds. At this stage the thought of human being comes out through the vocal organs in contact with air as shabda. Shabda is the shade of *Varnamala*, which is called 'garland of letters' according to John Woodruff's view.

## 2.5. Relation of Varnamala and Sangeet (Music) – the Vedic idea of Udgita

There is a deep relation between *Varnamala* and *sangeet*. *Varnamala* is the basic element of *Sangeet*. It imparts the morphological structure, the syntax of lyrics that constitutes *Sangeet*. When *Varnamala* is mixed by tune (*sur*), rhythm (*tala*), tempo (*laya*) then it becomes get the form of *Sangeet*. The impulse (stimuli) and experience (response) of the variety and significance of the cosmos is embedded in the ambit of *Sangeet*. *Sangeet* does not refer only song but also it refers instrumental music (*badya*), dance (*nritya*) and song (*geet*). It has been mentioned in *Sangeet Ratnakar* that:

“Gitangvadyangtathanrityangtrayangsangeetmuchyate”

So it can be said that *Sangeet* is the combination of vocal music, instrumental music and dance. Renowned researcher-musician P. K. Rajagopala Aiyar said that:

“Sangeet is the art wherein the ply of sounds pleases the ear. It is in itself a potent language which can convey the emotions of all animal beings. It is the most sublime of all the fine arts”.

Sage Yajnavalkya says that one, adept in playing on the *Vina* or one well versed in the *Jati (Raga) sastra*, which is based on a thorough, analytic study of the science of the srutis, i.e the *svarasukmasastra*, or a past-master of the *talasastra* – any one of the above can attain to *Moksa* without much effort.



It is said in '*Nayashastra*' that among the four Vedas the art of *Sangeet* is in the Sama Veda. The word 'sama' denotes 'brahman' who is identical to all and coincidental with all. It is evident that:

*"Samagana is therefore tantamount to heralding to the world the unity of the Soul as well as the consummation of life accruing from one's cognition of that truth. Lord Sri Krisna points out that, of all the Vedas, He is manifest most in the Samaveda."*

The word 'chanda' (rhythm) means 'vedgan' (the song of Vedas). The Veda which is recited through song is called 'Sama Veda.' The last eight chapters of 'Sama Veda' are recited (path kara) through song. The original sound or the condensed singularity is 'Om' - this tenet is described in Veda. 'Om' is the main origin place of varnamala and sangeet (song). 'Om' is the first sound of the cosmos. The impulse and the variety of the universe exist in this eternal sound. So 'Om' should be uttered before beginning the song. 'Om' is called 'Udgita' in 'Upanishada'. '*Udgita*' means the way of worship of *Sangeet*.

Sangeet is a composition of varna, sur and tala. So it can be said that varnamala is the fundamental element of sangeet. It said in Veda that there is a flavor of all things in the universe. The flavor of the cosmos is water. Water is the reason of creation of life. Life gives the birth of vakya (word). The flavor of words is in the 'Rik Veda'. Sama Veda is the flavor of 'Rik Veda'. Last of all 'udgita' or the worship of sangeet is 'Samaveda'. According to vaidantik view among the all flavor of the universe the flavor of 'udgita' is the best and absolute. Besides this 'udigita' is also the ultimate location of the cosmos.

Some questions may arise from the above discussion.

The questions are:

What 'Rik' is and what are '*Sama*' and '*Udgita*'?

'*Rik*' is '*Vak*' (word). '*Sama*' means '*Prana*' (life) and '*Udgita*' (worship) means 'Om', the primordial word. 'Om' is the unification of 'Vak', '*Prana*' and '*udgita*'. When these three things are conjoint with each other, then the cosmos get its flavours. From these flavours *Sangeet* is raised.

Human body conceives the flavour of the cosmos in their sense organ. God is present in human body. In spite of dwelling of God sin is also occupying in human body. Actually human body conceives both good and evil. Now a controversy is raised up from the above discussion that is if there is the presence of God in human body then how does evil access in human body?

The Divine has created the dialectics of *Avidya* and *Vidya* or good and evil for a reason – for the iteration or the spiral journey. The Anthropic form or the Human is the best creation of God in his own image. So, God gives all his aspects in the human and as the humane. Besides this the Supreme Consciousness also gives the way to rescue human from the lesser good or the evil. The way of rescue is '*udgita*' (worship).

With the help of sense organs and nerves human can identify good and evil. To remove evil from his mind he meditates and this meditation awakens the motor nerve of the brain. When the motor nerve is augmented then it moves in a circular way. From this moving existence (*astitwa*), radiation (*bichhuran*) and pleasure (*ananda*) gets up. At the same time rhythmic function (*chandagati*) and harmonious action (*chandakriya*) are also started. When this process becomes restless then it comes in the vocal cord ('*kanthaor bishudhha chakra*') and flows out as in the form of word (*varna*). This word is changed into *Sangeet*. Then it is attached with rhythmic function and harmonious action. Therefore, it is clear that *Varnamala* is the base of *Sangeet*,

there is an inseparable relation between *Varnamala* and *Sangeet*.

Basically, the syntax of mantras or *Riksis* transformed to *Sama* (Psalms), which is Udgita.

Basically *Sangeet* is made of *katha* (lyrics), *sur* (tune), *laya* (tempo) and *tala* or *chhanda* (rhythm). Lyric is the expression of living world. Tune is a melody, especially one that characterizes a certain piece of music. Tempo is the speed at which a passage of music is or should be played. Rhythm is a strong, regular repeated pattern of movement or sound. When all these elements are aggregated in the mind of and the reciprocal environment around the human, then a complete *Sangeet* is created.

## 2.6. Convergence

Based on the above discussion it may be said that *Varna* exists from the time of subtle stage of universe. Due to natural explosion the universe became condensed and subtle. *Varna* also became *Varnamala* (different types of letters) because of change of state of the universe. According to Swami Vivekananda's view:

*'The whole universe is one. There is only one Self in the universe, only One Existence, and that One Existence, when it passes through the forms of time, space, and causation, is called by different names, Buddhi, fine matter, gross matter, all mental and physical forms. Everything in the universe is that One, appearing in various forms. When a little part of it comes, as it were, into this network of time, space, and causation, it takes forms; take off the network, and it is all one'.*

*Varna* is the impulse of the universe and *Varnamala* are shade of different elements of the world.



