

EVOLUTION OF UNIVERSE : THE ANCIENT *PANCHA – BHAUTIKA* MODEL IN LIGHT OF MODERN SCIENCE

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ABSTRACT

In the ancient Pancha – Bhautika model of the creation of universe, the matter has been conceived as made up of five fundamental entities, called Pancha-Mahabhootas, that manifest in the beginning in the sequence Akasha (space), Vayu (air), Teja (fire), Apa (water) and Prithvi (earth) which have the specific characteristics of Shabda (vibration), Sparsha (touch, interaction), Roopa (shape), Rasa (taste) and Gandha (odour) respectively. A Pancha-Mahabhoota getting manifested at its turn carries the characteristics of all the previous ones in addition to its own. These five Mahabhootas combine in different proportions to yield a set of new five entities which are called the Pancha-Sthoolbhootas . The process of combining is called Panchikarana . These five new entities (Pancha-Sthoolbhootas) have been given same names as those of Mahabhootas and are the ones that are perceived by our sense organs. These five entities viz Akasha (space), Vayu (air), Teja (fire), Apa (water) and Prithvi (earth) of our daily experience, though bear the same names as the Pancha-Mahabhootas do , are , contrary to the wide spread belief, not the fundamental building blocks of universe/materials but are the outcome of the combination of the Mahabhootas after Panchikarana. The Pancha-Mahabhootas , may be viewed as property-based step-by-step evolution of a single energy form. In ancient Indian traditions this form, called Bindu, has been taken to be one form of Brahma having willingly encased Himself in Ahankar, and floating in the ocean of another form of Brahma , the Mahakala, (the eternal time) . The evolution of the universe begins by first appearance of Bindu followed by the five Pancha-Mahabhootas and Panchikarana . Keeping in mind the meaning of Vayu as motion-ness (Chalanam) , of Prithvi as stability (Sthira) etc. given in Yogvashishtha and other texts it is observed that in this scheme the characteristics Shabda, Sparsha, Roopa, Rasa and Gandha attributed respectively to Akasha, Vayu, Teja, Apa and Prithvi are the most logical properties and signatures that these Pancha-Mahabhootas would possess for evolution to proceed. An analysis of this Pancha-Bhautika model reveals a striking parallelism between the sequence in which the Pancha-Bhootas emerge and physically perceptible stages of matter that come across when an effort using the modern science is made to visualize the process of evolution starting from a single mass point (Bindu) . Wherever Akasha (space) is available , thee would be inevitable presence of Spanda (vibration). It is found that the concepts presented in the Pancha-Bhautika model, when used along with the modern thoughts , would yield a better understanding of the science of odour and smell, a subject in which the modern science is still striving for a theory. This model tells that materials having stable structures only would possess odor.

Keywords: Pancha-Mahabhootas; Akasha (space); Vayu (air); Agni (fire); Apa (water); Prithvi(earth); odor

INTRODUCTION

The ancient Indian texts are full of views about creation of the universe, its evolution and structure according to different traditions of Indian philosophy. These different ancient Indian views have been briefly summarized by Dr. R.C. Verma^[1-3]. Most of these views have one thing in common that the universe originated from a single principle. The state prior to the beginning of evolution has been contemplated in depth in the *Nasadiya Sukta* of *Rig Veda* and has been stated as not accessible by describing as “Then even nothingness was not, nor existence...nor was there then the torch of night and day.....there was only darkness wrapped in darkness...”^[4-5]. The *Nasadiya Sukta* have been discussed in detail by Dr. Vasudeva Sharan Aggrawal in his books titled “Ved Rashmi” and “Sparks from Vedic Fire”^[6,7]. It is agreed that prior to the gross manifestation of the universe the *Pancha-Mahabhootas*, the five fundamental entities, manifest first and then the further evolution of the universe depends upon different combinations of these *Pancha-Mahabhootas*. This all happens in the womb of time (*Mahakala*), another form of that principle, as stated in *Yogvashishtha*, “from the root to leaves and the fruits, all this universe in the form of a tree is engulfed by time”^[8]. The *Taittiriya Upanishada* says “*soakaamayati*, *bahu syam prajaayeti*” i.e. “He desired, let me manifest as many”^[9]. At that moment an entity, called “*Bindu*” appeared. The “*Bindu*” is one form of *Brahma* having willingly encased Himself in *Ahankaar*, and floating in the ocean of another form of *Brahma*, the *Mahakala*, (the eternal time). The *Mahakala* is ever existing and is termed as *Kala*, the moment we give a value to it by performing some measurements^[8]. Then the five entities “*Pancha-Mahabhootas*” known as *Akasha* (space), *Vayu* (air), *Teja* (fire), *Apa* (water) and *Prithvi* (earth) get manifested in this sequence. Among the *Pancha Mahabhootas* *Akasha* is the gross principle to manifest first. From the *Akasha* the next thing to emerge out is *Vayu* (air). From *Vayu* is formed *Agni* (*Teja*, fire) and from *Agni*, *Apa* (water) is formed. From *Apa* (water) *Prithvi* (earth) is formed (*akashat vayuh vayoragnih agnerapah adbhayah prithvi ...*)^[10-12]. These five entities i.e. *Akasha*, *Vayu*, *Agni*, *Apa* and *Prithvi* are not the gross objects usually

