Jain Metaphysics and Science:

A Comparison

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Dr. N.L. Kachhara, 2011

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Foreword

Is there any scope of 'comparison of philosophy and science'? There is one view, which out rightly denies it. According to it, science and philosophy are poles apart. In the field of spirituality, which is a part of philosophy, the nucleus is non-corporal substance—soul. On the other hand, science confines itself mainly with the corporal substance—matter. The physical order of existence has been explored by science through powerful apparatuses, but the non-physical order of existence (consciousness or soul) is beyond the range of such apparatuses.

This (above) view is however not acceptable to all. Hence, in the field of science itself, some eminent scientists are of the view that there is a scope of comparison between science and spirituality or science and philosophy. Albert Einstein, Werner Heisenberg, Erwin Schrodinger, David Bohm and many others like Sir Arthur Eddington, Sir James Jeans, and Herman Weyl have dealt with at length on this topic.

Fritjof Capra, in his famous work, Tao of Physics, has very aptly put forth his views on the comparison of science (mainly modern physics) and the oriental mysticism. I would like to quote a few passages from Tao of Physics to show that the author of our book, Dr. N.L. Kachhara, has indeed made a commendable effort to justify his idea of comparison of Jain metaphysics with science.

"The fact that the current changes in our value system will affect many of our sciences may seem surprising to those who believe in an objective, value-free science. It is, however, one of the important implications of the new physics. Heisenberg's contributions to quantum theory, which I discuss in great detail in this book, imply clearly that the classical ideal of scientific objectivity can no longer be maintained, and thus modern physics is also challenging the myth of a value-free science. The patterns scientists observe in nature are intimately connected with the patterns of their minds—with their concepts, thoughts and values. Hence, the scientific results they obtain and the technological applications they investigate will be conditioned by their frame of mind. Although much of their detailed research will not depend explicitly on their value system, the larger framework within which this research is pursued will never be value free. Scientists, therefore, are responsible for their research not only intellectually but also morally.

From this point of view, the connection between physics and mysticism is not only very interesting but also extremely important. It shows that the results of modern physics have opened up two very different paths for scientists to pursue. They may lead us—to put it in extreme terms—to the Buddha or to the Bomb, and it is up to each scientist to decide which path to take. It seems to me that at a time when close to half of our scientists and engineers work for the military, wasting an enormous potential of human ingenuity and creativity by developing ever more sophisticated means of total destruction, the path of the Buddha, the "path with a heart cannot be overemphasized." [p. xvii, Preface]

“The purpose of this book is to explore this relationship between the concepts of modern physics and the basic ideas in the philosophical and religious traditions of the Far East. We shall see how the two foundations of (twentieth-century physics—quantum theory and relativity theory—both force us to see the world very much in the way a Hindu, Buddhist, or Taoist sees it, and how this similarity strengthens when we look at the recent attempts to combine these two theories in order to describe the phenomena of the submicroscopic world: the properties and interactions of the subatomic particles of which all matter is made. Here the parallels between modern physics and Eastern mysticism are most striking, and we shall often encounter statements where it is almost impossible to say whether they have been made by physicists or by Eastern mystics.” [p. 4]

“Eastern thought—and, more generally, mystical thought—provides a consistent and relevant philosophical background to the theories of contemporary science; a conception of the world in which scientific discoveries can be in perfect harmony with spiritual aims and religious beliefs. The two basic themes of this conception are the unity and interrelation of all phenomena and the intrinsically dynamic nature of the universe. The further we penetrate into the submicroscopic world, the more we shall realize how the modern physicist, like the Eastern mystic, has come to see the world as a system of inseparable, interacting, and ever-moving components, with the observer being an integral part of this system.” [p. 11]

“Rational knowledge and rational activities certainly constitute the major part of scientific research, but are not all there is to it. The rational part of research would, in fact, be useless if it were not complemented by the intuition that gives scientists new insights and makes them creative. These insights tend to come suddenly and, characteristically, not when sitting at a desk working out the equations, but when relaxing in the bath, during a walk in the woods, on the beach, etc. During these periods of relaxation after concentrated intellectual activity, the intuitive mind seems to take over and can produce the sudden clarifying insights which give so much joy and delight to scientific research.” [p. 18]

“It is important to realize the difference between the mathematical models and their verbal counterparts. The former are rigorous and consistent as far as their internal structure is concerned, but their symbols are not directly related to our experience. The verbal models, on the other hand, use concepts which can be understood intuitively, but are always inaccurate and ambiguous. They are in this respect not different from philosophical models of reality and thus the two can very well be compared.

If there is an intuitive element in science, there is also a rational element in Eastern mysticism.” [pp. 20, 21]

“The firm basis of knowledge on experience in Eastern mysticism suggests a parallel to the firm basis of scientific knowledge on experiment. This parallel is further enforced by the nature of the mystical experience. It is described in the Eastern traditions as a direct insight which lies outside the realm of the intellect and is obtained by watching rather than thinking; by looking inside oneself; by observation.” [p. 22]

"When the rational mind is silenced, the intuitive mode produces an extra-ordinary awareness; the environment is experienced in a direct way without the filter of conceptual thinking." [p. 23]

Dr. N.L. Kachhara has written this book, in which he has elaborately explained the fundamental principles of Jain Metaphysics and some of the relevant concepts of modern science. This is the need of the hour. It will immensely benefit the students and the scholars of Jainism to understand it in the context of modern science.

The metaphysical theory of soul and *pudgala* (physical order of existence) of Jainism explains very scientifically various aspects of universe, but unfortunately till now it has not been presented in modern style. Dr. Kachhara has fulfilled this lacuna.

Specially, the theory of *karma* is a very special and significant contribution of Jainism, which explains the nature of that psycho-physical force called *karma* which is essentially a physical force generated by the soul. The beginning less coalescing of *karma* with soul is responsible for the transmigration of the soul in the labyrinth of birth and death. *Karma* becomes so powerful force that if not subsided or annihilated, it will endlessly make the soul to continue in the mundane existence. The Jain metaphysics has explained logically the cause and effect of *karma* and also the means to end the beginning less relationship of the soul and *karma*.

It is very important that the metaphysical views of Jainism should be understood and made use of to make soul free from the bondage of *karma*. Let us hope that the modern scientists may one day be able to at least hypothesize the subtle most material force of *karma* and its effect.

Besides this, the entire discussion of the six fundamental substances, as made by the author and as related it with the scientific concepts, makes a very interesting and useful academic probe into the nature of truth.

Muni Mahendra Kumar

Jain Vishva Bharati, Ladnun

Preface

Human mind has always been inquisitive. Who am I? Where from I have come and where will I go? Why there is biodiversity? Who has made this world? Why is the world as it is? Who governs this universe? Such questions agitated the human mind and led to the emergence of philosophy and science. The process of enquiry is as old as the human being is and shall continue until humans inhabit this world. Does it mean that these questions shall never be answered? The answer is both, 'yes' and 'no'. Some enlightened people found the answers but others have not. Like the questions, the answers are also personal. The answers found by the highly powerful omniscient, though perfect, do not satisfy our faculty. The truth can only be 'experienced' and not communicated. Everyone has to 'experience' the full answers to put a full stop to such inquisitive questions.

What is the truth? Is what we see the truth? All philosophies in the world deliberate on this question. What we see is the relative truth, which is temporary and transient. From this point of view, it is also untrue. The world is therefore both, true and untrue. The visible world appears to be powerful, but this is not correct. If we had the inner insight, we would discover that the visible world is the weakest and the invisible etheric world is the most powerful. The actual source of energy is the invisible world, and the understanding of which needs a deeper vision and perception. Making use of the invisible energy from the invisible world needs a higher pursuit.

What is the reality? Mathematicians see the reality through equations, physicists through experiments, astronomers through observations, biologists through gene structure, while evolutionists and geologists through fossil records. Hegel argued in his Science of Logic (1812-1814) that finite qualities are not fully ‘real’, because they depend on other finite qualities to determine them. Qualitatively infinity, on the other hand, would be more self-determining, and hence would have a better claim to be called fully ‘real’. Similarly, finite natural things are less ‘real’, because they are less self-determining than spiritual things like morally responsible people, ethical communities, and God. So any doctrine, such as materialism, that asserts that finite qualities or merely natural objects are fully ‘real’, is mistaken. Jain philosophy goes a step further and claims that only a person having infinite knowledge knows the absolute ‘real’ having infinite qualities. Those having finite knowledge can perceive, in spite of sophisticated instruments, only relative (subjective) truths. According to the Jain philosophy, the Arihant or Omniscient possesses infinite knowledge. The omniscient Lord Mahavira saw the absolute reality "as it is" in all respects. He saw things as small as a *paramanu* and as big as the *loka* (universe) in their absolute form. With his pure consciousness, he had the true knowledge of both the living and the non-living world. Though his main thrust was on emancipation of the soul, he answered all questions of the human inquisitive mind.

There are two methods of enquiry; the spiritual and the scientific. The spiritual methods entail identification of the inner self, while the scientific methods study the world theoretically and experimentally. The spiritual enquiry is largely conceptual and qualitative, whereas the scientific

enquiry is experimental, quantitative, and application oriented. The spiritual enquiry offers direct absolute knowledge, and the scientific approach provides relative knowledge that may change on further investigations. Both methods of enquiry have their merits and demerits, and one cannot replace the other. It would be wise to synthesize the two streams of thought, and explore the nature to the best of our ability and understanding.

While examining the reality from a scientific standpoint, one must bear in mind the basic characteristics of the two constituents involved. A reality has infinite attributes and modes, while the scientific investigation, theoretical or experimental, is generally limited to a specific aspect of reality. Mathematical equations in particular, describe a relationship between two aspects of the same or different reality, and reveal only the partial truth. The observations of an omniscient embrace all aspects of the reality simultaneously, and describe the full truth.

Lord Mahavira was very scientific in his approach. He did not acknowledge any "Creator" like in many other philosophers. He said that this world is comprised of six realities, where each one of the realities are independent and act according to their qualities and attributes. These six realities, namely the soul, matter (and energy), an agent for motion, an agent for rest, space and time, are necessary and sufficient to explain all the natural phenomena of the living and the non-living world. According to him, a reality is capable of eternal and continuous existence, through infinite succession of origination and cessation. The attribute of permanence implies that a real substance can neither be created nor destroyed.

The underlying concepts of nature are deep and involving, thus he appointed eleven renowned Vedic scholars as his chief disciples, who presented his teachings in scriptural form. These scriptures were orally transferred from generation to generation by his followers, and were finally committed to writing after about nine hundred years. The scriptures available today are the texts written by the Acharyas.

Jain philosophy is scientific in its deliberations. Many philosophers have recognized the scientific nature of Jain philosophy. Professor L.P.Tessitory is of opinion that “Jainism is of a very high order. Its important teachings are based upon science. The more the scientific knowledge advances, the more the Jain teachings will be proven.” In fact, the Jain system of thought is so wonderfully consistent with modern realism and science, that Dr.Walter Schubring observes, “He who has a thorough knowledge of the structure of the world, cannot but admire the inward logic and harmony of Jain ideas. Hand in hand with the refined cosmographical ideas, goes a high standard of astronomy and mathematics.”

According to Acharya Namichand Shastri, earlier the Acharyas were very critical, and maintaining the conceptual purity of the scriptural texts, they added explanations based on the contemporary knowledge. Later the Acharyas stopped the practice of updating the texts, and so the present version of many of the scriptures is based on the knowledge of 10^{th} and 11^{th} century A.D. The developments made in the last one thousand years, particularly the advances of modern science, are not reflected in these texts. Uttaradhyayana Sutra, one of the important Jaina texts, is of the firm view that the religious tenets and beliefs must also stand to reason. Acharya Siddhasen in his book Dvatrinshika, refused to accept the fact that whatever is old can pass without examination, rather he insisted that being old does not mean being stable or irrefutable. Some of the descriptions available in the scriptures are at variance with modern science. A rigorous

agreement is not necessary, but we should compare the scriptural texts with the scientific knowledge, and explain the differences. Science also strives to search for the truth, and certainly provides a logical test for scriptural beliefs. In the view of Professor Muni Mahendra Kumar:

1. Search for the truth should be our main aim. We should also ascertain that we have rightly followed the facts pronounced by the omniscient Lord. The real meaning of the scriptural statement, and in what context it has been made, must be known. Without this, we may accept a meaning of the statement, which was not intended by the Lord. Without understanding the real context, the meaning of the terms, and the right point of view, we cannot understand the scripture in the right perspective. Therefore, we must try to explore the truth.
2. The scientific information must be compared with the scriptural texts, and accepted to the extent it is true. We must neither accept nor oppose scientific information blindly. Even if the scientific facts are against the scriptures, we must assess them impartially and express our views on them.
3. Whether scripture or science, we must first improve our understanding. Accepting a fact without understanding it in the name of scripture or science, is doing injustice to it.
4. Our decision should not be based on our convenience or inconvenience, ease of communication, attraction for modernity, and other such implausible reasons. Similarly, we must not insist on traditions. A decision must always consider the facts of prevailing conditions, time, and specialties, rather than just the fact of being new or old.
5. In matters where the scriptures are neither for nor against, we should have no objection in considering the realities based on our wisdom, reason, and scientific evidence.

I have ventured into a scientific study of the six realities in this spirit. The study has helped me to understand the realities in the right perspective, and bring out many similarities between the scriptural text and science. The most revealing observation is that where as science explores the materialistic world, the scriptures deal with both, the living and non-living world with equal authority. Some of the propositions of the scriptures may not be immediately appreciated by the scientists, because of their one-sided view of the realities, but they would certainly admire the perception of the Omniscient. Once the scientists accept the existence of consciousness, Jain philosophy shall triumph in the scientific world.

The book is divided in seven Chapters, where each chapter presents the scriptural text and the related scientific concepts on the subject. Scientific interpretation of the scriptural texts is provided, and the two approaches are critically examined and compared. The study is a humble attempt to bridge the gap between these two important branches of knowledge, with the hope that their synthesis benefits them both.

Chapter one presents the concept, characteristics, attributes and modes of realities, called ‘substance’. A substance is capable of eternal continuous existence, through infinite succession of origination and cessation. A substance is also the assortment of qualities/attributes. The substance, the attributes and the power of modification, all three co-exist simultaneously. Each substance has common and special attributes. The modes subsist in both the substance and their quality. All substances maintain individual identity, but mix with each other to provide the world we see.

Chapter two deals with intangible substances: *dharma* (agent of motion), *adharma* (agent for rest), *akasa* and *kala*. All the four substances have been conceptualized to assist life and matter (including energy) in their operations. The concepts of *dharma* and *adharma* are unique to Jain philosophy. These agents are present all over the *loka* and provide passive help to life, matter, and energy, in their motion and rest respectively. They are the principal cause of division of *akasa,* into *lokakasa* and *alokakasa*. The scientific concept of luminiferous ether is different from *dharma* and *adharma*. The *akasa* of Jain philosophy qualifies to be the medium of propagation of light. *Akasa* is an infinite substance and its cosmic part, the *loka*, accommodates all other substances. The trans-cosmic *akasa* is infinite and spread beyond the cosmic space. The Newtonian space, like *akasa,* is an independent objective reality. The derivation of Einstein's theory of relativity that absolute space does not exist is not supported by Jain philosophy. *Kala* is also a substance. The absolute *kala* assists other substances in their modification, while the conventional *kala* is the 'time' and measures the interval of change. The concepts of space and time, in Jain philosophy and science are compared and discussed. The 'space' and 'time' as defined in Jain philosophy are related to matter, and an interrelationship between space, time, and matter is indicated, as established by the general theory of relativity.

Chapter three describes matter *(pudgala*), which in its purest form exists as *paramanu*, the smallest indivisible energy point. The matter has attributes of colour, taste, smell, and touch. Touch is a special quality, which determines three types of matter- *paramanu* having two touches, subtle aggregate (mass less) having four touches, and gross aggregates having eight touches and mass. A *paramanu* is eternal, it can neither be created nor destroyed, hence the total number of *paramanus* in the *loka* is unchanged, and this is the law of conservation of mass and energy. Both the matter and energy are modes of the same substance and are interconvertible. *Paramanu* has a charge, either positive or negative, and this charge is responsible for bonding between the *paramanus*. The bonding takes place between positive and positive, negative and negative, and positive and negative *paramanu,* according to specified rules. As per Jain philosophy, darkness, shadow, effulgence, and luster are also modes of matter. The properties of motion and the other characteristics of *paramanus* are described in detail. Matter is classified based on the characteristics of aggregates, formed by the bonding of *paramanus*. The scientific concepts of atom, elementary particles, fundamental forces, field theories, and mass are presented. P*aramanu* is a unit of energy, whereas the elementary particles are units of matter. The theories of colour, taste, smell, and hearing are reviewed.