# VIEW POINT - 2 THERMODYNAMIC PROPERTY OF HEAT WAVES

## 3.1. Fundamentals

In the light of above discussion it may be said that *Varnamala* exists in the universe from the time of creation and it explores after the great explosion of world. *Varna* is the shade of sound and sound has power, which may be called heat wave. In this section there is a discussion about thermodynamic property of heat wave.

There are a series of work in the contemporary times, which substantiates the thermodynamic property of the heat waves. Property of heat waves as contained in high frequency sound i.e. Ultrasound. The following aspects are sequentially forwarded herewith that may establish a thermodynamic property of sound and rhythm:

- Fourier Spectrum
- Definition of Ultrasound.
- Therapeutic property of Ultrasound.
- Instances of current works.
- Definition of SAR
- Application of SAR
- Attenuation of sound
- Summary of the discussion

## 3.2. Fourier Spectrum

Our auditory system provides us with an incredibly rich and nuanced source of information about the world around us. Listening is not only a very useful but also a very enjoyable activity. If ears, auditory brain

work as they should then we will be able to distinguish thousands of sounds effortlessly. Sound and hearing are important because they play a pivotal role in human communication. The sound, which we get from the outer world through ears, has a great effect or impulse on the mind of human beings. These effects come out from our mouth as a 'VARNA'.

There are essential discussions on physical acoustics and the physiology of the ear. Four aspects of hearing are:

1. Perception of pitch [p1],
2. Processing of speech [p2],
3. Localization of sound sources [p3] and
4. Perceptual separating of sound mixture [p4]

When we do not seek to sense vibrating air for the sake of it, but we hope to learn something about the sound sources, which are the objects and events surrounding us? For a proper understanding of hearing we should therefore start by learning at least a little bit about how sound waves are created in the first place, and how the physical properties of sound sources shape the sounds they make. To understand this we discuss briefly Fourier's idea.

According to Fourier's view the ear produces a mathematical transformation by converting sound and wave of pressure which travel through time and the atmosphere. It means that sound has a pressure of wave over time. This mathematical transformation handles sine function. Sound is a combination of sine function. Each sine function and the original sound has a distinct power spectrum that gives the amplitude per frequency. So it may be said that sound is a series of power of distinct pitches.

## 3.3. Definition of Ultrasound

Ultrasound (US) is a form of mechanical energy, not electrical energy and therefore strictly speaking, not really electrotherapy at all but does fall into the Electro Physical Agents grouping. Mechanical vibration at increasing frequencies is known as sound energy. The normal human sound range is from 16Hz to something approaching 15-20,000 Hz (in children and young adults). Beyond this upper limit, the mechanical vibration is known as ULTRASOUND. The frequencies used in therapy are typically between 1.0 and 3.0 MHz (1MHz = 1 million cycles per second).

## 3.4. Therapeutic property of Ultrasound

Therapeutic ultrasound refers generally to any type of ultrasonic procedure that uses ultrasound for therapeutic benefit. This includes HIFU, lithotripsy, targeted ultrasound drug delivery, trans-dermal ultrasound drug delivery, ultrasound hemostasis, cancer therapy, and ultrasound assisted thrombolysis. It may use focused ultrasound (FUS) or unfocused ultrasound.

Ultrasound is a method of stimulating the tissue beneath the skin's surface using very high frequency sound waves, between 800,000 Hz and 2,000,000 Hz, which cannot be heard by humans.

## 3.5. Instances of current works

From a long time so many research has been done about therapeutic ultrasound. Some instances of current works on this matter are discussed below.



In the paper “Coupling agents in therapeutic ultrasound: acoustic and thermal behavior” Casarotto, R.A. et al showed the comparison between transmissivity data and thermal behavior of 4 coupling media. The main outcome and result of their research is:

*“The transmission, attenuation, reflection coefficient, and acoustic impedance of gel, mineral oil, white petrolatum, and degassed water were measured with a density measurement cell. The temperature variation in the therapeutic ultrasound transducer was measured with a thermocouple. The transmissivity data showed that water and gel presented the highest transmission coefficient, the lowest reflection, and an attenuation coefficient and acoustic impedance close to that of the skin. The thermal data revealed the highest heating in the transducer during the insonation with white petrolatum and mineral oil, resulting from the thermal conductivity features of each medium.”*

Therapeutic Ultrasound has an effect on tendon healing, is shown by Enwemeka (1989) in his paper “The effect of therapeutic ultrasound on tendon healing”:

*“The effect of 1 MHz therapeutic ultrasound on the healing strength of tendons was studied in the tenotomized, repaired and immobilized right Achilles tendons of 26 rabbits. Twelve tendons were sonicated daily in continuous waves at a spatial averaged intensity of 1 W cm (2) [corrected] for 5 min. After nine consecutive treatments, the tendons were excised under anesthesia and compared biomechanically. Exposure to ultrasound induced a significant increase in both the tensile strength and the energy absorption capacity of the tendons. Although healing in rabbits may not translate directly to healing in humans, these findings suggest that surgically repaired human Achilles tendons may heal faster if ultrasound is applied during the early stages of healing.”*

Frizzell, L.A. and F. Dunn have conducted a research on the uses of Ultrasound on Biophysics. The main theme of their paper is, influence of Ultrasound on the practice of medicine, especially in obstetrics. It has been almost half a century since the first of ultrasonic devices were developed to provide an image of the fetus. The early study with these devices showed a potential to provide high-resolution information about the fetus, which, if obtained by other techniques, could pose significant risks. Ultrasound did not appear to be associated with any known hazards. Thus, diagnostic ultrasound also gained wide clinical acceptance because it is convenient to use, comfortable for the patient, and not very expensive. The Bioacoustics Research Laboratory has had a major role in assessing ultrasound-induced biological effects.

### 3.6. Definition of Specific Absorption Rate (SAR)

SAR means 'specific absorption rate'. SAR is a measure of the rate at which energy is absorbed by the human body when exposed to a radio frequency (RF) electromagnetic field; although, it can also refer to absorption of other forms of energy by tissue, including ultrasound . It is defined as the power absorbed per mass of tissue and has units of watts per kilogram (W/kg).

SAR is usually averaged either over the whole body, or over a small sample volume (typically 1 g or 10 g of tissue). The value cited is then the maximum level measured in the body part studied over the stated volume or mass.