perceived. These have also been called *Sukshma-Mahabhootas* as they are subtler and more basic. They get combined in different proportions to yield the five commonly known and perceived entities, again called by same names, viz *Akasha* (space), *Vayu* (air), *Agni* (fire), *Apa* (water) and *Prithvi* (earth). The process of combination is called *Panchikarana*^[12-14]. Thus, these five things, viz *Akasha* (space), *Vayu* (air), *Agni* (fire), *Apa* (water) and *Prithvi* (earth) coming in our daily experience and called as *Pancha – sthool-bhootas* (or simply *Pancha-bhootas*) are, contrary to the wide spread notion, not the basic building blocks of all matter but these themselves are made up of the five more subtler and fundamental entities known as *Pancha-Mahabhootas*. The *Pancha-Mahabhootas* have different attributes viz. *Shabda* (vibration), *Sparsha* (touch, interaction), *Roopa* (shape), *Rasa* (taste) and *Gandha* (odor) and therefore the *Pancha-Sthool-Bhootas* resulting after their combinations (*Panchikarana*) have different properties. From *Prithvi* (earth), plants and food grains get created. These *Pancha-Sthool-Bhootas* by further combining with themselves yield this universe^[10-14]. The process of creation and evolution has been described in *Agni Purana*^[15] and by *Adi Shankaracharya*^[16] in the following way. *Brahma* is unmanifested. At the impulse of desire of creation, *Mahat* followed by *Ahankar* emerged. From *Ahankar*, entities called *Pancha Tanmatra* viz *Shabda*, *Sparsha*, *Roopa*, *Rasa* and *Gandha*, appear. Then the five *Pancha Mahabhootas* get manifested in a sequence accommodating the *tanmatras* and possessing those specific characteristics. From the *Pancha Mahabhootas*, emerges the entire universe after *Panchikaranam*. The *tanmatras* are the characteristics of the *Mahabhootas*.

Although the *Pancha Mahabhootas* and *Panchikarana* have been clearly described in the ancient texts a lot of wrong notions prevail specially among scientific community of the present day society. The purpose of this article is to bring forth the concept of evolution based on *Pancha Mahabhootas*, as proposed by the ancient seers, and develop an understanding of the *Pancha-Mahabhootas* and their characteristics*

in light of ideas of modern science. An attempt has been made to analyse the Pancha -Mahabhootas and their associated characteristics with an idea to explore the possible scientific concepts buried deep into this which may be useful in further development of our understanding of the creation. Also, effort is made to address the question that for the evolution to proceed why should the Mahabhootas appear in the particular sequence viz Akasha (space), Vayu (air), Teja (fire), Apa (water) and Prithvi (earth) and why should they possess those specific characteristics Shabda, Sparsha, Roopa, Rasa and Gandha respectively. A preliminary report on these lines was published earlier^[17].

• **Foot Note :**

One of the techniques followed by the ancient seers for communicating an abstract concept to the disciple or to the general audience was to choose (and later on use) a word (or phrase) associated to a certain object (or situation) whose characteristics are well known and are most suitable for signifying the underlying theme of that particular concept. For example, Vayu (air) is always in motion, and Prithvi (earth) is stable (sthira, achala) for all practical purposes, so the word Vayu was used to express the concept of motion and the word Prithvi was used to express the concept of stability (sthiratva). This technique of communication, widely used in Sanskrit literature, is called 'Lakshana'. The authors feel that this might have been one of the reasons of spreading of wrong meanings of the concepts over the passage of time (centuries). In studying the ancient Sanskrit texts from science point of view, keeping in mind the possible use of 'Lakshana' technique greatly helps in deciphering the possible hidden meanings.

In the next section the details of the Panchikarana process as available in ancient Sanskrit literature is presented followed by description of Pancha- Mahabhootas and discussion. An attempt has been made to develop an understanding of the Pancha-Mahabhootas, from a view point of today's science concepts. As an application, use of this model to elaborate upon the still poorly understood subject of smell and odor (Gandha) is also discussed.