Chapter four, deals with the Jaina and scientific concepts of life. Life is a union of the soul and the body (matter). The soul has many identifiable attributes like consciousness and others. It exists in an embodied form (life), in an impure state, and as a liberated soul (*parmatma*) in the pure state. Life is broadly classified as immobile beings and mobile beings. The concept of immobile beings is unique to Jain philosophy. Mobile beings include infernal beings, celestial beings, animals, and human beings. The other two special concepts of Jain philosophy, namely the bio-potential and vital power, are described. The concept of consciousness (in west), biological classification of life, nutrition, and respiration, scientific concepts of DNA and genes, evolution and biodiversity, and the threats to biodiversity are presented. Life is classified based on the levels of consciousness in Jain philosophy, and the origin and body structure in biology.

Chapter five describes *vargana*, which are clusters of paramanus. *Varganas* are classified based on number of *paramanus* in the cluster. Out of the two classifications obtained in the scriptures, where one is of the eight *varganas* and the other of twenty-three *varganas*, the later is discussed in detail. The first four types of *varganas* are too small to have any practical use. The next ten types of lower *varganas* are mass less four-touch energy form, and five of them are used for the subtle application in life. The last ten types of higher *varganas* exist as eight-touch energy having varied applications. The additional four touches in higher *varganas* are supposed to be produced by the bonding between the constituent *paramanus*. Scientifically, a *paramanu* is a vibrating and moving charged energy point, and a *vargana* is electromagnetic matter. Each class of *vargana* has a frequency range. Amongst the higher order *varganas*, three types are used for the bodies of immobile organisms of different kind. The last *vargana* (the biggest type) constitutes the elementary particles and hence all the luminous matter. The four fundamental forces are supposed to arise by the bonding between *paramanus*. Gravitation is not perhaps, an independent force, as it appears to be a natural byproduct of the other three fundamental forces. Scientific interpretation of the important types of *varganas* is discussed. For example, the 5th *ahara vargana* is identified as bioelectricity, 13th *karman varganas* as coherent electromagnetic field, 17th Individual Body *vargana* as photon, etc. The *paramanu* is absolute quantum of energy, whereas the photon is the practical quantum of energy. The permanent nil *varganas* are suspected to provide the dark matter in the universe.

Chapter six provides a comparative study of Jain cosmology and the universe. The *Loka* has three major divisions; the upper, the middle, and the lower. The upper *loka* houses the heavens and the lower *loka* contains the hells. The middle *loka* contains countless islands and oceans. The central island is *Jambudweep*, which is divided in seven regions. Mobile beings are found only in the central mobile zone of this *loka*. The scientific knowledge of the universe including the solar system, the Milky Way galaxy, and the Andromeda galaxy is reviewed. The theories of the origin of the universe including the Big Bang Theory, the Steady State Theory, and others are briefly presented. The structure of the universe, based on general relativity is discussed and compared with the shape of the *loka*. The comparative study indicates that the Milky Way galaxy may be the *Jambudweep* and the middle *loka* is the known Universe. Jain philosophy does not support the theory of expanding universe, and provides justification for a steady and finite universe. A scientific explanation for the environment time cycle, in the local region of Bharat *ksetra* is presented.

Chapter seven is devoted to the origin and evolution of life. The scientific theories of abiogenesis, exogenesis and panspermia are first described. The theories of evolution, concepts of DNA, origin of life, and holographic model of the brain are presented. Next, the views of Jain philosophy about the origin and evolution of life are presented, where the Jains support the panspermia theory. According to Jain philosophy, life on Earth began with nano organisms, which are always found all over the *loka*. Consciousness plays an important role in evolution. Consciousness acting through *adhyavasaya* waves influences the genes and their mutation. The body determining karma provides an elaborate scheme of regulating and controlling the gene, to produce the body structures of different species and the biodiversity that we see. The evolution is the history of development of the consciousness of the soul. The soul progressively goes through

the phases of one to five sense organisms, and finally gets the human body. The next phase of development is marked by spiritual progress, which culminates in the liberated state of the soul. An evolution hypothesis, based on the natural forces and the inner forces of consciousness has also been proposed. The spirituality and the role of inner forces are also found to have a genetic base by science.

The study, first of its kind, is an attempt to lay the foundation for Jainologists and scientists to get closer and cooperate in exploring the nature in its entirety. A substance has infinite modes, though only a few of them are known. There is, therefore, immense scope to discover the new modes in an unending process. New modes of *pudgala* in the form of new inventions are being discovered by science every day. Not all of them are good for the humanity and the biological species at large. The responsibility of finding new modes, their application, and assessment of their impact rests on the humans. The doom of this planet Earth may have more to do with the human mind than with nature. Jain philosophy teaches us to condition the mind for optimum use of natural resources not only to protect the Earth, but also to help achieve the ultimate aim of enlightenment and emancipation of the soul. The goal of scientific developments should also be to cater to the general well being of the entire biological population, without which they lose their purpose. Jain philosophy shows the way to find a balance between the development and consumption of material power, and the development of the soul. The path shown by the omniscient supplements our wisdom, and allows us to make choices that would lead us to peace and harmony in the world we live in.

Narayan Lal Kachhara

About the book

--- This book by Dr.N.L.Kachhara is different in many ways. It deals with the basic concept of "Realities", both the visible i.e. Matter (*Pudgala*) and Life (J*iva*) and the intangibles: *Dharma, Adharma, Akasa* (Space) and *Kala* (Time), and then goes on to discuss *Vargana*, Cosmology and Evolution of Life. On each topic the Jain view and the modern scientific thought are compared side by side. Dr.Kachhara has made a scholarly and commendable effort in bringing both Jain thought and scientific view on the same pedestal, although there is scope for putting more rigors in these discussions. He neither uses the obscure language of scriptures nor the technical jargon of science but all subjects are discussed in a lucid and easily readable and understandable way. To make a meaningful comparison, the author has deviated from an orthodox view and has introduced some new concepts, which can be a matter of further investigation.

Dr.Narendra Bhandari
INSA Honorary Scientist
Member, Science Advisory Board, Chandrayaan-1, ISRO

---Dr.N.L.Kachhara, an eminent scientist and engineer of repute, has done a yee-man service to Jainism and students of Jain scriptures, by bringing out, in his lucid and attractive style, a very comprehensive, meticulous, scientific English version of description of six realities viz., *Dharma, Adharma, Akasa, Kala, Jiva* and *Pudgala*. There are no English equivalents available for most of the technical terms used in Jain scriptures, which are in Prakrit or Sanskrit. Dr.Kachhara has dexterously coined most appropriate English equivalents, which can be comprehended easily by scholars and students, not conversant with Prakrit and Sanskrit. The book fulfills a long felt need of such an elucidative scientific study of a very difficult subject. This book is one of the finest literary, scientific and philosophical works available.

Suraj Mal Jain
Consultant Environment & Forestry
Author of Environmental Ethics

---This is most up to date work done in this field covering latest scientific developments in almost all areas. One of the most serious and comprehensive attempt made in the recent years.

Dr.Surendra Singh Pokharna
Ex-Scientist, Physical Research Laboratory
Ahmedabad

Chapter 1
The Reality

1.1 Concept of Reality in Jain philosophy

What is a reality? We commonly believe that the things we see or perceive through our senses (or with the help of scientific instruments) are realities. All such things are forms of matter which are in fact modes of one reality called *pudgala* in Jain Philosophy. All physical things we know, from an atom or its sub particles to a planet or a star, are modes of the same reality *pudgala*. There are five other realities which exist in the universe. We feel the existence of some of them but all five are confirmed by omniscient who 'sees' the substances in their absolute and pure state. Our perception is limited and relative due to the frame of reference provided by our physical mind, and our beliefs. An omniscient sees the realities, physical and non physical, by his inner self without the help of senses and mind and therefore is able to perceive the realities in their absolute form. Although we cannot directly conceive all the realities, their existence is logically proved. The term reality or a substance is used in specific sense in Jain philosophy. This refers to the fundamental substances that constitute the *Loka*. *Loka* is also a technical term of Jain philosophy meaning the entire space in which all the six realities exist. The *Loka* is much bigger than the universe known to science as we shall see later. A substance (*dravya*) is capable of eternal continuous existence through infinite succession of origination and cessation. A substance is also the assortment of qualities / attributes. It experiences transformation or modification of its state. During this process of transformation the precedent mode ceases to exist and the succeeding mode originates but the basic nature of the substances is preserved in this change. This trinity of origination – cessation – permanence (OCP) is the basic characteristic of a substance. This rule applies to all substances and objects in nature. The attribute of permanence implies that a substance can neither be created nor destroyed; it can only change its form. Thus a substance is a reality or truth having permanent existence through change. Anything that does not confirms to the OCP rule is not a reality or a substance. All objects are, in fact, transitory permanent i.e. they are transient in respect of modes and attributes and permanent in respect of their basic substance hood. No object can be purely transitory or purely permanent. This is true of all objects whether living or non-living, physical or non physical, subtle or gross.

1.2 Characteristics a Substance

A substance has three characteristics, it is real, it follows the OCP rule, and it possesses attributes and power of modification. The substance, the attributes and the power of modification, all three co-exist simultaneously, no one can be separated from the other. The attributes discriminate between substances and modification produces conjugated form of substance. There can be no modification without a substance and no substance can exist without modification. Similarly, there can be no substance without an attribute and no attribute can exist without a substance.

Many attributes co-exist in a substance but the modifications take place in succession. Co-existence indicates steadiness and occurrence of successive change represents dynamic nature of a substance. Modification is a continuous process and the modes come in existence one after another. A new mode can not come in existence without the cessation of the previous one and a mode cannot cease to exist without origination of a new mode. The modification process is such that many cessations and originations take place in one '*samaya*'. A '*samaya*' is the smallest unit of time, a very tiny faction of a second as described later. All these characteristics are typical of a substance.

1.3 Six Realities or Substances.

According to Jain philosophy there are six (and only six) kinds of substances in nature.

(i) *Dharmastikaya* (or *Dharama*) – It helps motion of *Jiva* (life) and *pudgala* (matter and energy)

(ii) *Adharmastikaya* (or *Adharma*) - It helps *Jiva* and *pudgala* to assume rest position.

(iii) *Akasastikaya* (or *Akasa*) - It provides accommodation to all other five realities.

(iv) *Pudgalastikaya* (or *Pudgala*) – It means all matter and energy.

(v) *Jivastikaya* (or *Jiva*) – It refers to all forms of life.

(vi) *Kala* – time.

All the six substances co-exist and accommodate one another. Although they are mixed with each other they maintain their separate identity. The suffix *'astikaya'* used in first five realities above refers to the property of spatial extension. These substances are homogeneous continuum composed of multiple parts or *pradesas*. A *pradesa* is the space occupied by one *paramanu*. The term *'astikaya'* is a compound word made up of *'asti'* and *'kaya'* which respectively mean '(real) existence' and extensive body. The term *astikaya* thus means a real extensive magnitude i.e. having plurality of parts, (*pradesa*) in its constitution. *Kala* is not an *astikaya*, it has neither extension in space nor plurality of parts. Each of these substances continues to exist as an entity eternally.

1.4 Attributes of Substance

A substance is always associated with certain attributes called *gunas* (qualities). A substance does not exist without qualities. Conversely, attributes also do not exist without a substance. The attributes discriminate between substances. Each substance has infinite attribute, without this the existence of a substance is not established.

Attributes are of two types, common attributes and special attributes. The common attributes establish the identity and the special attributes define the specialty of a substance. The common attributes are characteristic of more than one substance and the special attributes are individual.

There one ten common attributes, the first six are universal and are found in all substances.

(i) *Astitva* - Eternal existence

Eternal existence means continued presence of a substance without going in extinction. It is a virtue of this attribute that the substance is neither created nor may it ever be destroyed and it maintains its eternal identity.

While propounding the division of Universal Reality into six substances each with its own particular characteristics, the Jain philosophy also emphasizes their unity by propounding certain

universal attributes possessed by all of then. The universal attributes "existence" may be regarded as the highest universal, and is proclaimed by Jains to be *mahasatta* i.e. essence of reality. This means that in spite of their multiplicity; the six substances comprise one universal system. This aspect of unity (viz. *mahasatta*) is emphasized not only in the individual substance's constitution as an individualistic trait (i.e. *avantarsatta*) but the unity of all real. Existence, however, should not be abstracted and postulated as the unitary substance of which the other substances may be taken as *paryayas* (modes). The six substances, in spite of their common characteristics of existence, are fundamental and irreducible one to another.

(2) *Vastutva* - Causal efficiency

Every substance is capable of performing a purposeful action (*arth kriya*). This happens due to its causal efficiency which emphasizes the aspect of 'change' in the substance.

Both 'being' and 'becoming' are necessary concomitants of reality and one is as ultimate as the other. Becoming or change presupposes causality, which is the fundamental nature of all real. According to Jains, change is integral in a substance and the stimulus of change is seated in the very nature of substance. This is *vastutua* or causal efficiency.

(3) *Dravyatva* – Substance hood

Substance hood is an attribute by which the mode of a substance keeps on changing continuously

The quality of substance hood enables a substance to the substratum of qualities and modes. Qualities and modes cannot exist without any support. Such a support is the substance. The quality characterizes the substance and the substance has the quality.

(4) *Prameyatva* – Objectivity

By virtue of this attribute a substance can become an object of one's knowledge.

(5) *Pradesatva* – Spatial existence

By virtue of this attribute the substance extends into the space. Therefore each substance has a shape.

(6) *Agurulaghutva* – Eternal persistence (Identity)

By virtue of this attribute the substance preserves its specific substance identity and the qualities retain their quality hood during change. The substance and qualities, in spite of numerous changes, maintain their separate identities. This attribute is the reason for individuality of a substance.

The interaction between two substances can never change the specific nature of either substance. Each substance which is the substratum of infinite qualities of its own continues to support its substance and they do not scatter away. The inalienability of the respective qualities of each substance also is due to this quality of *agurulaghutva*. The change in a substance takes place due to self interaction also. The interaction in all substances is called *'sadguna –hani- vriddni'* and takes place in 12 steps – 6 upwards and 6 downwards. An infinitesimal change takes place in each step and can be mathematically explained and expressed as under.

The six steps upward are

1. Infinitesimal increase.
2. by a countless fraction
3. by a countable fraction

4. numerable times
5. innumerable times
6. infinite times

The six steps downwards are in exactly reverse order.

(7) *Cetanatva* – Consciousness

Consciousness is the cause behind our experience. Consciousness provides us power of distinction between our self and others.

(8) *Acetanatva* – Inanimate quality. Lack of consciousness means inanimate state.

(9) *Murtatva* – Materiality

Materiality is identified by attributes like touch, taste, smell and colour.

(10) *Amurtatva* – Non-materiality

Lack of attributes like touch, taste, smell and colour is the identification of non-materiality.

Each substance has eight out of ten attributes listed above. *Jiva* has attributes of eternal existence, causal efficiency, substance hood, objectivity, spatial existence, eternal persistence, consciousness, and materiality. *Pudgala* has the attributes of eternal existence, causal efficiency, substance hood, objectivity, spatial existence, eternal persistence, inanimate quality and materiality. The rest four intangible substances have all attributes except consciousness and materiality.

The special attributes are as follows.

a) Soul – consciousness (*cetana*), righteousness (*samyaktva*) conduct (*charitra*) and dynamic nature (*kriyavati shakti*).
b) Matter – Touch, taste, smell, sight, dynamic nature.
c) Motion helper (*dharma*) – to provide passive help to soul and matter in their movement.
d) Rest helper (*adharma*) – to provide passive help to soul and matter to stop.
e) Space (*akasa*) – to give accommodation to all other five substances.
f) Time (*kala*) – an essential instrument of change in all substances.

1.5 The Modes (*Paryaya*)

The modes subsist in both substance and quality. They are infinite in number and transitional in nature. In other words, cessation of the precedent mode is followed by the origination of succeeding mode. The constant ongoing modification of a substance is called a mode. The modes are of two types – intrinsic mode (*arth paryaya*) and extrinsic mode (*vyanjana paryaya*). The intrinsic or substantive (attributive) mode is the intrinsic change in a substance which is subtle and continues without any external influence. The extrinsic mode (spatial modification) is the gross mode of existence which is stable and lasts for some time. The *jiva* and *pudgala* have both kinds of modes whereas the other four substances have got only intrinsic modes. It may be noted that qualities and modes cannot be absolutely different from the substance nor can they be absolutely identical with it. The difference is only that of reference and not that of existence. The continuous change that takes place in consciousness is *jiva*'s intrinsic mode while its existence as a particular organism, say a man, is *jiva*'s extrinsic mode which is with a determinate life – span. The molecular disintegration and aggregation that occur every moment in a physical object is an intrinsic mode. The physical object may have a particular mode – say a cup – for certain duration of time. This state of cup is extrinsic mode of matter.