### 3.7. Application of SAR

Brenin and his colleagues are testing whether high-intensity focused ultrasound could offer a safe and effective alternative to surgery, one that would leave no scar. “The device is already approved for non-invasive surgery in Europe by their version of the FDA, but this is the first time it has been tested in the U.S. for treatment of fibro adenomas, or for any type of breast tumor,” Brenin said.

The high-intensity focused ultrasound, in essence, concentrates sound waves to generate heat, much like a magnifying glass can focus light. The U.va researchers focusing those sound waves on fibro adenoma, can make them go away without needing to cut into the body.

Sound waves are LONGITUDINAL waves consisting of areas of COMPRESSION and RAREFACTION. Particles of a material, when exposed to a sound wave will oscillate about a fixed point rather than move with the wave itself. As the energy within the sound wave is passed to the material, it will cause oscillation of the particles of that material. Clearly any increase in the molecular vibration in the tissue can result in heat generation, and ultrasound can be used to produce thermal changes in the tissues, though current usage in therapy does not focus on this phenomenon (Williams 1987, Baker et al 2001, terHaar 1999, Nussbaum 1997, Watson 2000, 2008). In addition to thermal changes, the vibration of the tissues appears to have effects which are generally considered to be non-thermal in nature, though, as with other modalities (e.g. Pulsed Shortwave) there must be a thermal component however small. As the US wave passes through a material (the tissues), the energy levels within the wave will diminish as energy is transferred to the material. The energy absorption and

attenuation characteristics of US waves have been documented for different tissues.

Lehmann (1982) suggests that the desirable effects of **therapeutic heat** can be produced by US. It can be used to selectively raise the temperature of particular tissues due to its mode of action. Among the more effectively heated tissues are periosteal, collagenous tissues (ligament, tendon & fascia) & fibrotic muscle (Dyson 1981). If the temperature of the damaged tissues is raised to 40-45°C, then a hyperemia will result, the effect of which will be therapeutic. In addition, temperatures in this range are also thought to help in initiating the resolution of chronic inflammatory states (Dyson & Suckling 1978). Most authorities currently attribute a greater importance to the non-thermal effects of US as a result of several investigative trials in the last 15 years or so.

Clinical HIFU procedures are typically performed in conjunction with an imaging procedure to enable treatment planning and targeting before applying a therapeutic or ablative levels of ultrasound energy. When Magnetic resonance imaging (MRI) is used for guidance, the technique is sometimes called Magnetic Resonance-guided Focused Ultrasound, often shortened to MRgFU or MRgHIFU. The procedure is called Magnetic Resonance-guided Focused Ultrasound Surgery or MRgFUS. When diagnostic sonography is used, this technique is sometimes called Ultrasound-guided Focused Ultrasound (USgFUS or USgHIFU).

### 3.8. Attenuation of Sound

Ultrasound can be focused, either via a lens (for example, a polystyrene lens), a curved transducer, or a phased array (or any combination of the three) into a small focal zone, in a similar way to focusing light through a magnifying glass focusing light rays to a point. Using an exponential model of ultrasound attenuation (i.e. the ultrasound intensity profile is bounded by an exponentially decreasing function where the decrease in ultrasound is a function of the distance traveled through the tissue), this can be modeled as  $I=I_0e^{-\alpha z}$  Where  $I_0$  is the initial beam intensity  $\alpha$ , is the attenuation coefficient in units of inverse length, and z is the distance traveled through the attenuating medium.

In this model,  $-\frac{\partial I}{\partial z} = 2\alpha I = Q$  (Reference: P Hariharan et al. (2007)) is a measure of the power density of the heat absorbed from the ultrasound field. Sometimes, SAR is also used to express the amount of heat absorbed by a specific medium and is related to Q by dividing Q by the tissue density. Also, this demonstrates that tissue heating is



proportional to the intensity and the intensity is inversely proportional to the area over which an ultrasound beam is spread, which is why focusing the beam into a sharp point (i.e. increasing the beam intensity) creates a rapid temperature rise at the focus.

The amount of damage caused in the tissue can be modeled using Cumulative Equivalent Minutes (CEM). Several formulations of the CEM equation have been suggested over the years, but the equation currently in use for most research done in HIFU therapy comes from a 1984 paper by Dewey and Separate:

$$CEM = \int_{t_0}^{t_f} R^{T-T_{reference}} dt$$

### 3.9. Conclusion

The measured intensity  $I$  of transmitted through a layer of material with thickness  $z$  is related to the incident intensity  $I_0$  according to the inverse exponential power law that is usually referred to as Beer–Lambert law:

$$I(z) = I_0 e^{-\mu \rho z}$$

Where  $z$  denotes the path length. The attenuation coefficient is  $\mu$ . If it is uniform, the situation is referred to as linear attenuation and the law simplifies:

$$I(z) = I_0 e^{-\alpha z}$$

The Half Value Layer (HVL) signifies the thickness of a material required to reduce the intensity of the emergent radiation to half its incident magnitude. It is from these equations that engineers decide how much protection is needed for "safety" from potentially harmful radiation. The attenuation factor of a material is obtained by the ratio of the emergent and incident radiation intensities  $I/I_0$ .

The linear attenuation coefficient and mass attenuation coefficient are related such that the mass attenuation coefficient is simply  $\mu/\rho$ , where  $\rho$  the density in g/cm<sup>3</sup>. When this coefficient issued in the Beer-Lambert law, then "mass thickness" (defined as the mass per unit area) replaces the product of length time's density.



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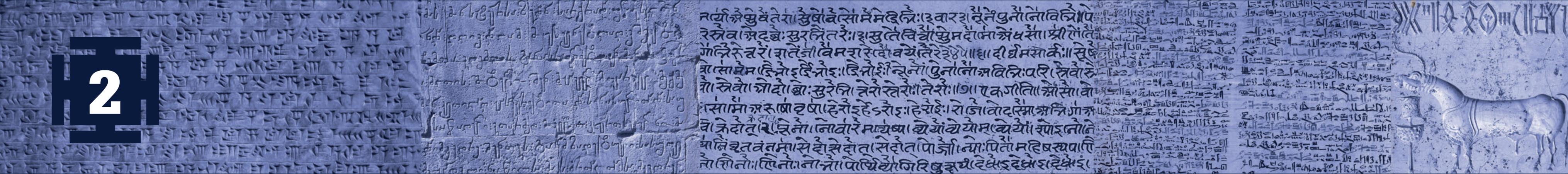
# PROJECT TWO: PART B

## An exploration of features of musical renditions by Digital Signal Processing

Exploring and designing an etymologic / articulation based foundation of *Varnamala* and a Signal processing driven exploration of features of Music / Songs, which constitutes the hierarchy of vowels and consonants of Sanskrit and other parental languages in the Indo-European language system.