PANCHIKARANA (COMBINATION) OF THE PANCHA-MAHABHOOTAS

The process of Panchikarana has been described by Adi Shankaracharya and others^[12-14]. It may occur in two ways, say A and B, as described below:

Process A : Each Mahabhoota gets divided into two equal parts. One half part remains as it is while the other half is again divided into four equal parts. These latter parts combine with the first half intact parts of each of the remaining four Mahabhootas yielding new entities called Pancha-Sthoolbhootas. This is presented in Table 1.

Process B : Each of the five Mahabhootas gets divided into twenty five equal parts. Twenty one parts stay as such whereas each of the remaining four parts go to join with the twenty one intact parts of the other Mahabhootas. The composition of the resulting Pancha-Sthool bhootas are given in Table 2.

The properties of the Pancha -Sthoolbhootas differ from each other because of the varying

proportions of the constituent Pancha - Mahabhootas present in them. The resulting Pancha -Sthoolbhootas are perceived by our sense organs.

DESCRIPTION OF THE CONCEPT OF THE PANCHA-MAHABHOOTAS (THE FIVE FUNDAMENTAL ENTITIES) WITH A SCIENTIFIC ANALYSIS

In what follows we make an attempt, by performing a thought experiment, to understand the *Pancha -Mahabhootas* and their associated characteristics with an idea to explore the possible scientific concepts buried deep into this. Also, effort is made to address the question that why the particular sequence in which the *Mahabhootas* appear has to be followed for evolution to proceed. Let us consider an entity, say a point object, to which it is possible to attribute different characteristics one after the other in a sequence. In ancient Indian traditions this entity has been taken to be the *Bindu* which has been described earlier^[18]. When the evolution begins the first *Mahabhoota* called *Akasha* (space) is manifested. Let us visualize by thinking of a room made available around the *Bindu*. At this instant nothing can be said about the location of the entity (*Bindu*) in that *Akasha* (space). We cannot say whether the entity is stationary inside or moving since no other attributes have been assigned except space and the property of motion is not yet known at this stage. So it is logical to accept that the entity is inside the *Akasha* and all

locations are probable. At different *Kala* (times) the entity is likely to be found at different locations in the *Akasha*. This is exactly what the word *Spanda* means. The word *Spanda* is derived from the root *spadi* in Sanskrit language which means ' little displacement, this way and that way or a throb, *spandanam cha kinchit chalanam* ' ^[19, 20] . The *Spanda* gives rise to the effect called *Shabda* and we can say that wherever there is a *Spanda* there is *Shabda*, these two co-exist. Therefore manifestation of *Akasha* and existence of *Shabda* are synonymous. Said in a different way the *lingam* (sign) of *Akasha* is *Shabda* i.e. *Shabda* is something by which presence of *Akasha* is inferred ^[21] or vice-versa. Also the same thing is expressed by saying that *Bindu* with *Akasha* possesses *naada* ^[22] . Thus it is clear that the presence of *Shabda* implies the presence of *Akasha*. The *spanda* that appears in *Akasha* necessitates the appearance of something like motion, velocity and direction. This is what the Sanskrit texts say- attached with *Akasha* are *Dik* (directions) and from *Akasha* appears *Vayu*.

Vayu is the next *Mahabhoota* to get manifested. The meaning of *Vayu* is motion-ness (*chalanam* , *Gati*) ^[21, 23, 24] and its characteristic is *Sparsha* (touch) ^[25] . The meaning of *Sparsha* may be taken as a contact giving rise to some form of interaction ^[26] . From Physics point of view, two objects would be called to interact only when something is moving (exchanging) between the two (Physics says that interaction between objects is mediated by some fundamental particles) ^[27] . Movement of any kind would result into interaction (*Sparsha*). The happening of *Sparsha* indicates the necessary presence of some motion i.e. *Vayu*. Therefore , it is implied that *Sparsha* may be called the characteristic feature of *Vayu*. Now since *Vayu* (motion) takes place in *Akasha*, the presence of *Vayu* anywhere implies the presence of both *Akasha* (space) and motion. The *Spanda* alongwith *Dik* (direction) and *Vayu* (motion) prompts us to think of something like vibration so well known in Physics ^[26] .