There are further divisions of modes. Both intrinsic modes and extrinsic modes can be catalyzed by the substance itself or by other substances. Accordingly, there are natural modifications and alienated modifications. The natural intrinsic modification occurs independently and does not have any relationship with outside substance. Such modifications take place in the state of omniscience of a living being. The alienated intrinsic modification has an instrumental cause e.g. the modes of attachment and aversion of a living being. The natural extrinsic modification is the spatial modification without relationship with any instrumental cause e.g. soul's extension into the space without help of any other substance at the time of liberation. The alienated extrinsic modification is the change in shape assumed by a substance in relationship with an instrumental cause, e.g. a living being having modes of human, subhuman, or of an infernal being. Further, the above modification can take place in the substance or its quality. For example the perceptual knowledge of a person is the alienated quality extrinsic, modification, and vitality etc. is the natural quality extrinsic modification. The body of liberated *jiva* is natural extrinsic modification of substance. The division or integration of objects is alienated extrinsic modification of substance and change in taste is alienated quality extrinsic modification. The touch, taste, smells and colour qualities of a *paramanu* are natural quality extrinsic modifications.

1.6 Secondary Attributes of Substance.

(1) Mutation (*parinami*) – Non-mutation (*aparinami*)

The mutation attribute is linked to modification of a substance. The *jiva* and *pudgala* have mutation and the other four substances do not have mutation in respect of extrinsic modification. All substances have mutation with respect to intrinsic modification. All substances present in the universe maintain their separate identity and therefore do not have mutation in this respect.

(2) Conscious (*jiva*) - Inanimate (*ajiva*)

The living beings (*jiva*) have consciousness and all other substances are inanimate.

(3) Physical (*murta*) – Non physical / Intangible (*amurta*)

A thing that is perceived by senses is physical and that which is not perceived is non-physical. Matter is physical because it has the qualities of touch, taste, smell and colour. *Jiva* and other four substances are non-physical. The quality of physical character and non-physical character in substances is natural is not imparted by any other agent. The fine form of matter is not perceived by senses but when the same matter assumes a gross form at some point in time it becomes sense perceptible. Mind can perceive both physical and non-physical things.

(4) Spatial (*sapradesa*) – Non- spatial (*apradesa*)

Dharma, adharma, akasa, Jiva and *pudgal* are spatial and *kala* (time) and *paramanu* are non-spatial.

(5) Solitary form (*ek rupa*) – Multiple form (*aneka rupa*)

Dharma, aharma and *akasa* are solitary and they cannot be divided in parts. Worldly *jiva, pudgala* and *kala* have multiple forms.

(6) Space (*ksetra*) – Non-space (*aksetra*)

The universe has space attribute. *Jiva pudgala, dharma, adharma* do not have space attribute and do not provide accommodation to other substance.

(7) Active (*kriya*) – Passive (*akriya*)

Jiva and *pudgala* are active substances. *Dharma, adharma, akasa* and *kala* are passive substances.

(8) Permanent (*nitya*) – Impermanent / Transient (*anitya*)

Dharma, adharma, akasa and absolute *kala* are permanent and eternal. From this consideration the universe is also eternal. *Jiva* and *pudgala* are transitory from the consideration of extrinsic modification and are permanent and eternal with respect to substance hood. Thus they are transient - permanent.

(9) Cause (*karan*) – Causeless (*akarana*)

Pudgala, dharma, *adharma* and *kala* are cause because they are helpful to *jiva*. The universe also belongs to this category. *Jiva* is causeless because being conscious and intangible it can not be a cause for worldly existence.

(10) Doer – (*karta*) – Non doer (*akarta*)

Jiva is doer and so he is also enjoyer. He enjoys the fruits of his own actions. *Jiva* is not doer for other beings and tangible substances. *Dharma adharma, akasa kala* and *pudgala* are non doer.

(11) Omnipresent (*sarvagata*) – local (*asarvagata*)

Akasa is omnipresent and other substances are local. An omniscient is omnipresent in respect of knowledge but he is not so from the consideration of substance.

(12) Admission (*pravesh*) – No – admission (*apravesh*)

No substance gets admission into any other substance. But since they have mixed presence in the space the universe can be said to admit all other substances.

Chapter 2

The Intangible substances– *Dharma, Adharma, Akasa* and *Kala*.

2.0 Substances

There are six substances in the universe as stated in the last chapter. We study the four non physical and passive substances viz. *Dharma, adharma, akasa* and *kala*. The active substances *pudgala* and *jiva* are the subjects of next two chapters.

2.1 *Dharmastikaya (Dharma)*

Dharmastikaya is helpful in the motion of active substances. It is a single individual and homogenous continuum pervading the entire *loka*, but does not extend beyond it. In fact, it is a cause of finiteness of the *loka*. Temporally, *dharma* is beginning less and eternal. Being non-physical and non-corporeal (*amurta*), it is devoid of sense-qualities of smell, taste, touch and colour, and, therefore, imperceptible to the sense – organs and physical instruments. Immobile itself, it passively assists the motion of mobile objects like *jiva* and matter and micro movements in all realities. Not even the minutest vibration is possible without the assistance of *dharma*. Hence, where there is no *dharma*, there is neither psychical activity nor physical activity like functioning of nerves, beating of heart, winking of eyelids, propagation of light waves, vibrations of any kind etc. *Dharma* passively assists the *jiva* and *pudgala* but does not actively help in their movement.

A question may be raised how origination – cessation – permanence (OCP) activities take place in an inactive substance like *dharma*. The origination can take place due to internal and external cause. Each substance has infinite eternal persistence qualities. These qualities experience continuous change implying self origination and cessation in the substance. The movement of *jiva* and *pudgala* also becomes the external cause for origination and cessation of modes in immobile *dharma*.

2.2 *Adharmastikaya (Adharma)*

Adharmastikaya assists *jiva* and *pudgala* to assume rest position. Its other characteristics are similar to dharma. It is also a single, indivisible and homogeneous continuum pervading the entire *loka* but does not extend beyond it (it is also a cause for finiteness of *loka*). It is *beginning less*, eternal, devoid of sense qualities and imperceptible to the sense organs and physical instruments. It is immobile and assists *jiva* and *pudgala* passively in assuming rest position. It does not stop moving *jiva* and *pudgala* but becomes a passive agent in retarding and stopping their movement just like a shade of tree prompts a traveling passenger to stop. An object reversing its direction stops momentarily before changing the direction and such turn is also assisted by *adharma*. The still positions of body concentration of mind, silence, staying motionless and all steady postures etc., are due to passive action of *adharma*.

Both *dharma* and *adharma* are supposed to have innumerable *pradesa*, equal to the number of *pradesa* of *loka*. This division in *pradesa* is for the sake of explanation of phenomena taking place in *loka*, otherwise both the substances are single indivisible whole units as mentioned before. It is presumed that one *pradesa* of *dharma* and one *pradesa* of *adharma* lay on one *pradesa* of *loka*. Maintaining such an arrangement, the *dharma* and *adharma* continue to have separate identity and do not 'enter' the *loka*.

There are two main reasons for assuming the existence of *Dharma* and *adharma*

1. Assist *jiva* and *pudgala* in the act of motion and rest.
2. Division of *akasa* into *lokakasa*, cosmic space, and *alokakasa*, trans-cosmic space

We believe that there is a cause for every action. *Jiva* and *pudgala* move, stop and travel throughout the cosmic space on their own. But an agent is required to help the act of motion (or stoppage) such that it itself is motionless and present everywhere in the cosmic space. In the absence of this agent motion is not possible. *Dharma* and *adharma* are present in the *loka* only and therefore *jiva* and *pudgala* cannot cross over to trans- cosmic space. The liberated soul has infinite vitality but cannot go beyond *loka* for the same reason.

Science has presented the concept of ether which, in due course of time, has been assigned different kinds of functions including propagation of light. Some authors assume that *dharmastikaya* is the medium of motion and *adharmastikaya* is the medium of rest. To me these propositions require a close examination and scrutiny. We briefly review the concept of ether and compare it with the Jaina concepts.

2.3 Luminiferous Ether

Scientists have hypothesized the existence of ether as a medium motion. Isaac Newton contended that light was made up of numerous small particles. This could explain such features as light's ability to travel in straight lines and reflect off surfaces. In order to explain refraction Newton postulated an "Ethereal Medium" transmitting vibrations faster than light. He said, "I do not know what this Ether is", but that if it consists of particles then they must be "exceedingly smaller than those of Air, or even than those of light." Christian Huygens, prior to Newton, had hypothesized that light was a wave propagating through an ether, but Newton rejected this idea. However, a century later, Young and Fresnel revived the wave theory of light when they pointed out that light could be a transverse wave rather than a longitudinal wave. A transverse wave apparently required the propagating medium to behave as a solid, as opposed to a gas or fluid. Later, Maxwell's equations showed that light is an electromagnetic wave. Maxwell's equations required that all electromagnetic waves in vacuum propagate at a fixed speed c. As this can occur in one reference frame in Newtonian physics the ether was hypothesized as the absolute and unique frame of reference in which Maxwell's equation hold. That is, the ether must be "still" universally, otherwise could vary from place to place. Nevertheless, by this point the mechanical qualities of ether had become more and more magical: it had to be a fluid in order to fill space, but one that was millions of times more rigid than steel in order to support the high frequencies of light waves. It also had to be mass less and without viscosity; otherwise it would visibly affect the orbits of planets. Additionally it appeared it had to be completely transparent, non dispersive, incompressible and continues at a very small scale.

Scientists argued that at any point there should be one special coordinate system, "at rest relative to the ether." Maxwell noted in late 1870s. that detecting motion relative to this ether should be easy enough – light traveling along with the motion of Earth would have a different speed than light traveling backward, as they would both be moving against the unmoving ether It was thought that earth's motion through ether would create a type of wind that bends light waves the same way that wind in the atmosphere bends sound waves. The famous Michelson – Morley experiment in 1887 did not support this observation and was the first clear demonstration that something was seriously wrong with the "absolute ether" concept. A conceptual different experiment carried out by Trouton and Noble in 1903 also confirmed the MM experimental result. These "ether- wind" experiments led to its abandonment by some scientists and to a flurry of efforts to "save" ether by assigning it ever more complex properties by others. A completely different attempt to save" absolute" ether was mode in the Lorentz – Fitzgerald contraction hypothesis. Albert Einstein's special theory of relatively dispensed with the requirement of ether. Lorentz on his side continued to use the ether concept. In 1911 he said "whether there is an ether or not, electromagnetic fields certainly exist, and so also does the energy of the electrical oscillations" so that," if we do not like the name of "ether", we must use another word for it." In the meantime Einstein changed his opinion about the ether concept. In 1920 he said that general relativity attributed tangible physical properties to space including some kind of medium for light, although not a material one."

Einstein compared the gravitational field and the electromagnetic field with ether. He said, "If we consider the gravitational field and the electromagnetic field from the stands point of the ether hypothesis, we find a remarkable difference between the two. There can be neither space nor any part of space without gravitational potentials, for these confer upon space its material qualities, without which it cannot be imagined at all. The existence of the gravitational field is inseparably bound up with the existence of space. On the other hand a part of space may very will be imagined without an electromagnetic field; thus in contrast with the gravitational field, the electromagnetic field seems to be only secondarily linked to the ether, the formal nature of the electromagnetic field being as yet in no way determined by that of gravitational ether.

Since according to our present conceptions the elementary particles of matter are also, in their essence, nothing else than, condensation of the electromagnetic field, our present view of the universe presents two realities which are completely separated from each other conceptually, although connected causally, namely, gravitational ether and electromagnetic field, or as they might also be called space and matter.

..... Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities, in this sense, therefore, there exists ether. According to the general theory of relativity space without ether is unthinkable, for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring rods and clocks), nor therefore any space time intervals in the physical sense. But this ether may not be thought of as endowed with the quality characteristic of ponder able media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it."

Later scientists also supported the concept of ether. Michelson stated in 1923 that even if relativity is here to stay we don't have to reject the ether. Herbert Ives wrote in 1940 that in the light of the experimentally found variation of clock rate with motion, this experiment does detect ether. G. Builder said in 1958 that there is no alternative to the ether hypothesis. Professor Sherwin supported in 1960 the "philosophical point of view" of Ives and Builder. Paul Dirac stated in 1951 that "we are rather forced to have ether."

Today, the majority of physicists hold that there is no need to imagine that a medium for light propagation exists. They believe that neither Einstein's general theory of relativity or quantum mechanics has need for it and that there is no evidence for it. As such, classical ether is an unnecessary addition to physics that violates the principle of Occam's rajor. Some physicists hold that there remain a number of problems in modern physics that are simplified by an ether concept, so that Occam's razor doesn't apply.

A number of new ether concepts have been proposed in recent years. However, most of these ethers differ considerably from the classical aluminiferous ether. Ole D. Rughede said in a paper published in 2006 "we assume to find in every point of space a flow in all directions of radiant energy from all astrophysical objects. The radiant energy will we name the "ether", and since it is present throughout the universe, we will call space the "Ether- space". Presuming the ether the medium sustaining all physical fields and forces the ether- space is the universal physical space." Starkman's ether affects the pull of gravity, not the movement of light waves, David Thomson and Jim Bourassa of Quantum Ether Dynamics Institute proposed (2006) a non-material ether as rotating magnetic field which is supposed to describe the quantum structure of the universe. This ether has qualities of reciprocal mass and charge in addition to the dimensions of length and time and is also the source of curved geometry as expressed by general relativity theory.

We note from above that scientists hypothesized luminiferous ether mainly for two reasons.

1. To have a medium of propagation for light waves.
2. To satisfy the requirements of some equations like Maxwell's equations and Einstein's general relativity.

Light as particle can travel in vacuum but as wave it requires a medium for propagation. Longitudinal waves can travel in fluids but a solid like medium is required for propagation of transverse waves. Dictated by such requirements and imagination of scientists the concept of ether changed in its course of history and eventually the basic aluminiferous ether assumed the form of gravitational field and electromagnetic field.

These and the ether of David Thomson are more like *varganas* of Jain philosophy which are also electromagnetic fields and provide a source for formation of sub atomic particles as shown in chapter 5.

The *dharma* is not a medium of motion like ether. According to Jain philosophy the medium of motion is *akasa* which is described below.

The Jaina concepts of *dharma* and *adharma* are more comprehensive and broad based. The scientific concepts are related to the physical world, for obvious reasons, but Jaina concepts fulfill the needs of both the *Jiva* and material world. According to Jaina philosophy a *Jiva* having *Karman* body and *tejas* body migrates through space from one life to another. The soul in pure form is non-material but *karman* body and *tejas* body are made up of *varganas* which are supposed

to be plasma like. A liberated pure soul travels from this land to end of *loka* in one *'samaya'*. The *dharma* and *adharma* assist this kind of journey of *Jiva* besides helping *paramanu, vargana* and aggregate matter in their motion and rest. Such comprehensive view is a specialty of Jain philosophy and is missing in scientific thinking, obviously so because main stream science does not recognize the existence of soul. It can be expected that with advancement as and when the existence of soul is accepted by science the Jaina concepts of *dharma* and *adharma* will also find acceptance in scientific community. The realities *dharma* and *adharma* having opposite character probably fulfill an additional function of maintaining a balance in the *loka*.

In other words, the *loka* maintains its finite shape because of *dharma* and *adharma*. In the absence of *dharma* and *adharma* the matter may either spread out in the infinite *akasa* or may contract into a Big Crunch by the force of gravity, a fear often expressed by scientists, and the *loka* may loose its identity and existence. The *dharma* and *adharma* are essential components of the scheme required for the existence and functioning of *loka.* The other essential components in the scheme are *akasa* and *kala* as described below.

2.4 *Akasastikaya* (Space)

Akasastikaya is a real substance. It is the container of all other substances, stationary or moving. It is boundless / infinite, eternal and one indivisible unit. It is non material and so does not possess the qualities of touch, taste, smell and colour. The portion of *akasa* which is occupied by other substances is called *loka* (cosmos). *Loka* is finite and is surrounded in all direction by a*loka* which is inert, empty pure boundless space. Beyond *loka* there is no object – animate or inanimate. No *paramanu* or *Jiva* can cross the boundary and go beyond the limit of *loka*. The *dharma* and *adharma* determine the boundary of the *lokaakasa* by their own finiteness and thus divided *akasastikaya* in two parts *loka* and *aloka*.