The ideas have been developed from the deep ecological works of Sir Arthur Avalon (John Woodruff) and the contemporary constructs of Signal Processing sciences and technology.

# 2



### The Team

Dr. Partha Sarathi Bera, Advisor (Project two) [Electrical Engineering]

Indira Chatterjee (Project two) [Signal Processing]

Tanaya Mukherjee Sarkar (Project two) [Linguistic-syntax driven research]



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## INTRODUCTION

The aim of the present study is to show thorough comparative analysis that the feature of a single song can be marked in their voice and expressing emotion when sung by various artists. For this the songs have been converted to digital voice signals using MATLAB software. Then the variation of amplitude with respect to time have been plotted followed by spectrum and cepstrum calculation and also different statistical values i.e. mean, standard deviation, variance of the musical sound signal have been calculated. A few Rabindra Sangeet have been taken for this purpose and they have been categorized as High, Medium and Low according to their speed. Then songs from each category have been analysed separately.

The songs have been selected in such a way that their initial letters remain the same for a particular category. These music signals i.e. numerous forms have been splitted with the duration of 0-15 Sec, 15-30 Sec and 30-45 Sec. The objective here is to show that the momentum of the wave of melody changes or varies along with the change of time. Besides, the selves of each artist are reflected when they sing a particular song. That is clear when the songs are analysed by splitting them and also if listened to for a long time. A comparative study has been made to differentiate the singing style of various artists.

The analysis is performed based on Fourier analysis i.e. spectrum and cepstrum of sound signal. Initially the sound signals are converted to wave functions and the variation of amplitude with respect to time have been plotted followed by spectrum and cepstrum plot and also different statistical characteristic i.e. mean, standard deviation, variance of the musical sound signal have been observed. The songs are categorised as Low, Medium and High in terms of speed of the song sung by the singer. Following is the mathematical background for the whole analysis.



# 2

## MATHEMATICAL BACKGROUND FOR THE ANALYSIS OF MUSIC SIGNAL

Initially analog sound signal is coded followed by sampling and quantization. Sampling and quantization are followed successively to convert sound signal into discrete wave function.

### 2.1. Sampling

Sampling Theorem says that a band-limited signal can be reconstructed exactly if it is sampled at a rate at least twice the maximum frequency component in it. In the sampling process, an analog signal  $x(t)$  is converted into a sequence (sampled sequence) of values  $(X_i)=x(i \times T)$  at a periodic time  $t_i = i \times T$  ( $i$  is an integer. Here,  $T$  (Second) is called the sampling period, and its reciprocal,  $s = 1/T$  (Hz) is termed the sampling frequency. If  $T$  is too large, the original signal cannot be reproduced from the sampled sequence; conversely, if  $T$  is too small, useless samples for the original signal reproduction are included in the sampled sequence.

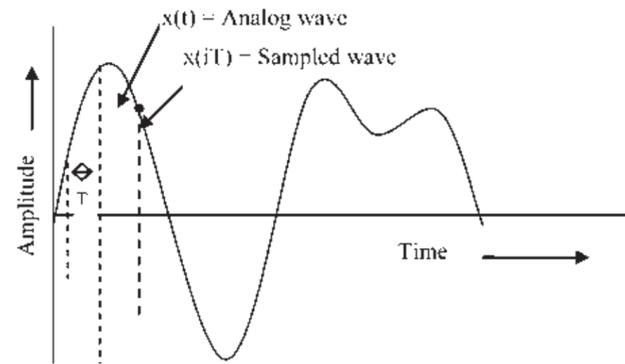


Fig. 1: Sampling of a music signal

### 2.2. Quantization and Coding

During quantization, the entire continuous amplitude range is divided into finite sub-ranges, and waveforms, the amplitudes of which are in the same sub-range, are assigned the same amplitude values. Figure below shows the input-output characteristics of an eight-level (3-bit) quantizer, where  $\Delta$  is the quantization step size.

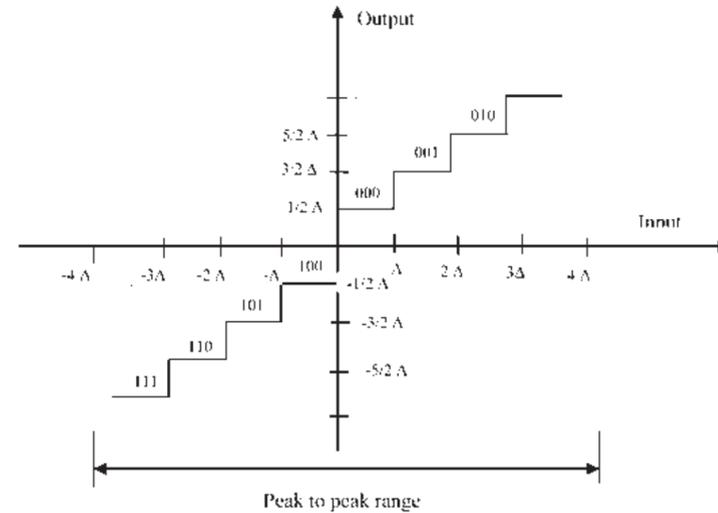


Fig. 2: Input output characteristics of 8 level (3 bit) quantization



# 3

## SPECTRAL ANALYSIS

### 3.1. Fourier Transform

The Fast Fourier transform (FFT) of a sampled time sequence  $x(n)$  is

$$X(n) = \frac{1}{2\pi N} \sum_{i=0}^{N-1} x(i) e^{-j\omega i} \dots\dots\dots(1)$$

$N$  = Total number of samples.

### 3.2. Window Function

In order to extract the  $N$ -sample interval from the speech wave to calculate the spectrum, the music wave must be multiplied by a time window. It attenuates gradually the amplitude at both ends of the extraction interval to prevent an abrupt change at the end points and produces the weighted moving average in the spectral domain. Here Hamming window  $WH(n)$  has been used as the window function for the music signal analysis. It's advantage is that the resolution in the frequency domain is relatively high and its spectral leak is small.