Agni (fire) (also known as *Teja*) is the third *Mahabhoota* to get manifested and its characteristic is *Roopa* (shape) ^[28] . The word *Teja* in Sanskrit is used to convey the meaning of fire , light or brightness. The concept of something having a *Roopa* (shape) is difficult to visualize without thinking about light and interaction. A beam of light or some such thing having no

interaction (*sparsha*) with an object can not reveal its *Roopa* (shape). The *Roopa* (shape) of something can be observed only by utilizing a tool such as beam of light/ electromagnetic radiation, beam of particles, sound waves etc. which interacts with that thing or emanates from it. Now, presence of interaction (*Sparsha*) indicates the necessary presence of motion i.e. *Vayu* (air). This is why in the *Pancha – Bhautika* model the manifestation of *Vayu* (motion, the root cause of interaction) precedes that of *Agni/Teja*. Also the *Vayu* (motion) present in any entity necessarily implies presence of energy which is also called *Agni*.

Apa (water) is the fourth *Mahabhoota* to get manifested . The meaning of *Apa* is fluidity ^[29] . Let us understand this. The discussion presented in previous paragraphs was for one point object, but it holds true for several point objects as well. According to “*soakaamayati , bahu syam prajaayati*” ^[9] presence of several point objects (*Bindu*) are possible. Each one has *Vayu* and *Teja*. Because of presence of *Vayu* i.e. *Sparsha* (interaction) some togetherness or preferential collective localization and clusterization becomes possible giving rise to some sort of concentration gradients. This ,in turn, would create a flow. So appearance of the property of flow (*Apa*) is very much consistent in the sequence of *Pancha - Mahabhootas* . Usually the meaning of *Apa* is taken as water. But actually *Apa* means an entity that has the property which gives rise to fluidity with gradient ^[29] . A cluster having some shape (*Roopa* i.e. *Teja*) and property of fluidity would give rise to what we call a liquid that might be thought of a sort of liquid chemical of today's science. The liquid chemicals in general have been called *Rasa* in *Ayurveda* and the subject that deals with them is called *Rasa-Shastra* ^[30-32] . Another meaning of the word *Rasa* as related to flow of different emotions is also prevalent but here we are taking their meanings that would relate to matter. The characteristic property assigned to *Apa* is *Rasa* (taste) ^[16] . It is known from modern science that in the process of sensing the taste of a material by the tongue, the material dissolves to form a liquid first, at the different types of taste buds situated there, which is further sensed ^[33,34] . Thus , we can easily accept that *Rasa* (taste) would be observed through liquid only. Thus assignment of *Rasa* as the characteristic of a liquid i.e. *Apa* is quite logical.

The fifth *Mahabhootas* to get manifested is *Prithvi* (earth). The *Mahabhootas* just preceding it is *Apa* (water). In *Apa* (water) whose main characteristic is *Rasa* the properties of the preceding three *Mahabhootas* viz *Roopa*, *Sparsha* and *Shabda* are also present. The interplay of *Shabda*, *Sparsha*, *Roopa* and *Rasa* i.e. *Akasha*, *Vayu*, *Teja* and *Apa* might be such that the localized clusters discussed in the earlier paragraphs are rendered larger as the number of “*Bindu*” is taken large and as a result relative motions (flow) would tend to get inhibited. This means that there appears now another thing that might be thought of to be similar to a solid of today's scientific vocabulary. This is the *Mahabhoota* called *Prithvi*. *Prithvi* is called *Sthira* and *Achala* also i.e. that which has the property of solidity and stability^[35]. The characteristic assigned to it is *Gandha* (odour)^[25]. This means that the appearance of *Gandha* implies a necessary presence of stable forms. Thus a liquid having *Gandha* would possess constituents whose structures are solid-like (*sthira* or stable). Thus, in general, according to the *Pancha – Bhautika* Model, a substance would possess odor only if it has constituents having stable structures and shape (*Roopa*).

DISCUSSION

According to the *Pancha – Bhautika* model the *Pancha -Mahabhootas* viz *Akasha* (space), *Vayu* (air), *Teja* (fire), *Apa* (water) and *Prithvi* (earth) are manifested first in this sequence. These have the specific characteristics of *Shabda* (vibration), *Sparsha* (touch, interaction), *Roopa* (shape), *Rasa* (taste) and *Gandha* (odour) respectively. A particular *Pancha-Mahabhoota* carries the characteristics of all the previous ones in addition to its own. The *Mahabhootas* combine in different proportions, by a process called *Panchikarana*, to yield a set of new five entities which are called the *Pancha-Sthoolbhootas* and bear the same names as the *Mahabhootas*. These are perceived by our sense organs. The *Pancha-Sthoolabhootas*, combine among themselves and this universe having complex looking variety of structures gets displayed. Now let us examine this, keeping in mind today's scientific advancements, with a view to extract some possible clues that might be helpful in developing more understanding of the laws of nature. In order to do so let us try to visualize the process of evolution. Whatever be the correct