Dharma and *adharma* are mutually inter-penetrating and concomitant with *loka*. Their existence and influence do not extend beyond *loka*, but within the cosmos they are all-pervading and co-extensive. They have a unity of locality with diversity of functions. Without these two, the systematic structure of the cosmos would have been a chaos. *Akasa* has infinite *pradesa* and all other substances have innumerable *pradesa*.

What are directions? According to Jain philosophy directions are relative and point to location of objects. The directions and sub-directions are defined only in the middle *loka*. A line joining two *pradesa* becomes a direction. The direction of sunrise is taken as east and that of sunset as west. When facing east the direction on right in south and that on the left is north. These are called solar directions. For a given specific purpose directions are also defined with respect to the observer. The front of the observer is east and back is west. South is on right side and north is on left side. These are called observer directions. Truly speaking there are no absolute directions in *akasa*.

2.5 *Kala* (Time)

Kala possesses the characteristic of 'persistence – through – change' and, therefore, is a substance. Its existence is necessary to define the duration (continuity), change (modification), motion, newness and oldness of substances. Time by itself cannot cause a substance to exist, but continuity of existence implies duration in terms of time. Mutation or change or modes also cannot be conceived without time, because change implies temporal succession in which modification

takes place. Similarly, motion implies different positions of an object in space in temporal succession. Lastly, time causes the distinction between the old and the new, the 'before' and the 'after'. *kala* is not *astikaya* i.e. it does not have spatial extension. Only the 'present' mode of *kala* is in existence, the 'past' has expired and the 'future' is yet to come. The singular present' *kala* cannot have spatial extension.

Kala is of two types – the absolute *kala* and conventional *kala*. The absolute *kala* assist modification/ change in substance and the conventional *kala* measures the duration of change. The Swetambara and Digambara traditions differ in the interpretation of absolute *kala*. According to Swetambara view since the absolute *kala* assists the substances like *jiva* – and *pudgala* in their modification it should be an attribute of the substance it is assisting. Thus the need of a separate substance like absolute *kala* is dispensed with. The Digambara concept of absolute *kala* is very different. According to this view the absolute *kala* is in the form of *kalanus* (*paramanus* of *kala*) which are placed one each on each *pradesa* of *loka*. The *kalanus* are separated from each other and therefore there is no spatial extension. The number of *kalanus* is equal to the number of *pradesa* (innumerable) in the *loka*. A *kalanu* assists the substances present on its *pradesa* in their modification. *kalanu* itself being a substance follows the rule of origination – cessation - permanence.

The concept of conventional *kala* is same in the two traditions. The smallest indivisible unit of conventional *Kala* is '*samaya*'. One '*samaya*' is the time taken by a *paramanu* moving at a medium pace to go from one *akasa pradesa* to the adjoining *pradesa*. All other units of conventional *kala* are multiples of '*samaya*'. These practical units of conventional *kala* are based on the movement of sun and moon.

Ghari, *muhurt*, month and year are some practical time units described in Jain philosophy. According to Jain philosophy the motion of sun and moon is observed in a limited part of middle *loka* and therefore there only the conventional time is defined. The standards of conventional time so obtained are used for measurement of intervals of duration in other regions of *loka*.

2.6 Scientific concepts of space and time

In physics, the concepts of space and time are so basic for the description of natural phenomena that their modification entail an alternation of the whole frame work we use in physics to describe nature. The concepts of space and time underwent radical modification from the Aristotle to the present time.

In Newtonian physics, matter particles moved in a three dimensional absolute space, filled with ether (medium of motion). It was an absolute space, always at rest and unchangeable. All changes in the physical world were described in terms of a separate entity called time, which again was absolute having no connection with the material world and flowing smoothly from the past through the present to the future. These concepts of space, time and ether were the basis of physics for almost three centuries.

Both Aristotle and Newton believed in absolute time. That is, one could always measure the interval of time between two events and that it would be the same whoever measured it. Time was completely separate from and independent of space. This commonsense view worked well

when dealing with apples or planets that move slowly but they don't work at all for things moving at or near the speed of light.

According to Einstein's relativity theory, space was not three dimensional and time was not a separate entity. Both were intimately connected and formed a four-dimensional continuum- "space – time". Furthermore, there was no universal flow of time. Concepts of an absolute space and an absolute time were, thus abandoned and became merely elements of language for describing observed phenomena.

Einstein's earlier theory of time and space, special relativity, proposed that distance and time are not absolute. The ticking rate of a clock depends on the motion of the observer of that clock, likewise for the length of a "yardstick". Published in 1915, general relativity proposed that gravity, as well as motion, can affect the intervals of time and of space. The key idea of general relativity, called the equivalence principle, is that gravity pulling in one direction is completely equivalent to acceleration in the opposite direction. A car accelerating forward feels just like sideways gravity pushing your back against your seat. An elevator accelerating upward feels just like gravity pushing you into the floor.

If gravity is equivalent to acceleration, and motion affects measurements of time and space, then it follows that gravity does so as well. In particular, the gravity of any mass, such as our sun, has the effect of warping the space and time around it. For example, the angles of a triangle no longer add up to 180 degrees, and clocks tick more slowly the closer they are to a gravitational mass like the sun.

Many of the predictions of general relativity, such as the bending of starlight by gravity and a tiny shift in the orbit of the planet Mercury, have been quantitatively confirmed by experiment Two of the strangest predictions, impossible ever to completely confirm, are the existence of black holes and the effect of gravity on the universe as a whole.

Beginning in 1917, Einstein and others applied general relativity to the structure and evolution of the universe as a whole. The leading cosmological theory, called the big bang theory was formulated in 1922 by the Russian mathematician and meteorologist Alexander Friedman. According to the big bang theory, the universe may keep expanding forever, if its inward gravity is not sufficiently strong to counter balance the outward motion of galaxies, or it may read a maximum point of expansion and then start collapsing, growing denser and denser, and gradually disrupting galaxies, stars, planets, people and eventually even individual atoms. Which of these two fates awaits our universe can be determined by measuring the density of matter versus the rate of expansion. Much of medium cosmology, including the construction of giant new telescopes has been an attempt to measure these two numbers with better and better accuracy. With the present accuracy of measurement, the numbers suggest that our universe will keep expanding forever, growing colder and colder, thinner and thinner.

In the opinion of Einstein the space and time are products of our imagination, the same way as the colour, shape and from of objects reside in our thoughts produced by our consciousness. Space is nothing more than the order in which the things are arranged (in space) and time is nothing more than the interval of time between events. The space and time do not have a real objective existence and yet the four dimensional continuum of space time is supposed to be an

objective reality. Time and space are separate subjective entities but when considered as four dimensional continuums they describe the real world.

Some scientists do not agree with the above proposition. They do not oppose the physical principle of four dimensional continuums of space and time but do not accept the view that space and time are dependent on the observer and do not have an independent objective existence. Hans Reichenbach, in his book "The philosophy of space and time", has deliberated on the philosophical as well as the physical aspect of the theory of relativity. In this book Reichenbach has proved the real independent existence of space and time mathematically and logically. According to him the mathematical space has many modes one of them supported by observations and experiments can be assumed to be the real space. Reichenbach has also refuted the wrong beliefs about time. Many scientists have started believing that time which is the fourth dimension, is like one of the dimensions of space. But this is not true. Combination of space and time in the four dimensional continuum of space and time only means that we describe any event in terms of four dimensions, three of space and one of time. Consideration of time as the fourth dimension does not change our concept about time. Accepting the theory of relativity, Reichenbach has shown that space and time are independent objective realities.

Henry Margenu also accepts the objective reality of space and time. He says that any thing that is relative does not become unreal. The theory of relativity does not accept an absolute space, but that does not mean that space is not real. It must be remembered that a mathematical theory describes a particular aspect of reality (if at all it does) and it does not represent the reality in totality. It shall be unfair to deny or accept the existence of a reality based on a mathematical equation, howsoever powerful. However, the scientists are still divided on the issue of reality of space and time.

2.7 Comparison of Jaina and scientific concepts

Akasa of Jains is a substance which accommodations all other substances stationary or moving. So all objects, including light particles, move in it, *Akasa* is non material, one indivisible unit having infinite *pradesa*. Its *pradesa* do not move like the particles of fluids and therefore, *akasa* provides a solid like continuum (at least for *paramanus*& *varganas*) in which transverse waves can travel. Thus *akasa* is the medium of propagation for light, were it photons or waves. The travel of light, however, like any other movement, requires the passive assistance of dharma. The *akasa* does not become an effective medium of propagation in the absence of dharma. The presence of any other substance like ether is not necessary in Jain scheme. The *akasa* serves the purpose of ether the scientists talk of. The *akasa*, *dharma* and *adharma* being non-material fulfill the needs of travel of both *jiva* and *pudgala*. *Dharma* and *adharma* must also be solid like substances so that their *pradesa* do not move, they superimpose on *akasa pradesa* in one-to-one manner. Both are present in *loka* and have the same shape as *lokakasa*.

The space of Newton is similar to *akasa* in some respects. Both are independent objective realities which are immobile and indivisibly whole entities. The Newton's space is void and requires the presence of ether but *akasa* does not need it to be a medium for propagation of light.

The time defined by Newton appears to be a fact rather than a substance. It measures the intervals of time like the conventional *kala* of Jains. Newton did not accept any limit on the velocity of light thus denying an inter relationship between space and time. According to the Jain

philosophy also speeds higher than velocity of light are possible as happens in the case of *paramanu* and some *varganas*. This aspect of speed is further discussed in chapter 5.

The Einstein's theory of relativity surmises that all speeds are relative and that the absolute velocity of any object can not be determined by any means. This generally is interpreted to mean that absolute space does not exist. If this is true then the Jaina concept of *akasa* does not agree with the theory of relativity. But before coming to such a conclusion we must ascertain that the impossibility of determining the absolute velocity sis due to subjective limitation of the observer or it is a real impossibility. It is by limitation of the observer then existence of the absolute speed can not be denied. In view of Jain philosophy such a limitation is indeed due to the observer. An omniscient observer perceives the substances in their absolute state as he does not face the limitations imposed by material sense organs. He can perceive the absolute velocity and the absolute space.

Werner Heisenberg clarifying the above situation said that the ether which was a requirement of Maxwell's equation has been disapproved by theory of relativity. This is sometimes interpreted to mean that there is no absolute space. But one must be careful in accepting such a statement. Although Heisenberg did not clearly accept the existence of independent immobile space but he did accept that rejection of ether does not imply rejection of absolute space. He also posed questions to critiques of theory of relativity. According to these critiques "the special theory of relativity in no way establishes the non-existence of absolute space and time. This theory only says that absolute space and time do not participate in common experiments. But it appropriate time standards are used in this theory, there may be no objection to acceptance of absolute space. The critiques of relativity theory may also say – "we hope that future advancements in standards will enable us to clearly define the absolute space... and then we shall be able to oppose the special theory of relativity." Thus it is seen that denial of the existence of absolute space on the basis of special theory of relativity may prove wrong.

Let us consider now the four dimensional continuum of space and time. It is difficult to comprehend the exact meaning of this concept. Clearly, it shall be wrong to say that for dimensional continuum means that time is one dimension of space. The Jain philosophy is very clear in this regard. If *pudgala*, *akasa* and *kala* are treated as separate entities then there is no objection to the theory of relativity. Jain philosophy also supports that gravitation and other effects produced by matter are also material entities. So all changes in space due to matter are also matter and have no connection with the space.

The confusion of scientists is further cleared by the doctrine of space propounded by Bertrand Russell. Concluding a philosophical proposition he writes – "in this way there are two kinds of space – one relative space and other absolute space. The first is known by our experience and the second is imagined or postulated. But this makes no difference in our ability to perceive space and the things like colour, sound etc. All of these are expressed by cause and effect principle and experienced by us. Our knowledge of space can not be different from our knowledge of colour, sound and smell." The two kinds of space mentioned by Russell can be called perceptual space and conceptual space. The *akasa* is the conceptual space of Russell and scientists are concerned with the perceptual space. But existence of perceptual space depends on the conceptual space. Thus it is seen that the concept of *akasa* is not only supported by the theory of relativity but

is also logical. The *lokakasa* is the perceptual space or simply space considered by scientists. This space contains matter and its effects like gravitation etc. According to Jain philosophy this space can be regarded as alienated intrinsic modification of *akasa* i.e. modification experienced by *akasa* due to the presence of matter.

The 'time' defined on the basis of movement of sun and moon or some event of matter is meaningful only for *pudgala* that is the physical world. It has no relevance to non-corporal substances like dharma, *adharma, akasa* and liberated soul. Consider now the connection between spaces (perceptual) and time as suggested by general theory of relativity. The perceptual space (finite) is influenced by matter. The time defined by events of matter must also be a property of *pudgala.* Since both space and time are related to *pudgala* an interconnection between them is indicated for the specific purpose of describing states of matter in space and time. Jain philosophy has therefore no objection to the concept of four dimensional continuums of space and time and the relationship between space, time and matter as provided by general theory of relativity in that specific context.

A final note on the role of four intangible substances is in order. The non-physical substances *dharma, adharma, akasa* and *kala* are four essential components of the scheme of *loka* which also contains the other two physical components, soul and matter. The actions and functions of the physical components are possible due to the existence of the four non-physical components. The intangible substances in fact provide a stage on which the physical actors, soul and matter, act and play. And for this act and play to take place no other thing except the six substances is required, that is, there is no need to presume the existence of any super power like God to create the stage and guide, control and prompt the actors in their play. The souls are self-motivated; they guide and control their own course, under the influence of *pudgala*, on the stage provided by the four intangibles, without any obligation. All the six substances are infinitely powerful and maintain their individual and distinct identity and existence; mutual cooperation among them makes the *loka* a coherent, purposeful and meaningful place where we experience the consciousness that guides our daily life and future.

Chapter 3
The Matter (*Pudgala*)

3.1 *Pudgalastikaya*

Jiva and *pudgalastikaya* are the two main substances in *loka*; the rest four viz., *dharma*, *adharma, akasa* and *kala* are passive helping substances. The word *pudgala* is a derivative made up of two words: *pud* meaning combining or fusion and *gala* meaning dissociation or fission. The properties of fusion and fission, which characterize all matter, are also responsible for the name *pudgala* given to this substance.

The characteristic attribute of *pudgala* is that it possesses the properties, which can be perceived by sense organs viz. colour, smell, taste and touch. Concomitance of all the four is emphasized by the Jains. In other words, if a thing is perceived by the sense of touch, it must also necessarily possess smell, taste and colour. The *paramanu* structure of *pudgala* is, as its name implies, absent in other *astikayas*. Whereas the other four *astikayas* are indivisible i.e. not disintegrable, *pudgala* is divisible. The ultimate indivisible unit of *pudgala* is called *paramanu*. *Paramanu* is the pure form of *pudgala* and all matter and energy are modes (impure) of *paramanu pudgala*. The *paramanu* can neither be created nor can it be destroyed. It is eternal. Although it possesses sense – qualities, it cannot be an object of sense – perception. It is the subtle most physical entity. By itself it transcends the sense experience, though it is basic constituent of all perceivable objects.

3.1.1 Attributes

Some attributes of *pudgala* were briefly described in chapter 1. *Pudgala* is the only substance which is *murta* and perceivable. *Rupatva / murtatva* or sensory perceptibility is the sum total of the four sensuous qualities mentioned above. All mutation of matter must possess all the four qualities as follows.

- Five types of primary colour : Black, blue, red, yellow, white
- Five types of taste: Sweet, bitter, pungent, sour & astringent
- Two types of odour: Good smell and bad smell.
- Eight types of touch: Cold, hot, smooth (positive charge), rough (negative charge), light, heavy, soft and hard.

Based on above qualities the substances can be of four types.

(i) Substance having one colour, one smell, one taste and two touches.

(ii) Substance having five colours, two smells, five tastes and four touch.
(iii) Substance having five colours, two smells, five tastes and eight touch.
(iv) Substance having none of these qualities – intangible substances.

Based on touch the *pudgala* is of three types

(i) Two touch (primary) *paramanu*.
(ii) Four touch (primary) subtle (*suksma*) aggregates (*skandha*) -energy.
(iii) Eight touch gross (*badara*) aggregates-energy and matter.

Cold, hot, smooth and rough are primary touch qualities of *pudgala*. The smooth touch is also regarded as positive charge and the rough touch is regarded as negative charge. We shall use these equivalence properties in our study. The other four touch qualities viz. light, heavy, soft and hard are secondary touch qualities. These touch qualities develop when bonding between infinite *paramanus* produces a gross aggregate. If number of negative *paramanus* is more in the bonding process the aggregate contains light touch quality and if positive *paramanus* are more then heavy touch is produced in the aggregate. When positive *paramanus* are in majority and they bond in cold condition soft touch is produced and when a majority of negative *paramanus* bond in hot condition hard touch is produced in the aggregate. The mass (or weight) of the aggregate is said to relate to the light and heavy touch qualities. These two qualities always co-exist, they are not found separately in aggregate. The four touch aggregates and *paramanu* are *agurulaghu* and mass less. The mass is a property of gross aggregates having eight- touch.