The equation of Hamming Window is as follows:

$$W_H(n) = 0.54 - 0.46 \cos\left(\frac{2\pi n}{N-1}\right) \text{ where } 0 \leq n \leq N-1 \dots\dots\dots(2)$$

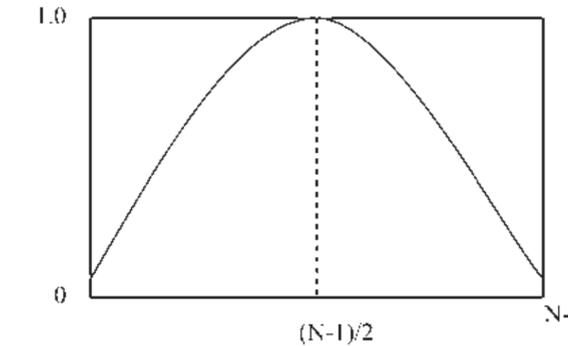


Fig.3: Hamming Window function

### 3.3. Cepstrum

The cepstrum, or cepstral coefficient,  $c(\tau)$  is the inverse Fourier transform of the short-time logarithmic amplitude. The cepstrum is the inverse transform of the spectrum. The independent parameter for the cepstrum is called queffrequency and since the cepstrum is

the inverse transform of the frequency domain function, the queffrequency becomes the time domain parameter.

When the cepstrum value is calculated by the DFT, it is necessary to set the base value of the transform,  $N$ , large enough to eliminate the aliasing similar to that produced during waveform sampling. The cepstrum then becomes

$$C_n = \frac{1}{N} \sum_{k=0}^{N-1} \log |X(k)| e^{j2\pi kn} \text{ for } 0 \leq n \leq N-1 \dots\dots\dots(3)$$

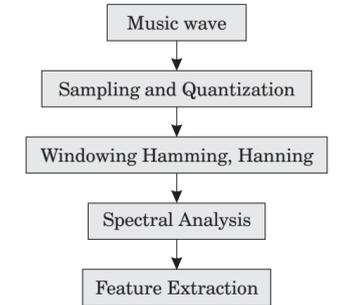


Fig.4: Block diagram of music signal analysis procedure



# RESULT AND ANALYSIS

In the present work, many songs of Tagore and classical songs sung by one and more singer have been collected as wav file. First, each song has been coded for easy handling the sound files and results. Then the amplitude vs time, spectrum and cepstrum have been plotted using MATLAB followed by mean and standard deviation, variance have been calculated for statistical analysis.

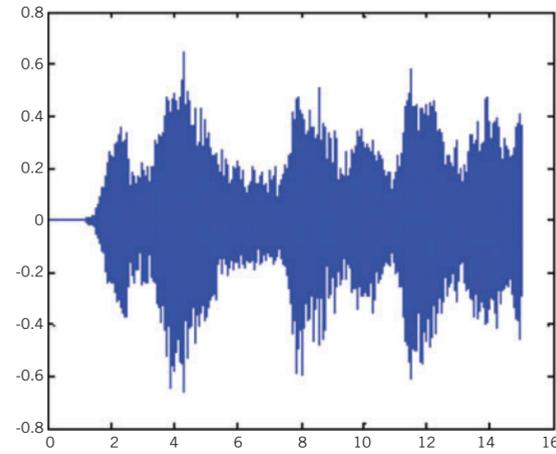


Fig.5: Plot of Amplitude vs time for 0-15 Sec sung by Chinmoy Chatterjee

As for example, the pictorial representation of amplitude vs time, spectrum and cepstrum and statistical data of a Tagore's song "Ei Udasi Haoar Pathe Pathe" sung by Chinmoy Chatterjee, Subir Sen and Suchitra Mitra for different time duration starting from 0 Seconds are given below. From the figure, it is seen that amplitude of the song sung by Suchitra Mitra is less compared to others but frequency is highest for all duration.

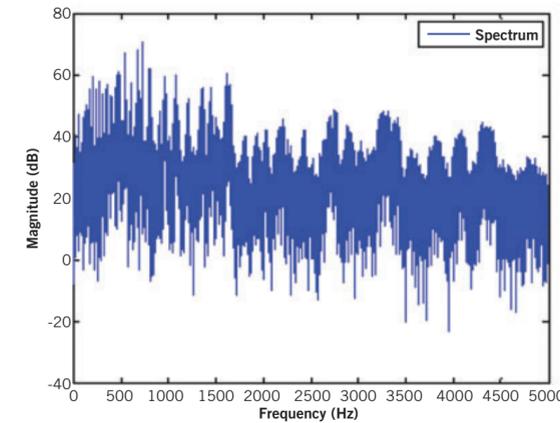


Fig 6. Plot of Spectrum for 0-15 Sec sung by Chinmoy Chatterjee

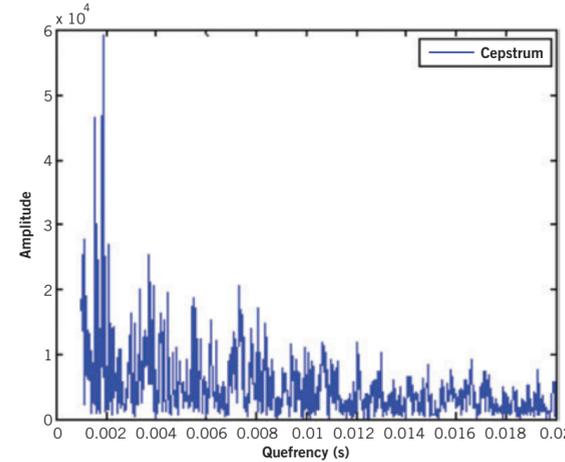


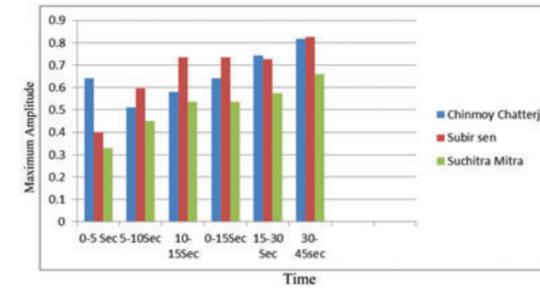
Fig.7: Plot of Cepstrum for 0-15 Sec sung by Chinmoy Chatterjee