model of evolution, big-bang or oscillating or something else, it is undisputedly true that some energy, whatever be its form, must be taken to be present in the beginning to start with (from law of conservation of energy). So consider a point object at a moment of time. An entity (an atom or a particle etc) having no size cannot be conceived. Therefore, to simulate the process of evolution that can be perceived by the mind, the first necessity is the 'size' i.e. a physical region (space) in which the entity is confined. The smallest space around an object would be equal to its size. For generality this may be taken to be bigger. Now, Quantum Mechanics tells us that a free particle in a region can be described only by wave functions that may be viewed as something giving rise to sort of wave patterns in that region and which give finite probability for the particle to be found anywhere within that region^[36-39]. So the very concept of 'space', gives rise to the concept of wave patterns present within it. Extending this argument further we can say that the moment we assign a 'space' to the energy form (the point particle) the appearance of wave patterns is inevitable. Now look at the *Pancha – Bhautika* model. The first *Mahabhoota* to get manifested is *Akasha* (space). The signature of *Akasha* is *Spanda* or *Shabda*. If we take the meaning of the waves as *Spanda* and the initial energy form as *Bindu*, then we find that both the *Pancha – Bhautika* model and Physics are leading to similar ideas, at this stage of evolution. However the *Pancha-Bhautika* model goes still further. It is an abstract formalism and therefore can be applied to any relative sizes. This means that as long as we keep on thinking of a 'space' (i.e. *Akasha*) there would be the inevitable presence of *Spanda* (*Shabda*) within that space irrespective of the relative scales of size we use (10^n meters, where n may be any positive or negative number). Therefore, within the size of a mass point there would be presence of *Spanda* (*Shabda*). Thus, a tiny mass point may be viewed as a confined *Spanda* (*Shabda*) and a majestic galaxy would also possess a *Spanda* (*Shabda*).

As discussed in the previous paragraph the availability of space gives rise to quantum mechanical wave patterns. These in turn yield the values of the probability of finding the object at a location within that space. For a free particle in a box these waves are standing waves that are formed by two similar waves travelling in

opposite directions. Though the waves travelling in the opposite directions appear due to requirements for solutions of the quantum mechanical wave equation, these may be considered as arising because of the reflection that occurs at the boundary of the box. Reflection can occur due to, sort of, some interaction at the boundary. Therefore, the very act of making a space available to our experimental point object in our thought experiment seems to bring forth the concept of motion and interaction also. This is all because of space only (since we are visualizing the evolution starting from a point object, assigning a finite space to start with should not be objectionable. This restriction may be relaxed later on). Now see what the *Pancha-Bhautika* model says here. It says “*Akashat Vayuh*” i.e. from space emerges *Vayu*. As explained in earlier sections the meaning of *Vayu* is motion and its associated property is *Sparsha*. Taking the meaning of *Sparsh* (touch) as 'interaction' we find that the rule '*Akashat Vayuh*' is consistent with physics not only as a rule but also in the order of its appearance. Had there been no space, motion (and interaction) would not have emerged. This agrees with what the *Pancha – Bhautika* model tells that a particular *Mahabhoota* carries the properties of the preceding ones i.e. in *Vayu*, there is presence of *Akasha* too. In fact when we visualize in our mind that a point object is assigned a small space around it, what we are doing is that we are dividing the whole conceivable space into at least two parts, one small one around the point object and the other outside it in which the observer is also residing (in order to carry out the thought experiment, there is a necessity of presence of an observer).

It was stated earlier also that the *Taittiriya Upanishada* says “*soakaamayati, bahu syam prajaayati*” i.e. “He desired, let me manifest as many”. According to this there would be many *Bindu*. Now let us analyze the situation where there are more than one *Bindu* (point object). Let us consider two point objects each one encaged in their own spaces (*Akashas*) (that are their sizes) and located somewhere in the space containing the observer. According to the rule '*Akashad Vayuh*' there will be *Spanda* and *Vayu* (motion). It means that the two point entities would have *Spanda* inside as well as interaction (*Sparsha*). This is what would be expected from physics considerations. Inside the new bigger box the two

particles would have their new wave patterns and will have interaction among themselves and also at the boundary. The *Pancha-Bhautika* model tells that the signature (characteristic) of *Vayu* (motion) is *Sparsha* (interaction) i.e. for any interaction (*Sparsha*) to occur there must be presence of motion (*Vayu*). Stated in a different way, there would be no interaction if there is no motion. Physics says that the interaction between two objects occurs through the mediation by some particles that move between them.