In the true sense the *paramanu* and aggregates as a class have no beginning; they have always been in existence. But a particular aggregate or *paramanu* has a beginning and a life. The minimum life of a *paramanu* as *paramanu* and that of an aggregate as aggregate can be one '*samaya*' and maximum life can be innumerable '*samayas*'. Therefore, they undergo change. The *pudgala* are of two types, subtle and gross, as said earlier. The subtle does not remain subtle and gross does not remain gross for all time. After innumerable '*samaya*' the subtle changes to gross and gross changes to subtle form. Similarly, the colour and other attributes of *pudgala* also change with time. A black colour of one degree can stay in the same condition for a minimum time of one '*samaya*' and a maximum time of innumerable '*samaya*'. Thereafter, one degree black shall change to innumerable degree black by the internal process of '*sadguna – hani – vridhhi*' described earlier. Intrinsic modification occurs in every substance every moment. Extrinsic modification of gross aggregates is also certain after innumerable '*samaya*'.

A subtle aggregate and *paramanu* are not perceivable in that form but if the same aggregate assumes a gross form on modification it becomes perceptible. It is because of this property that a subtle aggregate is also said to be the subject of sense organs. The mind can perceive the subtle as well as gross objects. The mind does not physically contact the object of its knowledge but perceives it by resolve. The mind with the help of sense organs acquires the cognitive and articulate knowledge. Only some modes of all substances become the object of cognitive and articulate knowledge. The scriptures are *pudgala* in physical form but are non-physical in the articulate form. With the help of articulate form of scriptures and its own thoughts the mind perceives both the gross and subtle objects. The omniscient knows fully the physical and non-

physical objects including a *paramanu*. A person with clairvoyance knowledge also has the ability to perceive gross and subtle objects. Common persons know subtle objects by scriptural knowledge and inference.

3.1.2 Classification

Jain philosophy describes the character of an object through fourfold determinant: the substance (*dravya*), space (*ksetra*), time (*kala*) and attributes (*bhava*). The *pudgala* is described as under:

(i) Substance wise: Infinitely infinite *paramanus* exist either independently (in Free State) or in combination with infinite composite bodies (*skandhas*).

(ii) Space wise: Each and every space-point (*pradesa*) of cosmos (*loka*) is occupied by infinite number of *paramanus*. There is not a single space-point where there is neither *paramanu* nor a composite body. According to Jain cosmology, there is no vacuum anywhere in the cosmos. That is, the entire cosmic space is 'plenum'. Vacuum exists only in trans-cosmic space.

(iii) Time wise: The physical existence is eternal and indestructible, not a single *paramanu* is created or destroyed.

(iv) Attribute wise: It is a substratum of infinite qualities making infinite types. Again, since each of these infinite varieties is capable of infinite mutations and transformations, the entire physical existence is infinitely infinite.

Pudgala has been classified in various ways. We consider some of them below.

3.1.2.1 Two types

The *pudgala* can be classified in two types as

(i) *Paramanu* or freely existing ultimate existence.

(ii) *Skandha* or composite aggregate composed of two to infinite number of *paramanus*.

Composite aggregates are again of two types (a) 4-touch (*catuhsparsi*) and 8-touch (*astasparsi*). The four- touch bodies have only four primaries touch viz, hot, cold, smooth and rough. The eight touch bodies; on the other hand, have in addition the secondary touch properties viz., heavy, light, hard and soft. The four touch bodies are *agurulaghu* and mass less.

Pudgala can be classified in two types in another way.

(i) *Suksma* (Subtle) – These are sense imperceptible. This does not mean that *suksma pudgala* is devoid of sense data. They become perceptible to persons having power of extra sensory perception. *Paramanus* and all aggregates composed of two, five, and ten up to innumerable *paramanus* are subtle. In fact, all four touch aggregates are subtle and sense imperceptible.

(ii) *Badara* (gross) – Those aggregates, which are perceivable by sense organs, are *badara* or gross. Aggregates composed of infinite *paramanu* and which have eight- touch are gross as well subtle. Only some eight touch aggregates are sense perceivable and therefore gross.

There is yet another way of classifying *pudgala* in two ways.

(i) Associable or capable of interaction with soul. The associated *pudgala* is supposed to be of conscious character.

(ii) Non-associable or not capable of interaction with soul. All *paramanus* in Free State are non-associable. Amongst the composite bodies some can interact, while some cannot.

3.1.2.2 Three Types

The *pudgala* can be classified into three types in respect of the cause of transformation viz,

(i) *Prayoga – Parinata* (body matter). The *pudgala* (matter), which is taken in and transformed into body form by vital processes of living beings, falls in this category.

(ii) *Misra – parinata* (mixed body substance matter). The *pudgala* (matter), which was associated with living beings in the past, but is now abandoned by it, and therefore, is no longer being transformed by the agency of vital processes, but undergoes auto-transformation, is *misra* (mixed)–*parinata*. That is, transformations, which are partly under the influence of soul and partly due to the nature of the substance itself, belong to this category. Shoe-leather is an instance of this type.

(iii) *Visrasa-parinat* (auto–transformed). Matter, which undergoes natural trnasformation i.e. without interaction with living beings, is *visrasa-parinat*. Clouds, rainbow, meteors, etc. are instances of this class.

Subtle changes take place in every substance every moment. Gross changes occur in soul and *pudgala* only. In this respect both soul and *pudgala* are similar but as far as the total changes are concerned *pudgala* far exceed soul. Changes in *pudgala* make the world change. Everything from the beginning to end in the world is governed by the natural changes taking place in *pudgala* and soul. The universe is self-managed from this point of view. Considering alienated modifications, the universe is governed by changes caused by union and separation of soul and *pudgala*. Soul and *pudgala* influence each other and both experience self-generated and alienated modification. Taking a comparative view, the amount of *prayog – parinat* (body matter) is least of all, the *misra – parinat pudgala* is infinite times more and the *visrasa – parinat pudgal* is still infinite times more than this.

3.1.2.3 Four Types

From structural aspect, physical reality can be classified into four types.

9. *Skandha* (aggregate)
10. *Skandha* –desa (aggregate fraction)
11. *Skandha- pradesa* (aggregate unit)
12. *Paramanu*

These are the four basic structural modification of physical reality, out of which infinite modes are produced.

(i) Aggregate: An aggregate is formed by combination of *paramanus*. The smallest aggregate is produced by two *paramanus* and the largest is the material spread extending over the whole cosmos.

(ii) Aggregate fraction: An aggregate fraction is a part of the aggregate (mentally divided). This is an example of physical division. Chemically a substance may be compounded of two or more elements. In this case, each element is an aggregate fraction. It should

be remembered that division is merely conceptual. When, on the other hand, an aggregate breaks up physically or chemically into fragments, each fragment becomes a whole aggregate and not aggregate – fraction.

(iii) Aggregate - unit. An aggregate- unit is an indivisible undetached part of aggregate. This is also merely conceptual.

(iv) *Paramanu*. The infinitesimally small, indivisible and free particle of matter is *paramanu*. This is described in detail below.

Out of the four, the aggregate (*skandha*) and *paramanu* are the main types. The aggregates and *paramanus* are produced in three ways – by division, by union or by both.

Division: The breaking apart of an aggregate by internal or external cause is called division.

Union: Combination of different substances and bonding between them is called union

Division – Union: Division – union means division and union taking place in the same process simultaneously. An aggregate break up and at the same times combines with another aggregate to produce a new aggregate giving a division – union.

The *pudgala* may be extensive (*sapradesa*) or non-extensive (*apradesa*). A pudgal occupying one *pradesa* is said to be non-extensive. For example, a *paramanu* is non-extensive. From the consideration of substance an aggregate is extensive. But from the consideration of space an aggregate may be extensive or non-extensive (since up to infinite number of *paramanus* can be accommodated in one *pradesa*).

3.1.2.4 Six Types

Generally, largeness is equated with grossness (*sthaulya*) and smallness is equated with subtlety (*sauksmya*). However, size is not the criterion in this classification. Gross is that which prevents other substances to pass and which can be stopped by others, or which cannot occupy space which is already occupied by others or which cannot pass through others and which does not allow others to occupy the space occupied by it.

Conversely, subtle is that which does not hinder others and cannot be hindered by others (or which can occupy the space which is already occupied by others or can pass through others). A mustered – seed is smaller in size than a drop of water but whereas water can pass through a cloth, the mustered seed cannot. Therefore water is subtle, mustered is gross.

From the point of view of penetrability *pudgala* is divided into six classes.

1. Gross-gross (*badara-badara*), i.e., very gross. This kind consists of very large solid aggregates of matter such as mountains, rocks, wood, etc. which do not unite by themselves when broken or divided, and also such bodies which can be physically transported without containers.
2. Gross (*badara*). This kind consists of large aggregates of matter in fluid form such as water, oil, milk, juice, air etc. that become united again by themselves when broken or divided, and which have to be carried in containers.
3. Gross-subtle (*badara-suksma*). This kind consists of aggregates which can neither be cut nor broken, nor can be physically transported, but are visible, e.g., light, shadow, image, etc.
4. Subtle-gross (*suksma-badara*). This kind consists of aggregates, which are not visible, but can be perceived by other four senses, e.g., aggregates of sound, taste, smell and touch.

5. Subtle (*suksma*). These aggregates are not perceivable by any sense organ. However, they interact with soul and are transformed by it in the form of thought, speech, karma, etc. (that is *mano-vargana, bhasha – vargana, karman- varagana* etc.)
6. Subtle-subtle or extra – subtle (*suksma-suksma*). This kind consists of aggregates, which are so subtle that they do not interact with soul. They include the aggregate, which are composed of less than infinite number of *paramanus*.

The *varganas* form another classification of *pudgala* and they are described in chapter 5.

3.1.3 The Alienated Modes of *Pudgala*

There are ten important alienated modes of the physical substance.

1. Sound (*Sabda*).

Sound is produced by collision or separation of two or more physical objects. It is the agitation set up by knocking together or splitting of two aggregates. It is of two kinds – (i) natural or spontaneous, e.g. thunder and (ii) that produced by conscious effort. The later is again of two kinds – (i) lingual and (ii) non-lingual. The lingual sound is again o two kinds- (i) articulate i.e. made up of alphabetical composition, and (ii) inarticulate i.e. sound produced by subhuman animals. Non-lingual sound is produced with the help of (musical) instruments. From a different aspect, sound may be divided into three kinds.

(i) Sound produced by animate organisms.
(ii) Sound produced by inanimate objects.
(iii) Sound produced jointly by both.

Thus sound is not a quality but modification of *pudgala*. Sound is in the form of waves produced by the vibrations of sounds – producing bodies and is propagated by material medium such as air or water but not by space ,i.e. vacuum.

2. Integration (*Bandh*)

All the physical objects are produced either by integration (*bandh*) or by disintegration (*bheda*). The integration is of two types – (i) natural (*vaisrasika*) and (ii) made by animate organisms (*prayogika*). The natural kind is again of two types – (i) with a definite beginning and (ii) without a beginning. Some instances of natural integration, which have a beginning, are clouds, lightening, rainbow etc. The only instances of eternal or beginning less integration are *dharma*, *adharma* and *akasa*.

Integration made by living organisms is necessarily with a definite beginning and can be divided into two kinds.

(i) Integration of one kind of matter with another, e.g., production of chemical compounds.
(ii) Combination of matter with living beings.

The last one is again of two types – (i) karma-*bandh*, bondage of Karma-*vargana* (with soul), and (ii) no-karma-*bandh*, combination of other groups of *pudgala* with soul in vital functions.

Jain philosophy provides elaborate rules for bonding between *paramanus*. The bonding takes place due to positive and negative charge of *paramanus*. The charge of a *paramanu* varies in a range. Let M be the minimum charge and that the charge increase in steps of 1, 2 or 3 etc. units. The *paramanu* can have a charge M, M+1, M+2, M+3 etc. The rules for bonding between

paramanus are given in table 1. It is seen that there is some variation is the rules in Swetambara and Digambara traditions. In both traditions a *paramanu* having a minimum charge does not bond with other *paramanu*. If charge is more than minimum value and differs by two units and more then the two *paramanus* can bond according to both traditions. These rules are also applicable to bonding between an aggregate and a *paramanu* or between two aggregates.

Table 1 Bonding rules for *paramanus*

	Value of charge of two *paramanus* bonding	Swetambara		Digambara	
		Similar charge *paramanu*	Dissimilar charge *paramanu*	Similar charge *paramanu*	Dissimilar charge *paramanu*
1	M + M	No	No	No	No
2	M+ (M+1)	No	No	No	No
3	M+ (M+2)	No	No	No	No
4	M+ (M+3)	No	No	No	No
5	(M+x) + (M+x)	No	Yes	No	No
6	(M+x) + (M+x+1)	No	Yes	No	No
7	(M+x) + (M+x+2)	Yes	Yes	Yes	Yes
8	(M+x) + (M+x+3) etc.	Yes	Yes	Yes	Yes
	x is positive integer.				

The qualities of the aggregate produced by bonding depend on the qualities of the constituent *paramanus* or aggregates. For instance one degree black *paramanu* on combining with higher degree white *paramanu* becomes white. When one degree black *paramanu* combines with one degree white *paramanu* a grey colour shall be produced in the aggregate.

3. Micro and Macro sizes (*Sauksmya* and *sthaulya*)

The physical universe is composed of innumerable varieties of physical objects, from a *paramanu* to a giant star. Both these opposite qualities are special attributes of *pudgala*. Largeness and minuteness are, however, mostly relative terms. Largeness of an object is relative to the minuteness of another object. The *paramanu* is the minutest object and the greatest aggregate (*acitta maha skandha*) is that which pervades the entire cosmic space (*loka*). Between these two extremes all other objects are relatively minute or large. There is a special process defined in Jain philosophy as *kevali samudghat*, which means expansion of soul's space points just before attaining the omniscient state, by a monk. In this process the *pudgala paramanus* attached to the soul spread and fill the entire cosmic space. This *pudgala* formation is also called the great aggregate.

4. Shape/Configuration (*Samsthana*)

This is also an important attribute of the physical existence. It is related to the capability of the physical objects to extend in the space. Shapes have infinite varieties, but they can be divided broadly into two groups.

(i) Regular or symmetrical. A shape that can be compared with other shapes is regular e.g. sphere, cube, pyramid etc.

(ii) Irregular or asymmetrical. A shape that is indefinite is irregular e.g. clouds, rocks etc.

Large and complex objects break up into smaller and simpler components. Division or disintegration is of two types (i) natural, and (ii) made by living organisms. Natural disintegration is the spontaneous decay of the physical substance. Natural forces such as internal stress, earthquake, wind, rain, flow of water, etc may cause this.

Disintegration produced by living organisms is of many varieties depending upon the method of division and separation. Division by sawing or splitting (utkara), division by breaking into smaller pieces (*khanda*), division by grinding (*curna*), layer-by-layer separation (*pratara*), division by fissures (*anutatika*), etc. are some examples of division.

5. Darkness (*Andhakara*)

Light is an attribute of *pudgala* and is the cause of visibility. Darkness, the anti-thesis of light and the cause of invisibility are also an attribute of *pudgala*. Darkness, according to Jain belief, is not merely absence of light but is a specific combination of physical bodies in which black colour is predominant.

Scientifically, darkness is absence of light. A dark object reflects fewer visible photons than other objects, and therefore appears dim in comparison. Most objects that absorb visible light reemit it as infrared light. So, although an object may appear dark, it is likely bright at a frequency that a human being cannot see. The scientific definition of light includes the entire electromagnetic spectrum, not just visible light, so it is physically impossible to create perfect darkness. The Jaina view that darkness is an attribute of *pudgala* is thus verified by science.

6. Shadows (*Chhaya*)

Shadows and image are also produced by light, and are, therefore, physical things. Every object emits radiations. These radiations when incident on a reflecting surface produce an image. The image is clear when the reflecting surface is mirror like and blurred when the reflecting surface is rough.

7. Hot Effulgence (*Atapa*)

Hot effulgence is the sunlight or light from a fire or a lamp etc. The emission from such sources is composed of both the heat radiations and light, the sun light carries less light radiations (35%) and more heat radiations. The fire is hot and its radiations are also hot.

8**. Cold Effulgence (*Udyota*)**

Cold effulgence is predominant in light radiations, and there is very little heat. Reflection of sunlight by moon etc falls into this kind. Light radiated from the tiny body of a glow-worm is mostly light (99%) and only little heat (1%).