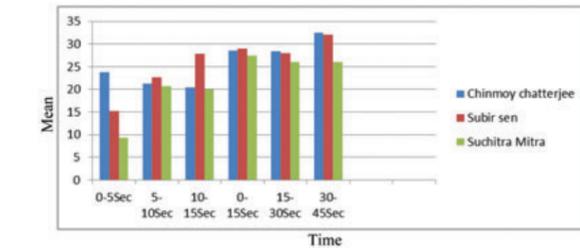
## Ei Udasi Haoar Pathe Pathe (E\_Low)

Figure 8: List of 7 features

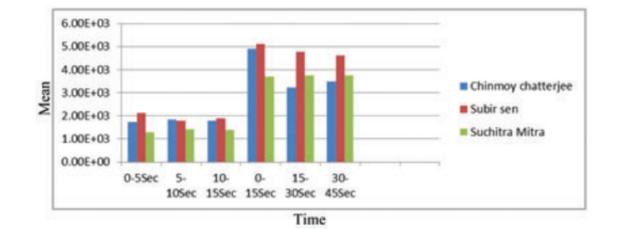
Column Chart for Calculated Max Amplitude After Quantization



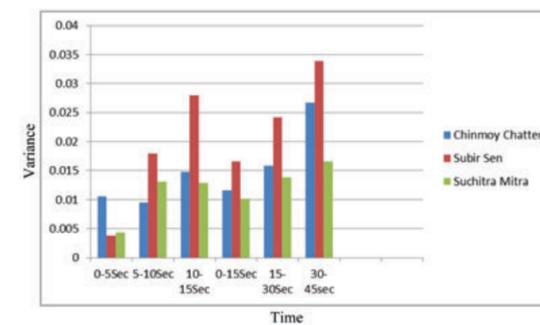
Column Chart for Calculated Mean Values After FFT of Windowed Signal



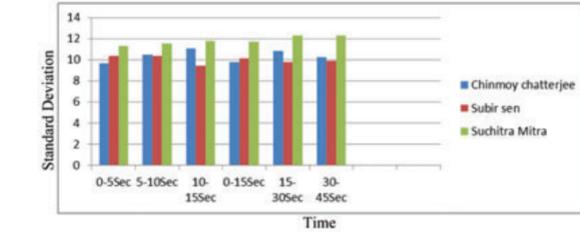
Column Chart for Calculated Mean Values After DFT of Log Spectrum



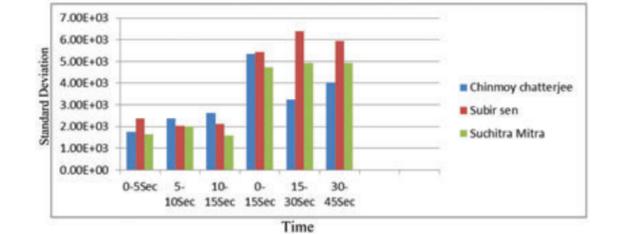
Column Chart for Calculated Variance After Quantization



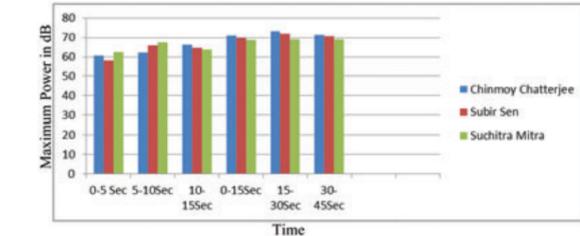
Column Chart for Calculated Standard Deviation After FFT of Windowed Signal



Column Chart for Calculated Standard Deviation After DFT of Log Spectrum



Column Chart for Calculated Max Power in dB After FFT of Windowed Signal



Column Chart for Calculated Amplitude After DFT of Log Spectrum



## CONCLUSIONS

The present analysis has shown mathematically how the speed of song is, characteristics of singer, are very specific for a particular song and singer. The music signal is actually a function of amplitude vs. time and its numerical representation can be observed using MATLAB software. The plot of amplitude vs. time has shown the changes of amplitude with respect to time for a particular song in the present analysis and the comparative analysis of maximum amplitude and variance for different time duration has been performed successively considering a Rabindra Sangeet of low category sung by three different singers using bar diagram and the diagrams have clearly shown the similar characteristics for a particular singer. The spectrum and cepstrum have been plotted and the standard deviations and mean values have been compared using bar diagram and found similar.