The interaction between two point objects can be thought of as sort of bond between them (since we are visualizing the evolution, let us assume that the interaction is such that attraction is there). Now, let us bring a third point object. The space (*Akasha*) that contained the first two objects would have to be enlarged to include the space (*Akasha*) of the third object also. In this space, a structure (shape) may get formed from the three objects. Bringing in a fourth point object would give rise to a three dimensional aggregate whose shape (structure) would depend upon the total energy content. So, after space and motion, the next item that we should be talking about is the energy and the structure (form). If we equate the terms 'energy' and 'structure' to '*Agni*' and '*Roopa*' respectively, then we see that this is exactly what the *Pancha-Bhautika* model tells. The third *Mahabhoota* to get manifested is *Agni* (*Teja*, fire) and its characteristic is *Roopa* i.e. *Roopa* (structure) is determined by *Agni* (*Teja*). Bringing in more objects would only enlarge the size of the aggregate that would acquire different possible shapes. As given in Table 3, a *Mahabhoota* possesses, along with its own characteristics, the characteristics of the preceding *Mahabhootas* as well. Therefore, when the *Teja* (*Agni*) has got manifested, having *Roopa* as its characteristics, *Vayu* and *Akasha* (space) are also present with their signatures '*Sparsha* (motion/interaction)' and '*Shabda*'. It means that, due to *Vayu* (motion) there would be some flexibility in the *Roopa* (structure). Also at this stage we may imagine that the formation of such aggregates might be taking place at more than one place. The presence of *Vayu* (motion) may render the aggregates moving relative to each other resulting in gradients and flow. These properties are similar to that of a liquid. Also the *Mahabhoota* to get manifested after *Agni* (*Teja*) is *Apa* (water) whose characteristic is *Rasa* (taste) as explained

in the previous section. So appearance of a liquid like entity becomes possible after the manifestation of the fourth *Mahabhoota* called 'Apa'

We can continue the process of simulation by bringing in more and more point objects (*Bindu*). By the virtue of presence of *Vayu* (motion) and resulting '*Sparsha* (interaction)' in all directions, the relative motions (flow) might be restricted at certain locations and some cluster like a solid may emerge with a stable structure (*Roopa*). In the *Pancha-Bhautika* model the fifth *Mahabhoota* to get manifested is *Prithvi* (earth). The meaning of *Prithvi* (earth) is *sthira* also. It means that where structures are *sthira* (fixed, stable), *Prithvi* is present (see foot-note in the beginning for the technique of *Lakshana* used to convey the concepts). Thus manifestation of the fifth *Mahabhoota* '*Prithvi*' is consistent with the formation of solids in evolution of universe in our thought experiment. The characteristic of *Prithvi* is '*Gandha* (odour)'. The *Pancha-Bhautika* model tells that odour will be present only when the substance has constituents with *sthira Roopa* i.e. stable structures. Conversely, from presence of *Gandha* (odour) presence of *Prithvi* (stable structure) is inferred.

Now, we make an attempt to analyze the 'odour' a bit more. According to the *Pancha-Bhautika* model all the five *mahabhootas* viz, *Akasha* (space), *Vayu* (air), *Teja* (fire), *Apa* (water) and *Prithvi* (earth), are, after '*panchikarana*', present in a material that we perceive in our daily life and *Prithvi* would have the characteristic of odour (*Gandha*). It means that when 'odour' is manifested, all the other previous four *Mahabhootas* would have already appeared in proportions decided by the rules of *Panchikarana*. Taking off any one of the previous ones breaks the sequence at that. For example, in the manifestation of *Gandha*, *Akasha*, *Vayu*, *Agni* and *Apa* also are getting manifested. Removal of any one of these would prevent the *Gandha* to appear. This can be visualized by considering a sample kept in a container and the sensor nose is outside it. The space inside the container is the *Akasha* for the sample. So any kind of motion (*Vayu*) would occur only inside it. Since the space between the container and the nose is not available to the sample, *Gandha* cannot go beyond the container.