9. Luster (*Prabha*)

Luster is a light ray emitted by certain gems and the like.

3.1.4 *Paramanu*

The canonical literature, in general, and the Bhagwati sutra in particular, defines *paramanu* in various ways from different angles. It is the basis (ultimate constituent) of physical universe. It is indivisible, indestructible, impenetrable, incombustible and imperceptible to sense organs. It cannot be split or destroyed by any means whatsoever. *Paramanu* is a true point. It has no half-

portion, no middle portion and no *pradesa*. It has no length, no breadth and no depth. It is dimensionless. It is truly infitesimal.

Paramanu is the pure form of *pudgala* and possesses the intrinsic qualities of touch, taste, odour and colour. A *paramanu* has one of the five primary colours, one of the two smells, one of the five tastes, two of the four primary touch i.e. either hot or cold and either smooth (positive change) or rough (negative charge). Although the four qualities are permanently possessed by a *paramanu*, the intensity of the qualities does not remain constant. A *paramanu* possessing one unit of blackness at any moment may sometimes later possess two, three or many units of blackness. In the free state the mutation is only in the intensities of colour, etc. i.e. x unit black changes to y unit black but black does not become white or red etc., but during and after union with others, change in colour etc., may also take place. It follows from this that at any given moment there would be *paramanus* with different intensities of blackness etc. In the same way there would be *paramanus* with various degrees of other qualities.

A single free *paramanu* is invisible not only to the naked eyes but also to any other physical instrument. Its existence is to be inferred by the collective action and reaction of infinite *paramanus*. Only the omniscient (*kevalajnan*i) and those who possess superlative visual intuition (*paramavadhi jnani*) can perceive and cognize the nature of a free *paramanu*.

The term *paramanu* is the short form of *dravya paramanu* or *paramanu– pudgala*. The Bhagavati sutra enumerates four types of *paramanus*– indivisible units.

(i) *Dravya – paramanu* or *pudgala-paramanu*– The indivisible unit of *pudgala* substance.

(ii) *Ksetra paramanu* – The indivisible unit of space i.e. space – point or *akasa – pradesa* (space occupied by one *pudgala paramanu*).

(iii) *Kala paramanu* – The individual unit of time called *samaya*.

(iv) *Bhava paramanu* – The indivisible unit or quantum of intensity of sensuous qualities, viz. colour, odour, taste and touch.

Thus, *paramanu* is the direct unit of physical substance (*pudgala*) and also the indirect unit of space, time and modification. The quantitative difference in matter- space – time as well as the qualitative difference in physical objects may ultimately be traced to constitution of *paramanu*. Thus, being the constituent element of physical composite bodies, it may be considered to be the determinant of the difference of aggregates, and for the same reason, it is also their substantial cause. By its own motion (vibration, oscillation etc.) it becomes the measure of time unit '*samaya*'.

On ultimate analysis, the whole physical universe is *paramanu*. The *paramanus* have the innate capacity of uniting with one another to form composite bodies. The composite bodies are liable to the process of disintegration and the united *paramanus* may become free *paramanus* and thus the process of association and dissociation goes on eternally. The *paramanu* is the ultimate cause '*karan paramanu*' – as well as the ultimate end – product – '*antya paramanu'*.

Paramanu by itself is not *kaya* (extensive body), because it is a singularity. However, when united with other *paramanu* in a composite body, it is a constituent of *kaya*. *Paramanu* never loses its identity even though it participates in the union to produce composite bodies. Thus not a single *paramanu* is destroyed nor a new one created. The total number of *paramanu* is eternally the same. A composite body of infinite number of *paramanus* may also occupy a single space –point. There

is not a single space-point in the whole of cosmos, which is not occupied by *paramanus*. It cannot, however, cross the boundary of *loka* since *dharma* is absent in the *aloka*. In its free state, the *paramanu* does not interact with soul and, therefore, serves no useful purpose.

3.1.4.1 Motion (*Gati*) and Dynamic Activity (*Kriya*) of *Paramanu*.

Paramanu is capable of being dynamically active (*kriyavan*). When mobile, it may have vibratory as well as migratory motions. The activity of a *paramanu* is not continuous but rather in the form of quanta. When dynamic, it can assume a very high velocity, since it is completely mass less, there is no upper limit to its speed, and it can travel from one end of *loka* to the other in one *samaya*.

Paramanu has a propensity to become dynamically active. This does not mean that all *paramanu* are active everywhere and at all times under all conditions. There is an element of uncertainty in the origination and cessation of the dynamic activity of *paramanu*. A *paramanu* can remain at rest on a single space – point for sometime. Maximum period of inactivity is innumerable *samaya*, after which it must move. On the other hand, maximum period of activity is innumerably small portion of an *avalika*. Minimum period of activity and inactivity is one *samaya*. In short, the dynamic activity of *paramanu* is not continuous, that is there are alternate periods of rest and motion. *Paramanu* may be self-activated or may be acted upon by other *paramanu*(s) or composite bodies.

The motion and dynamics of *paramanu* in some respect follow certain rules. These rules are summarized below.

1. In the absence of external forces, the *paramanu* moves in a stright line.
2. Under the influence of external forces, the *paramanu* may change direction and speed.
3. Soul has no direct influence on the motion of *paramanu*.
4. The minimum distance traveled by *paramanu* in one *samaya* is space between two adjacent points and the maximum distance traveled is the entire length of *loka.*
5. The maximum period of inactivity (rest) is innumerable *samaya* and the maximum period of activity is innumerable fraction of *avalika*.

On the other hand the *paramanu* also follows some rules of uncertainty.

1. It is uncertain, after what interval of time will a *paramanu* at rest will become dynamic (and release energy). This time-interval may be from one *samaya* up to innumerable *samayas*. However, after an interval of innumerable *samayas*, it will become active for sure.
2. Similarly, it is uncertain up to what duration of time a dynamic *paramanu shall* continue to be active. This duration could be one *samaya* to innumerable fraction of an *avalika*. But it will surely cease to be active after this maximum interval.
3. It is uncertain, which direction will a *paramanu* take at the commencement of motion? It can move in any possible direction.
4. It is uncertain, what type of dynamic activity will be commenced by an inactive *paramanu*. It may just vibrate or rotate or migrate or do all these movements simultaneously.
5. It is uncertain again what will be the intensity of a *paramanu's* dynamic activity. Will it move with minimum, maximum or intermediate velocity?

Paramanu generally cannot be stopped or hindered by any object (*apratighati*) and at the same time it does not cause hindrance to others. The following conditions apply.

1.Except in special cases given (below) the motion and activity of *paramanu* cannot be stopped or restrained by any material object or soul. A *paramanu* in motion is capable of penetrating and passing though any type of obstruction in its way.

2.A *paramanu* can occupy a space – point which is already occupied by others (*paramanu*, aggregate or soul), without losing its free state.

3.A *paramanu* can commence and continue its own motion and activities irrespective of the other occupants of the same space.

The special conditions in which the motion and activity of *paramanu* can be hindered are.

1.Dharma, which is necessary helping agent for motion, is present in *loka* and absent in a*loka*. The *paramanu*, therefore, cannot go from *loka* to *aloka*.

2.When part of an aggregate, and united with other *paramanus*, *paramanu* loses its free state and the capacity for independent activity. In this case the motion and activity of *paramanu* is hindered.

3.Collision between two self-activated *paramanus* moving at a high velocity may hinder the movement of both.

Some intrinsic qualities of *paramanu* are also factors in determining its velocity. When the intensity of negative charge of *paramanu* becomes a maximum, the velocity of *paramanu* reduces without any external influence. A *paramanu* with higher negative charge moves at a lower velocity then a *paramanu* with lower negative charge. The velocity is lowest for a *paramanu* with maximum negative charge. A *paramanu* having positive charge favours rest position. Both negative and positive charge may vary due to self-modification process (*sadgun- hani-vridhi*) and the velocity of *paramanu* would change accordingly.

3.2 Atom

We now study matter as described in modem science.

Elementary Particles

The matter is made up of molecules and these, in turn are made up of atoms. A typical atom consists of a nucleus composed of positively charged protons and neutral neutrons surrounded by a cloud of orbiting negatively charged electrons. Ernest Rutherford first postulated this model in 1913. At that time, it was thought that all matter consisted of these elementary particles. These particles are tabulated in Table 1.

Table 1 Elementary Particles

Property	Electron	Proton	Neutron
Symbol	e^-	p^+	n
Mass (kg)	9.109×10^{-31}	1.673×10^{-27}	1.675×10^{-27}
Mass (MeV)	0.51	938.2	939.6
Electric Charge	-1	+1	0

In 1928 Paul Dirac predicted that all particles should have opposites called anti-particles. The anti-particle of electron is positron. It is identical in every respect to the electron apart from its electric charge, which is (+1). When an electron and positron come in contact, they mutually annihilate each other producing a flood of energy in accordance with Einstein's equation.

Normally the total energy equivalent of the rest mass of particle is not released. About one thousand millionth fraction of this energy is released in chemical reactions. Even in a nuclear reaction about one percent of total energy is released. But interaction between a particle and anti particle releases full hundred percent energy equivalent to the rest mass of particle.

Both the proton and the neutron have anti particles. These also destroy each other if they meet with their particle. Ordinary matter is made up from particles. It appears that the universe is made up of ordinary matter. Matter composed of anti- particles is known as anti matter. Anti matter can be created in the laboratory but does not last long as it quickly comes in contact with ordinary matter and is destroyed.

It is now known that there are many more elementary particles than the six described above. These have been created using modem high-technology equipment. These have been divided into a number of groups depending on their properties. Most of these newly discovered particles have their anti-particles. The laws of physics are not quite the same for particles and anti-particles.

Leptons

The electron (e) is the simplest of the leptons. There are two heavier leptons called the muon (μ) and the tau (τ). Both are unstable and decay to simpler, more stable particles. Both have anti-particles. Muons are found in the air as cosmic rays enter the Earth's atmosphere and smash into atoms and molecules.

Another type of lepton is the enigmatic neutrino (ν). There are three types of neutrino, each one associated with one of the three leptons described above (e,μ,τ). They are called the electron neutrino (ν_e), muon neutrino (ν_μ) and tau neutrino (ν_τ).

Neutrinos hardly react with other types of matter. They can easily pass through the Earth. They have no electric charge. Each one has its anti-particle version so there are six types of neutrinos. Neutrinos have a very low mass and one type can change into one of the other two types. Leptons are never found in the nucleus of atoms. The six leptons are tabulated in Table 2

Table 2 Leptons

Name of Lepton	Symbol	Mass (MeV)
Electron	e	0.511
Electron neutrino	ν_e	~o
Muon	ν	106
Muon neutrino	ν_μ	~0
Tau	τ	1777
Tau neutrino	ν_τ	~0

Baryons

The two most common baryons are the proton and neutron. They are both of similar mass but the proton has a single positive charge. They are collectively known as nucleons. Both are found in the nuclei of atoms, being kept there by the strong nuclear force that binds them together. In recent years it has been suggested that baryons are made up of even more elementary particles

called quarks. Quarks are found in six types called flavours. In 1989 it was shown that only three pairs of quarks could exist. These correspond with the three leptons and the three neutrinos. Quarks are unusual in having fractional electric charges. Quarks are much smaller than wavelength of visible light and so do not have any colour in the normal sense. The quarks are tabulated in Table 3.

Table 3 Quarks

Name of quark	Symbol	Charge	Mass (MeV)
up	u	+ (2/3)	2- 8
Down	d	- (1/3)	5-15
Strangeness	s	- (1/3)	100-300
Charm	c	+(2/3)	1000-1600
Bottom (or Beauty)	b	- (1/3)	4100-4500
Top (or Truth)	t	+ (2/3)	180000

Baryons are made up of quark triplets. The proton is composed of two u quarks and a d quark.

+ (2/3) + (2/3) - (1/3) = + 1

The neutron is made from two d quark and a u quark.

- (1/3) - (1/3) + (2/3) = 0

The proton and neutron are stable particles in most nuclei. Outside the nucleus or in certain unstable nuclei, neutrons decay. There exist other baryons, produced in high energy experiments that are less stable. These too are made up of quark triplets. Hundreds of these particles are known. All six quarks have their anti-quarks with charges opposite in value to their quark counterparts. The (u) anti- quark has a charge of - (2/3) while the (d) anti-quark has a charge of + (1/3). The anti-proton is made up of (u) (u) (d) and has a charge of -1.

Mesons

In a nucleus, the protons and neutrons are not really separate entities, each with its own distinct identity. They change into each other by rapidly passing particles called pions (π) between themselves. Pions are the most common of the mesons. Mesons are composed of quark / anti-quark pair. The positive pion (π^+) is made from a u quark and d anti-quarks. The negative pion (π^-) is made from a d quark and u anti-quark. Kaons are short lived mesons that decay into simpler particles. Normally, particles and ant-particles decay in a similar way.

All of the above particles are referred to as fermions. Particles have a property called spin. The spin of fermions has half integer values (1/2, 3/2, etc.). Because of this spin, fermions obey the Pauli Exclusion Principle. This means that two fermions cannot occupy the same energy states. With electrons this gives rise to atoms whose electrons are distributed in shells. These shells give atoms their differing chemical properties.

Forces

There is another type of particle called boson. Bosons are known as force carriers Bosons have integer spin (0, 1, and 2). Bosons do not obey the Pauli Exclusion Principle.

When two particles interact they exchange a boson. The bosons exchanged between matter particles are said to be virtual particles because, unlike 'real' particles, a particle detector cannot directly detect them. We know they exist, however, because they do have a measurable effect; they give rise to forces between matter particles.

Bosons can be grouped into four categories according to the strength of the force that they carry and the particles with which they interact. It should be emphasized that this division into four classes is man-made; it is convenient for the construction of partial theories, but it may not correspond to anything deeper. Ultimately, most physicists hope to find a unified theory that will explain all the four forces as different aspects of a single force.

The first category is the gravitational force. This force is universal, that is, every particle feels the force of gravity, according to its mass or energy. Gravity is the weakest of the four forces by a long way; it is so weak that we would not notice it at all were it not for two special properties that it has; it can act over large distances, and it is always attractive. This means that the very weak gravitational forces between individual particles in two large bodies, such as the earth and the sun, can all add up to produce a significant force. Some people suggest the existence of a graviton to carry the gravitational force.

The next category is the electromagnetic force, which interacts with electrically charged particles like electrons and quarks, but not with uncharged particles such as gravitons. It is much stronger than the gravitational force. The electromagnetic force between electrons is about 10^{42} times bigger than the gravitational force. The force between two positive (or negative) charges is repulsive, but the force is attractive between a positive and a negative charge. A large body, such as earth and the sun, contains nearly equal number of positive and negative charges. Thus the attractive and repulsive forces between the individual particles nearly cancel each other out, and there is very little net electromagnetic force. However on the small scales of atoms and molecules, electromagnetic forces dominate. The electromagnetic attraction between negatively charged electrons and positively charged protons in the nucleus causes the electrons to orbit the nucleus of the atom; just as gravitational attraction causes the earth to orbit the sun. The electromagnetic attraction is pictured as being caused by the exchange of large number of virtual mass less particles of spin 1, called photons.

The third category is called the strong nuclear force, which holds the quarks together in the proton and neutron, and holds the protons and neutrons together in the nucleus of an atom. It is believed that this force is carried by spin-1 particle, called gluon, which interacts only with itself and with the quarks. The strong nuclear fore has a curious property called confinement. It always binds particles into combinations that have no clour.

The strong force is 100 times stronger than the electromagnetic force. In fact, it is the strongest force in nature. It has the shortest range of all forces, equal to about the diameter of the proton. Strong force interactions are very fast i.e. they take about 10^{-22} second.

The fourth category is called the weak nuclear force which is responsible for radioactivity and which acts on all matter particles of spin ½ but not on particles of spin 0, 1 or 2 such as photon and gravitons. Three bosons (w^+, w^- and z^0) carry the weak nuclear force. This is the force responsible for beta decay in which a neutron spontaneously disintegrates into a proton by emitting an electron and mass less neutrino. The electrons, which are emitted in this process, become

powerful radiations and are used in biology, medicine and industry. Weak interactions are also fast and take about 10^{-10} second.

All known particles fall into two classes, bosons or fermions. Many bosons can occupy the same state at the same time. This is not true for fermions only one fermion can occupy a given state at a given time. This is why solids can't pass through one another. Why we can't walk through walls, because of Pauli repulsion – the inability of fermions (matter) to share the same space the way bosons (forces) can. Bosons do not have antiparticles. They are mass less. Photon, gluon and graviton do not have electric charge. The graviton has not yet been observed directly or indirectly.