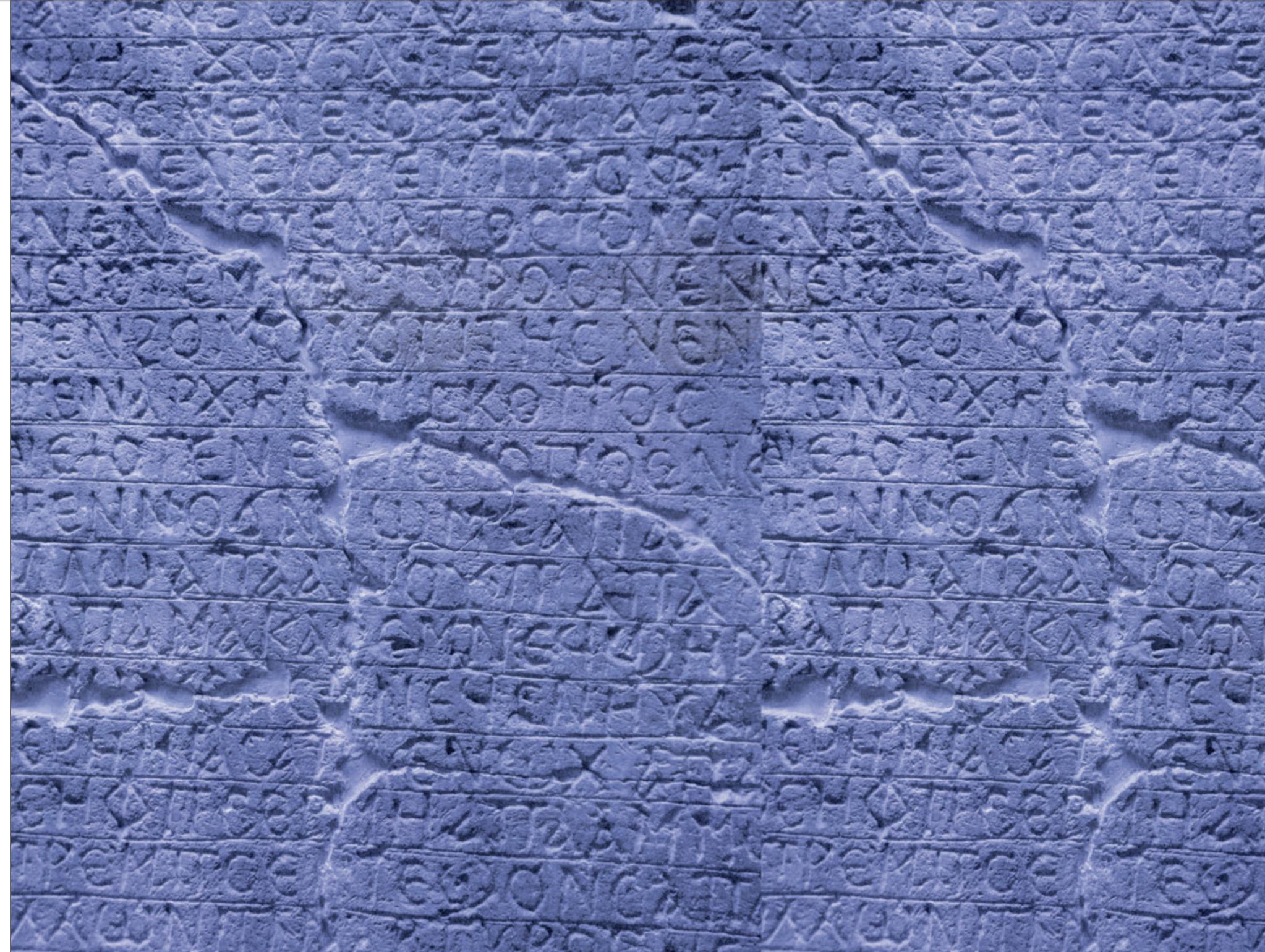
### 5.1. Future Scope of Work

LPC (Linear Predictive Coding) coefficient of each music signal may be calculated for different duration and compared. Wavelet analysis may be performed on these music signals and different features may be extracted. The deep exploration of *Varnamala* as an embedded feature of response-stimuli studies may be initiated accordingly.



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The time has perhaps come for the Indian mind, long preoccupied with political and economic issues, for a widening of its horizon. Such a widening is especially necessary for Bengal.

The Bengali has always led and still leads the higher thought of India, because he has eminently the gifts which are most needed for the new race that has to arise. He has the emotion and imagination which is open to the great inspirations, the mighty heart-stirring ideas that move humanity when a great step forward has to be taken. He has the invaluable gift of thinking with the heart. He has, too, a subtle brain which is able within certain limits to catch shades of meaning and delicacies of thought, both those the logic grasps and those which escape the mere logical intellect. Above all, he has in a greater degree than other races the yet undeveloped faculty of direct knowledge, latent in humanity and now to be evolved, which is above reason and imagination, the faculty which in Sri Ramakrishna, the supreme outcome of the race, dispensed with education and commanded any knowledge he desired easily and divinely. It is a faculty which now works irregularly in humanity, unrecognised and confused by the interference of the *samskāras* stored in the memory of the race and the individual. It cannot be made a recognised and habitual agent except by the discipline which the ancient Indian sages formulated in the science of Yoga. But certain races have the function more evolved or more ready for evolution than the generality of mankind, and it is these that will lead in the future evolution. In addition, the race has a mighty will-power which comes from the long worship of Shakti and practice of the Tantra that has been a part of our culture for many centuries. No other

people could have revolutionised its whole national character in a few years as Bengal has done. The Bengali has always worshipped the Divine Energy in her most terrible as well as in her most beautiful aspects; whether as the Beautiful or the Terrible Mother he has never shrunk from her whether in fear or in awe. When the divine force flowed into him he has never feared to yield himself up to it and follow the infinite prompting, careless whither it led. As a reward he has become the most perfect *adhāra* of Shakti, the most capable and swiftly sensitive and responsive receptacle of the Infinite Will and Energy the world now holds. Recently that Will and Energy has rushed into him and has been lifting him to the level of his future mission and destiny. He has now to learn the secret of drawing the Mother of Strength into himself and holding her there in a secure possession. That is why we have pointed to a religious and a spiritual awakening as the next necessity and the next inevitable development.

But along with his great possessions the Bengali has serious deficiencies. In common with the rest of India he has a great deficiency of knowledge, the result of an education meagre in quantity and absolutely vicious in method and quality. And he is inferior to other Indian races, such as the Madras and Maratha, in the capacity of calm, measured and comprehensive deliberation which is usually called intellect or reasoning power, and which, though it is far from the whole of thought, is essential to the completeness of thought and action. By itself the logical or reasoning intellect creates the accurate and careful scholar, the sober critic, the rationalist and cautious politician, the conservative scientist, that great mass of human intelligence which makes for slow and careful progress. It does not create the hero and the originator, the inspired prophet, the mighty builder,

the maker of nations; it does not conquer nature and destiny, lay its hand on the future, command the world. The rest of India is largely dominated by this faculty and limited by it, therefore it lags behind while Bengal rushes forward. The rest of India has feared to deliver itself to the Power that came down from above to uplift the nation; it has either denied its call or made reservations and insisted on guiding it and reining it in. A few mighty men have stridden forward and carried their race or a part of it with them, but the whole race must be infused with the spirit before it can be fit for the work of the future.

On his side the Bengali, while in no way limiting the divine

inrush or shortening the Titan stride, must learn to see the way he is going while he treads it. For want of a trained thought-power, he follows indeed the ideas that seize him, but he does not make them thoroughly his own. He thinks them out, if at all, rapidly but not comprehensively, and, in consequence, though he has applied them with great energy to the circumstances immediately around him, a new set of circumstances finds him perplexed and waiting for a lead from the few men to whom he has been accustomed to look for the source of his thought and action. This is a source of weakness. For the work of the present, and still more, for the work of the future, it is imperatively necessary to create a centre of thought and knowledge which will revolutionise the brain of the nation to as great an extent as its character and outlook has been revolutionised. A new heart was necessary for our civilisation, and, though the renovation is not complete, the work that has been done in that direction will ensure its own fulfilment. A new brain is also needed, and sufficiency of knowledge for the new brain to do its work with thoroughness...