. Removal of space (*Akash*) stops the odor from

emanating. This explains why properly sealed cans do not send the odors outside. If some smell is being sensed, it means that the space from the sample to the nose of the observer (senser) is available and is part of the *Akasha* for this case. Also, it indicates that the constituents of the sample that move out have *Prithvi* i.e. have stable structures. Since in *Prithvi*, *Vayu* i.e. 'motion' is also present, the stable structure should be taken as some average structure. Thus, only in those systems where *Akasha* (space) is available, *Vayu* (motion) is present, *Agni* (*Teja*, energy) giving rise to a *Roopa* (shape) is present, *Apa* (water) giving fluidity and *Prithvi* (earth) responsible for solidity (stable rigid structures), would create a smell. Let us look at the modern concepts now. According to the modern theories the nose contains several million receptors of 500 to 1000 different types to which molecular groups of suitable structures can dock upon^[33, 40,41]. Molecules with different shapes and structures sit on these sensory receptors which in turn create electrical signals that are recognized as a specific odor by the brain. It has been recently suggested that the type of the electrical signals i.e. odor would depend upon the shape and chemical structure of the groups and presence of certain infra-red vibrations in them. For example an ester has fruity smell, compounds with -SH groups have smell of rotten eggs. A theory which gives a complete picture of the process of smell and odor is still awaited, whereas the *Pancha-Bhautika* model clearly says that *Gandha* (odor) would be present only when there is the presence of all the *Pancha-Mahabhootas* i.e. when space, motion, structure, fluidity and stability are all present. An object having a stable structure would necessarily possess an odour. Since *Pancha-Bhautika* model applies at all scales, a tiny system such as a molecule would have an odor and the earth or a galaxy too would possess some odor. Whether these could be experimentally observed or not would depend upon the sensitivity of the instruments used. A detailed study of this might be helpful in developing an enhanced understanding of the subject of smell and odor.

The *Pancha-Bhautika* model gives some other very important indications also. The *Pancha-Sthoolabhootas* viz *Akasha* (space), *Vayu* (air), *Teja* (fire), *Apa* (water) and *Prithvi* (earth) that are sensed by us are not pure entities

but are complicated combinations (*Panchikarana*) of more subtler *Pancha-Mahabhootas* including *Akasha* (space). Therefore, *Panchikarana* sets a limit to the maximum achievable density of an object. At this point we can only say that all the material, by whatever name we call them, would possess a fraction of their volume as empty space. Also, wherever there is *Akasha* (empty space), there would be necessary presence of *Shabda* (*Spanda*). An electron in an atom would possess *Shabda* where planets and galaxies will also possess *Shabda* (*Spanda*). Work on quantitative treatment on these lines is in progress and will be published elsewhere.

CONCLUSION

The ancient Indian *Pancha-Bhautika* model of the evolution of universe was studied in light of modern science. Our findings are summarized below:

(1) The universe originated from a single principle. Prior to the gross manifestation of the universe the *Pancha-Mahabhootas*, the five fundamental entities manifest first in a sequence and then the further evolution of the universe depends upon different combinations of these *Pancha-Mahabhootas*. This all happens in the womb of time (*Mahakala*), another form of that principle. The *Pancha-Mahabhootas* are *Akasha* (space), *Vayu* (air), *Agni* (*Teja* fire), *Apa* (water) and *Prithvi* (earth). These have specific characteristics of *Shabda* (vibration), *Sparsha* (touch, interaction), *Roopa* (shape), *Rasa* (taste) and *Gandha* (odor) respectively. However in any of them the characteristics of all preceding ones are also present.

(2) The five entities (*Pancha-Mahabhootas*) combine through a process called *Panchikarana* to give rise to five new entities (*Pancha-Sthoolbhootas*) called by same names. These further yield all the world that we sense around.

(3) The appearance of the *Pancha-Mahabhootas* in the sequence: '*Akashad vayuh, vayoragnih, agnerapah, adbhyah prithvi...*' having their specific characteristics is nothing but a sequential addition of the most desired property that must start playing its role at that moment of time for the evolution to proceed. It is clearly mentioned in the Sanskrit texts that the '*lingam*' i.e. signature or identification of *Akasha* is *Spanda* (vibration) which gives rise to *Shabda*. The meaning of *Vayu* is motion. Without a motion of some kind interaction (*Sparsha*) cannot

occur., Therefore *Vayu* has the characteristic of *Sparsha* (touch/interaction). *Agni* (*Teja*, fire) is associated with energy that determines the *Roopa* (shape, structure). *Apa* (water) is an entity having the property of fluidity and has the characteristic of *rasa* (taste). *Prithvi* is that which has the property of being *Sthira* i.e. *Prithvi* relates to solidity and stability and has *Gandha* (odor) as its characteristics. The scientific meanings are easily revealed once we notice that *Lakshana* techniques has been widely used in ancient Sanskrit texts to convey a concept as explained earlier as a footnote.

(4) By visualizing a thought experiment of simulating the evolution of the universe starting from a point to a solid matter, it is found that the characteristics of the *Pancha-Mahabhootas* are consistent with the present Physics concepts.

(5) The *Pancha-Mahabhootas* are such that any of these would possess its own characteristics as well as the characteristics of all the preceding ones. For example, *Vayu* appearing at the second step possesses properties of both *Akasha* and *Vayu*. The signatures of *Akasha* and *Vayu* are *shabda* and *sparsha* respectively. The meaning of *Vayu* is motion (*gati*). The observation of *sparsha* (interaction) anywhere would be expressed by saying that *Vayu* is present there. Alternatively, if *Vayu* is present in some system, it means that the properties of motion, interaction and touch are present.