The number of "basic forces" has changed over the years. The electric and magnetic forces once thought separate gradually become unified as electromagnetic forces. More recently, weak interactions have joined electromagnetic interactions to become electro weak interaction. In all likely hood, strong and gravitational interactions will eventually join electro weak to give us one grand system of interactions between objects in our universe.

3.3 Field Theories

In order to appreciate field theory we must know about two important developments in physics - quantum mechanics and the theory of general relativity. Quantum mechanics is a fundamental branch of theoretical physics that replaces classical mechanics and classical electromagnetism at the atomic and sub atomic levels. Along with general relativity, quantum mechanics is one of the pillars of modern physics. Quantum mechanics is a more fundamental theory than Newtonian mechanics and classical electromagnetism, in the sense that it provides accurate and precise descriptions for many phenomena that these "classical" theories simply cannot explain on the atomic and subatomic level. For example, if Newtonian mechanics governed the working of an atom, electrons would rapidly travel towards and collide with the nucleus. However, in the natural world the electron normally remains in a stable orbit around a nucleus seemingly defying classical electromagnetism.

The foundations of quantum mechanism were established during the first half of the twentieth century. In 1900, the German physicist Max Plank introduced the idea that energy is quantized, in order to derive a formula for the observed frequency dependence of the energy omitted by a black body. In 1905 Einstein explained the photoelectric effect by postulating that light energy comes in quanta called photons. In 1913 Neil Bohr explained the spectral lines of the hydrogen atom, again by using quantization. In 1924, the French physicist Louis De Broglie put forward his theory of matter waves by stating that particles can exhibit wave characteristics and vice versa. These theories are collectively known as the old quantum theory.

Modern quantum theory was born in 1925, when the German physicist Werner Heisenberg developed matrix mechanics and the Austrian physicist Erwin Schrödinger invented wave mechanics and the non-relativistic Schrödinger equation. Heisenberg formulated his uncertainty principle in 1927. The Uncertainty Principle states that both the position and the momentum cannot simultaneously be known with infinite precision at the same time. Quantum mechanics does not pinpoint the exact values for the position or momentum of certain particles in a given space in a finite time, but rather, it only provides a range of probabilities of where that particle might be. The Copenhagen interpretation of quantum mechanics took shape in 1927. According to it, the probabilistic nature of quantum mechanics predictions cannot be explained in term of some

other deterministic theory, and does not simply reflect our limited knowledge. Quantum mechanics provides probabilistic results because the physical universe is itself probabilistic rather than deterministic.

Starting around 1927 Paul Dirac began the process of unifying quantum mechanics with special relativity by proposing the Dirac equation for the electron. During the same period, Hungarian polymath John von Neumann formulated the rigorous mathematical basis for quantum mechanics as the theory of linear operators and Hilbert spaces. Beginning in 1927, attempts were made to apply quantum mechanics to fields rather than simple particles resulting in what are known as quantum field theories. Early workers in this area included Dirac, Pauli, Weisskopf, and Jordan. This area of research culminated in the formation of quantum electrodynamics by Feynman, Dyson, Schwinger, and Tomonaga during the 1940s. Quantum electrodynamics is a quantum theory of electron, positron, and the electromagnetic field, and served as a role model for subsequent quantum field theories. This theory represents the interactions of charged particles mediated by force carrier photons. The quantum field theory of the strong nuclear force is called quantum chromo dynamics, and describes the interactions of the sub nuclear particles quarks and gluons.

In 1967, two Americans Sheldon Glashow and Steven Weinberg and a Pakistani Abdus Salam proposed independently a theory unifying electromagnetism and the weak nuclear forces. This unified theory was governed by the exchange of four particles the photon for electromagnetic interaction, and a neutral Z particle and two charged w particles for weak interaction. Their theory was given experimental support by the discovery, in 1983, of the Z and W bosons at CERN by Carlo Rubbia's, team.

The next logical step towards the unification of the fundamental forces of nature was to include the strong interaction with the electroweak forces in a theory called the Grand Unified Theory (GUT). The strong interaction acts between quarks via the exchange of gluons. There are eight types of gluons, each carrying a colour charge and an anti-colour charge. Based on this theory, Sheldon Glashow and Howard George proposed the first grand unified theory in 1974, which applied to energies above 1000 GeV. Since then there have been several proposals for GUTs, although none is currently universally accepted. A major problem for experimental tests of such theories is the energy scale involved, which is well beyond the reach of current accelerators. However, there are some falsifiable predictions that have been made for low energy processes that do not involve accelerators. One of these predictions is that the proton is unstable and can decay. It is at present unknown if the proton can decay although experiments have determined a lower bound of 10^{35} years for its lifetime. It is therefore uncertain, at the present time, whether any GUT can provide an accurate description of matter.

Gravity has yet to be included in a theory of everything. Theoretical physicists have been so far incapable of formulating a consistent theory that combines general relativity and quantum mechanics. The two theories have proved to be outstanding problem in the field of physics. In recent years the quest for a unified field theory is largely trusted on string theory.

Relativistic quantum field theory has worked very well to describe the observed behaviors and properties of elementary particles. But the theory itself only works well when gravity is so weak that it can be neglected.

String theory is believed to close this gap. By this theory we can combine quantum mechanics and gravity and we can talk sensibly about a string excitation that carries the gravitational force. Think of a guitar string that has been tuned by stretching the string under tension across the guitar. Depending on how the string is plucked and how much tension is in the string, different musical notes will be created by the string. In a similar manner, in string theory, the elementary particles we observe in particle accelerators could be thought of as the "musical notes" or excitation modes of elementary strings. The average size of a string is about 10^{-35} meter. This means that strings are way too small to see by current or expected particle physics technology.

String theories are classified according to whether or not the strings are required to be closed loops, and whether or not the particle spectrum includes fermions. In order to include fermion in string theory, there must be a special kind of symmetry called super symmetry, which means for every boson there is a corresponding fermion. Super symmetric partners have so far not been observed in particle experiments, but scientists are hopeful of finding evidence for high-energy super symmetry in the next decade.

There are several kinds of string theories. The bosonic string theory deals with bosons only with both open and closed strings. A superstring theory deals with super symmetry between forces and matter. There are five kinds of superstring theories one of which uses both open and closed strings and four use closed strings only. For bosonic strings the quantum mechanics can be done sensibly if the space-time dimensions number 26. For super strings the space-time dimensions are 10. Attempts are on way to collapse all the string theories into one theory, which people want to call M theory, for it is the mother of all theories. We still don't know the fundamental M theory but a lot has been learned about the eleven – dimensional M theory and how it relates to superstrings in ten space-time dimensions.

Discovery of a theory is only part success. According to Stephan Hawking –"Even if we do discover a complete unified theory, it would not mean that we would be able to predict events in general, for two reasons. The first is the limitations that the uncertainty principle of quantum mechanics sets on our powers of prediction. There is nothing we can do to get around that. In practice, however, this first limitation is less restrictive than the second one. It arises from the fact that we could not solve the equations of the theory exactly, except in very simple situation. We already know the laws that govern the behaviour of matter under all but the most extreme conditions. In particular, we know the basic laws that underline all of chemistry and biology. Yet we have certainly not reduced these subjects to the status of solved problems. We have, as yet, had little success in predicting human behaviour from mathematical equation! So even if we do find a complete set of basic laws, there will still be the intellectually challenging task of developing better approximation methods, so that we can make useful predictions of the probable outcomes in complicated and realistic situations. A complete, consistent, unified theory is only the first step. Our goal is a complete understanding of the events around as, and of our own existence."

3.4 What is Mass?

Isaac Newton presented the earliest scientific definition of mass in 1687: "The quantity of matter is the measure of the same, arising from its density and bulk conjointly." That very basic definition was good enough for Newton and other scientists for more than 200 years. They

understood that science should proceed first by describing how things work and later by understanding why. In recent years, however, the why of mass has become a research topic in physics.

The foundation of our modern understanding of mass is far more intricate than Newton's definition and is based on the standard model of particle physics, the well-established theory that describes the known elementary particles and their interactions.

Fundamental particles have an intrinsic mass known as their rest mass (those with zero rest mass are called mass less). For a compound particle, the constituent's rest mass and also their kinetic energies of motion and potential energies of interactions contribute to the particle's total mass. The Standard Model lets us calculate that nearly all the mass of protons and neutrons is from the kinetic energy of their constituent quarks and gluons (the remainder is from the quarks rest mass). Thus, about 4 to 5 percent of the entire universe – almost all the familiar matter around us – comes from the energy of motion of quarks and gluons in protons and neutrons.

Unlike protons and neutrons, truly elementary particles – such as quarks and electrons - are not made up of smaller pieces. The explanation of how they acquire their rest masses gets to the very heart of the problem of the origin of mass. The account proposed by contemporary theoretical physics is that fundamental particle masses arise from interaction with the Higgs field. But why is the Higgs field present throughout the universe? Why isn't its strength essentially zero on cosmic scale, like the electromagnetic filed? The Higgs field is a quantum field.

Particles that interact with the Higgs field behave as if they have mass, proportional to the strength of the field times the strength of the interaction. Our understanding of all this is not yet complete, and we are not sure how many kinds of Higgs fields there are. With the super symmetric standard model, at least two different kinds of Higgs fields are needed. The two Higgs field, give rise to five species of Higgs boson, three that are electrically neutral and two that are charged. The masses of neutrinos could arise rather indirectly from these interactions or from yet a third kind of Higgs field. The neutrino masses are less than a millionth the size of the next smallest mass, the electron mass.

The theory of the Higgs field explains how elementary particles acquire the mass. But the Higgs mechanism is not the only source of mass-energy of the universe. About 70 percent of the mass – energy of the universe is in the form of so-called dark energy, which is not directly associated with particles. The chief signs of the existence of dark energy are that the universe's expansion is accelerating. The precise nature of dark energy is one of the most profound open questions in physics. The remaining 30 percent of the universe's mass-energy comes from matter, particles with mass. The most familiar kinds of matter are protons, neutrons and electrons provide about one sixth of the matter of the universe or 4 to 5 percent of the entire universe. A smaller contribution comes from neutrinos, which is less than half a percent of the universe.

Almost all the rest of matter – around 25 percent of the universe's total mass-energy is matter we do not see, called dark matter. We deduce its existence from its gravitational effects on what we do see. We do not yet know what this dark matter actually is. Experiments indicate that the dark matter should be composed of massive particles because it forms galaxy – sized dumps under the effects of the gravitational force. A variety of arguments have let us concluded that the dark matter cannot be composed of any of the normal Standard Model particles. The leading

candidate particle for dark matter is the lightest super partner. The mass of lightest super partner (LSP) is thought to be about 100 proton masses.

Thus we have understood the three ways that mass arises. The main form of mass we are familiar with – that of protons and neutrons and therefore of atoms – comes from the motion of quarks – bound into protons and neutrons. The proton mass would be about what it is even without the Higgs field. The masses of quark, themselves, however, and also the mass of the electron, are entirely caused by the Higgs field. Those masses would vanish without the Higgs. Most of the amount of super partner masses and therefore the mass of the dark matter particle comes from additional interactions beyond the basic Higgs one.

3.5 Body Senses

3.5.1 Colour

Colour is the perception of the frequency (or wavelength) of light. It is a perception, which in humans derives from the ability of the fine structures of the eyes to distinguish (usually three) differently filtered analyses of a view. The full spectrum of the incoming radiation from an object determines the visual appearance of that object, including its perceived colour. A surface that diffusely reflects all wavelengths equally is perceived as white, while a dull black surface absorbs all wavelengths and does not reflect. Though the exact status of colour is a matter of current philosophical dispute, colour is arguably a psychophysical phenomenon that exists only in our minds. A "red" apple does not give off "red light', and it is misleading to think of things that we see, or of light itself, as objectively coloured at all. Rather, the apple simply absorbs light of various wavelengths shining on it to different degrees, in such a way that the unabsorbed light, which it reflects, is perceived as red. An apple is perceived to be red only because normal human colour vision perceives light with different mixes of wavelength differently – and we have language to describe that difference.

Most light sources are not pure spectral sources; rather they are created from mixtures of various wavelengths and intensities of light. To the human eye, however, there is a wide class of mixed – spectrum light that is perceived the same as a pure spectral colour. An apple, which is perceived as red with spectrum sources, may be perceived to have a different colour with a light source, which is at variance with spectral source.

Although Aristotle and other ancient scientists speculated on the nature of light and colour vision, it was not until Newton that light was correctly identified as the source of colour sensation. Goethe studied the theory of colours, and in 1801 Thomas Young proposed his tri chromatic theory, which was later, refined by Hermann von Helmhotz. That theory was confirmed in 1960s. In 1931, an international group of experts called the Commission International d Eclairage (CIE) developed a mathematical colour model. The premise used by the CIE is that colour is the combination of three things a light source, an object, and an observer.

A light wave can be analyzed as a superposition of sine waves, each of which has a specific frequency and wavelength. Electromagnetic radiation is a mixture of radiation of different wavelengths and intensities. When this radiation has a wavelength inside the human visibility range (approximately from 380 nm to 740 nm), it is known as light within the (human) visible spectrum. The light's spectrum records each wavelength's intensity. The full spectrum of the incoming radiation from an object determines the visual appearance of that object, including its

perceived colour. The intensity of a spectral colour may alter its perception considerably. The colours of the visible light spectrum are red, orange, yellow, green, cyan, blue and violet. In addition to these spectral colours there are many colour perceptions that by definition cannot be pure spectral colours. Some example of necessarily non-spectral colours is the achromatic colours (black, gray and white) and others colour such as pink, tan and magenta. The perception of colour is influenced by biology, long-term history of the observer, and also short-term effects such as colour nearby.

The retina of the human eye contains three different types of colour receptor cells or cones. (i) The S-cones, called short – wavelength cones are most responsive to light that we perceive as violet, with wavelengths around 420 nm, (ii) The L-cones, called long wavelength cones, are most sensitive to light we perceive as yellowish green with wavelengths around 564 nm, and (iii) The M-cones, the middle wavelength cones, are most sensitive to light perceived as green, with wavelengths around 534 nm. The sensitivity curves of the cones are roughly bell-shaped, and overlap considerably. The incoming signal spectrum is thus reduced by the eye to three values, sometimes called tri stimulus values, representing the intensity of the response of each of the cone types. The set of all possible tri stimulus values determine the human colour space. It has been estimated that humans can distinguish roughly 10 million different colours, although the identification of a specific colour is highly subjective, since even the two eyes of a single individual perceive colours slightly differently. A mixture of three colours called primaries can generate most human colour perceptions. These primary colours are red, blue and green.

According to Jain philosophy, matter, as aggregate or *paramanu*, has the qualities of touch, taste, odour and colour. Being objective reality, these qualities do not depend on the observer. An observer may or may not perceive the object in its true state due to inability or limitation of his sense organs or sensing system but this does not alter the nature of the object. An object is composed of infinite number of *paramanus* and it has all the colours. But when we see the object we do not perceive all the colours. For instance, a parrot has all the colours but we perceive only the green colour. This is due to limitation of our sense organ. An observer possessing superlative powers may see all the colours of parrot. In other words, from the absolute point of view (*nischaya naya*) the parrot has all the five colours and from practical point of view (*vyavhar naya*) its colour is green. The observer and the subject are independent having separate existence and the observer does not influence the nature of the subject. Similarly, truly speaking, the grass is not green, it has all the colours. The number of *paramanus* having green colour are more than the *paramanus* of any other colour and therefore we see the grass as green.

The Jain and scientific point of views are similar in some respect, as both believe that the colour is a quality of the object. What radiations of the incident light are absorbed depends on the characteristic of the object. Science offers no explanation for why certain radiations are absorbed and an object reflects other radiations. Science can answer this question only when the true nature of the matter has been understood. According to Jain philosophy colour etc. are objective realities of matter and these cannot be truly perceived by physical senses.

3.5.2 Taste

Taste is the ability to respond to dissolved molecules and ions called Testants. Humans detect taste with taste receptor cells. These are clustered in taste buds. Each taste bud has a pore

that opens out to the surface of the tongue enabling molecules and ions taken into mouth to reach the receptor cells inside. A single taste bud contains 50-100 taste cells representing all 5 taste sensations. Each taste receptor cell is connected, through an ATP – releasing synapse, to a sensory neuron leading back to the brain. There are five primary taste sensations (1) salty (2) sour, (3) sweet (4) bitter and (5) umani.

3.5.3 Smell (Olfaction)

Olfaction, the sense of odor (smell), is the detection of chemicals dissolved in air (or, by animals that breathe water, in water). In vertebrates smells are sensed by the olfactory epithelium located in the nose and processed by the olfactory system.