The practice of Brahmacharya is the first and most necessary condition of increasing the force within and turning it to such uses as may benefit the possessor or mankind. All human energy has a physical basis. The mistake made by European materialism is to suppose the basis to be everything and confuse it with the source. The source of life and energy is not material but spiritual, but the basis, the foundation on which the life and energy stand and work, is physical. The ancient Hindus clearly recognised this distinction between *kāraṇa* and *pratiṣṭhā*, the north pole and the south pole of being. Earth or gross matter is the *pratiṣṭhā*, Brahman or spirit is the *kāraṇa*. To raise up the physical to the spiritual is Brahmacharya, for by the meeting of the two the energy which starts from one and produces the other is enhanced and fulfils itself.

This is the metaphysical theory. The application depends on a right understanding of the physical and psychological conformation of the human receptacle of energy. The fundamental physical unit is the *retas*, in which the *tejas*, the heat and light and electricity in a man, is involved and hidden. All energy is latent in the *retas*. This energy may be either expended physically or conserved. All passion, lust, desire wastes the energy by pouring it, either in the gross form or a sublimated subtler form, out of the body. Immorality in act throws it out in the gross form; immorality of thought in the subtle form. In either case there is waste, and unchastity is of the mind and speech as well as of the body. On the other hand, all self-control conserves the energy in the *retas*, and conservation always brings with it increase. But the needs of the physical body are limited and the excess of energy must create a surplus which has to turn itself to some use other than the physical. According to the ancient theory *retas* is *jala* or water, full of light and heat and electricity, in one word, of *tejas*. The excess of the *retas* turns first into heat or *tapas* which stimulates the whole system, and it is for this reason that all forms of self-control and austerity are called *tapas* or *tapasyā* because they generate the heat, or stimulus which is a source of powerful action and success; secondly, it turns to *tejas* proper, light, the energy which is at the source of all knowledge; thirdly, it turns to *vidyut* or electricity, which is at the basis of all forceful action whether intellectual or physical. In the *vidyut* again is involved the *ojas*, or *prāṇaśakti*, the primal energy which proceeds from ether. The *retas* refining from *jala* to *tapas*, *tejas* and *vidyut* and from *vidyut* to *ojas*, fills the system with physical strength, energy and brain-power and in its

last form of *ojas* rises to the brain and informs it with that primal energy which is the most refined form of matter and nearest to spirit. It is *ojas* that creates a spiritual force or *vīrya*, by which a man attains to spiritual knowledge, spiritual love and faith, spiritual strength. It follows that the more we can by Brahmacharya increase the store of *tapas*, *tejas*, *vidyut* and *ojas*, the more we shall fill ourselves with utter energy for the works of the body, heart, mind and spirit.

This view of the human soul was not the whole of the knowledge on which ancient Hinduism based its educational discipline. In addition it had the view that all knowledge is within and has to be evoked by education rather than instilled from outside. The constitution of man consists of three principles of nature *sattva*, *rajas* and *tamas*, the comprehensive, active and passive elements of universal action, which, in one of their thousandfold aspects, manifest as knowledge, passion and ignorance. *Tamas* is a constitutional dullness or passivity which obscures the knowledge within and creates ignorance, mental inertia, slowness, forgetfulness, disinclination to study, inability to grasp and distinguish. *Rajas* is an undisciplined activity which obscures knowledge by passion, attachment, prejudgment, predilection and wrong ideas. *Sattva* is an illumination which reveals the hidden knowledge and brings it to the surface where the observation can grasp and the memory record it. This conception of the constitution of the knowing faculty made the removal of *tamas*, the disciplining of *rajas* and the awakening of *sattva* the main problem of the teacher. He had to train the student to be receptive of illumination from within. The disciplining of *rajas* was effected by a strict moral discipline which induced a calm, clear, receptive state of mind, free from intellectual self-will and pride and the obscuration of passion, — the famous discipline of the brahmachārin which was the foundation of Aryan culture and Aryan moral; and the interference of wrong ideas was sought to be removed by strict mental submission to the teacher during the receptive period, when the body of ascertained knowledge or right ideas already in man's possession was explained to him and committed to memory. The removal of *tamas* was effected by the discipline of moral purity, which awakened the energy of *tejas* and electricity in the system and by the power of *tapasyā* trained it to be a reservoir of mental force and clarity. The awakening of illumination was actively effected by the triple method of repetition, meditation and discussion. *āvṛtti* or repetition was

meant to fill the recording part of the mind with the *śabda* or words, so that the *artha* or meaning might of itself rise from within: needless to say, a mechanical repetition was not likely to produce this effect. There must be that clear still receptivity and that waiting upon the word or thing with the contemplative part of the mind which is what the ancient Indians meant by *dhyāna* or meditation. All of us have felt, when studying a language, difficulties which seemed insoluble while grappling with a text suddenly melt away and a clear understanding arise without assistance from book or teacher after putting away the book from our mind for a brief period. Many of us have experienced also the strangeness of taking up a language or subject, after a brief discontinuance, to find that we understand it much better than when we took it up, know the meanings of words we had never met with before and can explain sentences which, before we discontinued the study, would have baffled our understanding. This is because the *jñātā* or knower within has had his attention called to the subject and has been busy in the interval drawing upon the source of knowledge within in connection with it. This experience is only possible to those whose *sattvic* or illuminative element has been powerfully aroused or consciously or unconsciously trained to action by the habit of intellectual clarity and deep study. The highest reach of the *sattvic* development is when one can dispense often or habitually with outside aids, the teacher or the text book, grammar and dictionary and learn a subject largely or wholly from within. But this is only possible to the Yogin by a successful prosecution of the discipline of Yoga.

Sri Aurobindo  
The Brain of India



## SandHI Team



**Prof. Partha P. Chakrabarti**, Director, IIT Kharagpur

**Prof. Sunando Dasgupta**, Dean (SRIC), IIT Kharagpur

**Prof. Pallab Dasgupta**, Associate Dean (SRIC), IIT Kharagpur

**Prof. Joy Sen**, PI, Sandhi Initiative & Varanasi / Future of Cities initiative, IIT Kharagpur

**Prof. Priyadarshi Patnaik**, PIC, Documentation and Dissemination Cell, Sandhi Initiative, IIT Kharagpur

**Prof. Bhargab Maitra**, PI, Future of Cities initiative, IIT Kharagpur