(6) *Gandha* is the sole characteristic of *Prithvi* i.e. of an entity having stable structure (*Sthira, achala*). The *Prithvi*, being the fifth *Mahabhoota* to appear would possess the characteristic of all the four preceding ones. It means that it would possess *Akasha*, *Vayu*, *Agni* and *Apa* as well. So the *Gandha* is the combined effect of all this where solidity plays the dominant role. A liquid sample having an odor indicates that the molecular aggregates emanating from the sample have space (*Akasha*) available, are in motion (*Vayu* is present), have sufficient energy (*Agni*) so that a shape (*Roopa*) is defined and have fairly stable (*sthira*) structure (*Prithvi* is present).

(7) A material having no stable structure (*Prithvi*) will not possess any *Gandha*. Also anything having a stable structure would definitely possess a *Gandha*. Thus a tiny molecule or a still

subtler object would possess a *Gandha* and a mighty galaxy too would possess a *Gandha*. It is a concept that appears very promising for the development of an understanding of the subject of odor and smell.

(8) The *Pancha-Bhautika* model of evolution indicates that there is an upper limit of the density of a substance that can be achieved since *Akasha* (space) is always present according to *Panchikarana*. This point needs further quantitative treatment.

(9) The manifestation of *Akasha* is the first

step for evolution and there is no lower or upper limit for its extent. So according to *Pancha-Bhautika* model self similar evolution sequences are possible at subatomic scales as well as at terrestrial scales. “*Akasshad Vayuh*” says that once space is available motion must manifest i.e. nothing can be found in a state of rest in the absolute sense: an electron in the space (size) of atom would be moving and a galaxy too, in the cosmos would be moving and there will be presence of *Shabda* (*Spanda*, vibration) as well.

TABLE -1

Panchikarana - A : Composition of the *Pancha-Sthoolbhootas* (*Panchikrit Mahabhootas*) in terms of the *Pancha-Mahabhootas* according to process A.

<i>Pancha - Maha- Bhoota</i>	<i>Pancha-Sthoolbhootas</i>				
	Akasha (space)	Vayu (air)	Teja (fire)	Apa (water)	Prithvi (earth)
<i>Akasha (space)</i>	1/2	1/8	1/8	1/8	1/8
<i>Vayu (air)</i>	1/8	½	1/8	1/8	1/8
<i>Teja (fire)</i>	1/8	1/8	1/2	1/8	1/8
<i>Apa (water)</i>	1/8	1/8	1/8	1/2	1/8
<i>Prithvi (earth)</i>	1/8	1/8	1/8	1/8	1/2

TABLE -2

Panchikarana –B : Composition of the *Pancha-Sthoolbhootas* (*Panchikrit Mahabhootas*) in terms of the *Pancha-Mahabhootas* according to process B.

<i>Pancha - Maha- Bhoota</i>	<i>Pancha-Sthoolbhootas</i>				
	Akasha (space)	Vayu (air)	Teja (fire)	Apa (water)	Prithvi (earth)
<i>Akasha (space)</i>	21/25	1/25	1/25	1/25	1/25
<i>Vayu (air)</i>	1/25	21/25	1/25	1/25	1/25
<i>Teja (fire)</i>	1/25	1/25	21/25	1/25	1/25
<i>Apa (water)</i>	1/25	1/25	1/25	21/25	1/25
<i>Prithvi (earth)</i>	1/25	1/25	1/25	1/25	21/25

TABLE -3
Characteristics of the *Pancha-Mahabhootas*

<i>Pancha - Maha- Bhoota</i>	Characteristics				
<i>Akasha</i> (space)	<i>Shabda</i> (<i>spanda</i> , waves)				
<i>Vayu</i> (air)	<i>Shabda</i> (<i>spanda</i> , waves)	<i>Sparsha</i> (touch, interaction)			
<i>Teja</i> (fire)	<i>Shabda</i> (<i>spanda</i> , waves)	<i>Sparsha</i> (touch, interaction)	<i>Roopa</i> (shape)		
<i>Apa</i> (water)	<i>Shabda</i> (<i>spanda</i> , waves)	<i>Sparsha</i> (touch, interaction)	<i>Roopa</i> (shape)	<i>Rasa</i> (taste)	
<i>Prithvi</i> (earth)	<i>Shabda</i> (<i>spanda</i> , waves)	<i>Sparsha</i> (touch, interaction)	<i>Roopa</i> (shape)	<i>Rasa</i> (taste)	<i>Gandha</i> (odor)

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