As discovered by Lind B. Buck and Richard Axel, mammals generally have about 1000 genes for odor receptors. Humans have 347 functional odor receptor genes. Odor receptor nerve cells may function like a key – lock system: if the odor molecule can fit into the lock the nerve cell will respond. An alternative theory, the vibration theory proposed by Luca Turin (1996, 2002), a British biophysicist, posits that odor receptors detect the frequencies of vibrations of odor molecules in the infrared range by electron tunneling. Turin argued that two of our other senses vision and sound- are based on the brain's interpretation of vibrations and spectra so why not smell? The fact that smell is a spectral sense like sight and sound might also help explain a strange but very rare condition known as synaesthesia where the "sufferer's" senses are mixed up. Several musical composers claim to be able to hear in colours or smell sounds and very young babies are thought to have a mixed up sense of the world where various inputs – sight, sound and smell – are not processed separately by the brain. However, the major predictions of this theory have been found lacking (Keller and Vosshall, 2004), though other studies disagree.

According to Jain philosophy the entire body is potential Integrated Sensory Organ (Karan). The skin performs the function of all sense receptors. In practice light, waves and odour encounter the whole body and just not eyes, ears or nose. The signals may be generated in the whole body but have high concentration in the eyes ears and nose respectively. However, if high intensity signals from the specified organs are absent, the mind can amplify the weak signals produced elsewhere in the body. In a recent study a women was able to recognize colours simply by touching when her eyes were blind folded.

Olfaction and taste together contribute to flavor. The human tongue can only distinguish among five distinct tastes, while the nose can distinguish among hundreds of substances. This is the reason why food has little flavour when your nose is blocked, as from a cold.

The importance and sensitivity of smell varies among different organisms: most mammals have good sense of smell, whereas most birds do not, with the exceptions being the tubenoses and the kiwis. Among mammals it is well developed in the carnivores and ungulates, which must always be aware of each other, and in those, such as moles, who smell for their food. It is less well developed in the catarshine primates, and non-existent in cetaceans, which in compensation have a sensitive and well – developed sense of taste. Insects primarily use their antennae for olfaction. Sensory neurons in the antenna generate odor-specific electrical signals called spikes in response to odor.

3.5.4 Hearing

An object produces sound when it vibrates in matter. The vibrating object sends a wave of pressure fluctuation through the atmosphere. Sound waves approaching the ear enter either directly or are reflected by the pinna down the auditory canal (meatus) and are conducted to the cochlea by the three ossicles. Sound waves travel through the ear canal to the ear drum (tympanic membrane). The auditory can resonate and amplify sounds within a frequency range of about 2000 Hz to 5500 Hz up to a factor of 10.

Successive compressions and rarefactions of air reaching the ear drum causes the ear drum to vibrate. The vibrations travel to cochlea through three small bones. The bones act as interlocking levers, which amplify the force of the eardrum. This causes a further amplification of the sound vibration, up to 20 times at some frequencies. The hair-like structures (dendrites) in the cochlea resonate at various different frequencies. The vibrations stimulate neurons to produce electrical impulses, which are sent along the auditory nerve to the brain for processing. The brain is able to detect the relative direction of a sound and is also able to perceive the relative distance of a sound source.

The ear can hear sounds form 20 Hz to 20000 Hz. It is most sensitive to frequencies between 500 Hz and 4000 Hz, which corresponds almost exactly to the speech band. Human pressure perceptions range from 20 micro pascal to 200 pascal. Loudness is a subjective term describing the strength of the ear's perception of a sound. It is intimately related to sound intensity. Decibel is a relative measure and is used to quantify both pressure and intensity levels.

Chapter 4
The Life

4.1 Atman and Soul in Jain Philosophy

In the first chapter we learned about *jiva* as one of the substance existing in *loka*. We need to know more about *jiva* for understanding its functioning. In the last chapter we studied the characteristics of *paramanu* and its aggregates. The *paramanu* is the pure form of *pudgala* and is the real substance; the aggregates are impure and consist of modes of *paramanu*. Unlike *paramanu pudgala*, which occurs in pure form, the *jiva* naturally exists in impure form. The impurity in *jiva* is due to karma attached to it. *Jiva* without karma, which are *pudgala*, is not found naturally. Thus the *jiva*, which was described as non-corporeal, is in fact corporeal as found in nature. In practice only the impure corporeal form of *jiva* is capable of performing any physical action, the non-corporeal form of *jiva* cannot do anything physical. This is an important concept and must be clearly understood.

In order that we maintain clarity of description we define the following.

Soul - It is the corporeal form of jiva having karma body (and also luminous body) that is soul means a composite structure of jiva and karma. The soul is doer and enjoyer of sensual acts of pleasure and pain through physical activities of body, speech and mind. The soul interacts with the external world through karma. Karma determines the degree of impurity of the soul, more are karma more is the impurity and vice versa. The consciousness of Jiva with less karma is more explicit and with more karma it is less explicit.

Atman - It is the sentient part of the soul that is, it is the jiva substance in the impure state or it is the non-corporeal part of corporeal soul. Being non-corporeal atman by itself is incapable of performing physical acts of body, speech and mind which are characteristic of life. In canonical terms atman is neither doer nor enjoyer of physical acts of pleasure and pain. When the soul performs physical acts, the atman possessing consciousness undergoes modification and depending on the level of consciousness experiences knowledge, conation, bliss and vitality. The manifestation of consciousness and hence the knowledge, conation, bliss and vitality attributes of atman are limited by karma, the pure atman having full manifestation of consciousness enjoys unlimited knowledge, conation, bliss and vitality.

It may be noted that the terms atman and soul describe the reality *jiva* from different points of view and so bear a definite relationship. There is a correspondence between the two in the sense that the same measure of impurity is reflected in both. The knowledge, perception, bliss and vitality of atman have a direct but inverse relationship with the karma of the soul. More are karma more is the cover on inner power of atman and vice versa. That is, in the most impure state of the soul least power of atman is expressed and in a pure soul without karma the atman enjoys infinite knowledge, perception, bliss and vitality. The correspondence relationship between soul and atman is just like the relationship between an object and its image in a mirror. The atman acts like a mirror and karma acts as the object. An image of the karma is formed in the atman and the atman

is illusioned to consider the image as his real self and he behaves accordingly. The image is the cover on atman that inhibits its intrinsic qualities and hinders direct knowledge and perception. It represents ignorance in the super knowledge atman. The image being an exact copy of the object experiences the same changes as the karma. If it any stage realization comes that the image is not himself it is an external influence then atman becomes aware of his own real self and tries to do away with the image by eradicating karma.

Depending on the state, the following forms of atman are also defined.

1. External atman (*Bahiratman*) – state of the atman which forgetting his own real capabilities considers the outside world as the source of pleasure and pain (the body is also external to atman). He identifies himself with the body. This is known as the state of wrong belief (*Mithyatva*).
2. Inner atman (*Antaratman*) – state of atman, which recognizes that the real source of pleasure and pain is within. Atman differentiates between himself and body. Three stages of this state of atman have been described.

(a) Lowest inner atman – atman has the right perception (that he is different from the body) but has not initiated serious action to remove the impurity that is responsible for pain and pleasure and his alien form (4^{th} spiritual stage, see chapter 7)

(b) Medium inner atman – stages of atman in the path of purification of the self by reducing passions (5^{th} -6^{th} spiritual stages).

(c) Highest inner atman – the stage of the atman where most passions have been eliminated (7^{th}-12^{th} spiritual stage).

3. *Paramatma* (Super atman) – atman free of passions and enjoying the true-self having infinite knowledge, perception, bliss and vitality.

There are two types of *paramatma.*

1. Arihant (Omniscient) – atman enjoys his infinite capabilities due to elimination of psychical (*ghatin)* karma but is still embodied due to remaining physiological (*aghatin)* karma (13^{th} spiritual stage).
2. Liberated soul *(Siddha*) – atman in the purest state without karma and body. He enjoys infinite knowledge, perception, bliss and vitality continuously forever. Atman being non-physical, the constraints of time and space do not apply.

It is seen from above that the terms atman and soul can be used interchangeably bearing in mind that they refer to state of *jiva* from the absolute and practical points of view respectively.

Souls are infinite (in the *loka*). Every soul has individual existence; individual soul is the central concept of Jain thought. The total number of souls in *loka* does not change. This means soul can neither be created nor destroyed. The life (organism) is an embodied soul. All species found in nature are modes of soul. Modes change according to karma. The soul is born as a particular species according to his karma. The body is an outfit which the soul keeps on changing to proceed forward on the path of purification. Soul is too subtle to be a subject of our perception, it can be perceived by omniscient only. Life and consciousness are coextensive. Wherever there is life, there is consciousness and the vice versa. But there are degrees of explicitness or manifestations of consciousness in different organisms. In the lowest class of organisms, it is very

much latent, while in human beings, it is very much manifest. It is entirely distinct from all inanimate existence. Characteristic qualities viz. colour, odour etc. inherent in physical existence has no relevance in the case of *jiva,* and hence, it cannot be recognized by sense perception. Consciousness manifests itself in several ways: intuition, perception (cognitive elements), emotions, will, attitude and behaviour, awareness of pleasure and pain.

Some of the observations, which help validate the existence of soul, are:

1. Self-consciousness possessed by a living being like I am, I am happy, I am sad, etc. The body does not make such experiences. Expressions like, I have done it, I do it, I will do it indicate the existence of soul the doer.
2. The intention of doubt, curiosity, inquisitiveness, etc. is expressions of consciousness. The doubt I am or I am not, also generates in soul and not in the body.
3. The soul is the counterpart of matter (*ajiva*). The existence of a substance without a counterpart cannot be supported logically.

The following main facts about soul are noted in Jain philosophy.

1. Soul is beginning less, endless and eternal. It cannot be destroyed. As a substantial reality it remains the same all the time, in past, present and future, and so it is perpetual. Considering modes in the form of different bodies, soul is transient.
2. In embodied existence, soul and body appear to be same but this is not really so. Body is different from soul.
3. Soul contracts or expands to occupy the space of the body he assumes. The same soul can pervade the body of an elephant or an ant. Not withstanding the size of the body, the number of *pradesa* of soul remains the same.
4. Atman is non corporeal and is recognized by his power of knowing objects.
5. Soul is the source of intuition, perception, happiness and vitality in a living organism.
6. Soul possesses powers. The main powers are the power of intuition and knowledge, vitality and will power.

1. 7 Being invisible, soul is identified by his ability of cognizance, an embodied soul desires for comical amusement, recreation, pleasure, speech, movement etc.
2. The *karman varganas* (form of energy) attracted by a soul get converted into karma unaided. This is further discussed in Chapter 5.
3. The thoughts and actions of a soul leave a permanent impression. These impressions are stored in the karma body, which moves with the soul in his journey from one body to another.

10 The bondage of karma with the soul is beginning less. The karma can be shed from soul by practicing austerity and penance. This in fact, is the way to get rid of karma and attain the state of salvation.

11. Atman is non-corporeal but he is embodied due to his karma..

12. All living organisms have similar potential powers and abilities but every living organism is in a different state of development. The development of the soul is determined by own purifying efforts and other governing factors.

13. There is no place in *loka* where soul in subtle or gross form (of organism) is not present.

The number of *pradesas* of *dharma, adharma, loka* and soul are although equal they differ in respect of space occupied. The space occupied by *dharma*, *adharma* and *loka* is always the

same but the space occupied by a mundane soul keeps on changing by the process of contraction and expansion taking place according to the size of the body the soul occupies. However, the space occupied by soul is never as low as the space of a *paramanu* and as big as the space of *loka*, except at the time just prior to attaining omniscience (*kevali samudgat*). For this reason soul is said to have a medium size. In the psychical order of existence the soul occupies the space of the body it assumes and this should not be confused with the size of soul. The number of *pradesa* of a soul (innumerable) is imaginary and not real, the concept only helps us in defining the size of soul. Truly speaking the soul is one indivisible whole and never suffers any division and reunion.

From the absolute point of view consciousness is the characteristic of soul. This characteristic is not found in any other substance. Soul follows the rule of origination –cessation - permanence as described in Chapter 1. The flow of mutation power of soul is a continuous process. The potential consciousness in each soul is infinite but its manifestation is different in different souls. The explicit intuition power of soul depends on his intuition deluding karma. More are intuition-deluding karmas less is the explicit intuition power and vice versa. However, a minimum fraction of total potential intuition power is always explicit in a soul; otherwise there would be no difference between soul and matter.

The total intuition power and full consciousness are released in the omniscient state, where soul becomes *paramatma*, the all – knowing god. Such a state can be attained by any capable (*bhavya*) soul. All the liberated souls maintain their identity and individual existence and continue to have consciousness as power of intuition and perception, which now are infinite. The embodied existence of soul and the related aspects of age, ailments, shape, pleasure and pain, contraction and expansion are all governed by karma. These phenomena become irrelevant when all karmas are destroyed and soul attains liberation. The liberated soul is therefore called *sad-chit-anand* i.e. one who enjoys permanent bliss. Liberated souls being body less do not experience any kind of vibrations; they are in the state of eternal calm having infinite power of intuition, perception, vitality and permanent bliss. All liberated souls are alike, fully developed, perfect and independent. There is no other power (God) controlling these liberated souls nor are these souls a part of a super soul as is generally believed in some other faiths. A liberated soul is pure and is never reborn. All embodied souls are impure and have a cover of karma. Liberated souls are free of karma.

4.2 Classification of Soul

Primarily souls are of two types, the liberated souls (substantial reality) and mundane souls (psychical order). The mundane souls are further classified as follows.

(i) Active souls (*vyavahara rasi*) and Inactive souls (*avyavahara rasi*)

Active souls are the psychical order souls who assume different kind of modes in accordance with their karmas and who take birth anywhere in the *loka*. Inactive souls are confined to the bottom part of lower *loka* (*nitya nigod,* see fig 6.4). Their modes always belong to the least developed category of nano organisms called *nigod*. Their lifespan is so short that in a period of one heartbeat they complete seventeen life cycles. An inactive soul *comes* out of *nitya nigod* and becomes and active soul when a soul in *loka* is liberated. Thus the number of active souls (mundane) in *loka* is always same. In this process the number of liberated souls increases and the number of inactive souls decreases. The total number of liberated souls is infinite and the total number of inactive souls is infinitely infinite. Thus there is an inexhaustible stock of inactive souls

whose population shall not materially change at any time in future, even after migration of infinite souls to active category. All inactive souls are alike.

(ii) Souls capable of liberation (*bhavya Jiva*) and souls not capable of liberation (*abhavya jiva*).

Some souls are capable of liberation and some are not. However, there is no test to find out which soul is capable and which is not capable of liberation. This is known only to omniscient.

(iii) Mobile beings (*trasa jiva*) and immobile beings (*sthavar jiva*). Mobile beings are found in the central region of the *loka* known as *trasnadi* (see fig 6.4). The immobile beings are found all over *loka*. The *nitya – nigod jiva*s are also immobile beings. Immobile beings have only one sense.

(iv) Subtle (micro and nano) organisms (*suksma jiva*) and gross organisms (*badar jiva*)

The subtle organisms are not visible to naked eyes. They may be immobile like nano organisms or mobile like bacteria and archaea (comparatively gross micro organisms). Gross organisms are visible to naked eye. They range from one sense plant and vegetation to five sense beings.

(v) Organisms having mind (*samanaska*) and organisms without mind (*amanaska*)

Normally five sense organisms have mind. All organisms having one to four sense and also some five-sense organisms do not have mind. All human beings and terrestrial, aquatic and aerial animals have got mind. Organisms without mind also do possess some thinking ability but that is negligible.

4.2.1 Classification of soul based on birth

Souls are of four types according to birth

1. Infernal beings (*Naraki*)

The souls living in hell are infernal beings. The hellish lands are contained in the lower *loka* (see fig 6.4). The souls in the middle *loka* who are very cruel, wicked and evil minded take birth in hell. The infernal beings are subjected to physical and mental torture and suffer the rages of heat and cold.

2. Animals

Animals are the biggest group among active souls. All souls having one to four senses necessarily belong to animal category. They include organisms like worms, ants, fly, insects etc. Higher animals have five senses. They include terrestrial and aquatic beings and birds. The five sensed animals generally have mind. Some animals are supposed to have asexual spontaneous birth (*sammurchan*) and such organisms do not have mind. They are also underdeveloped and have a short span of life.

3. Human beings

Humans are highest developed and capable beings. Human beings are of three kinds (i) born on land of action (ii) born on land of inaction and (iii) having birth by agglutination (*sammurchim*). Humans born on a land of action make their living by productive efforts employing skills of agriculture craft, trading, reading, writing, defending and self protection, etc. Humans on lands of inaction are born in pairs of male and female and depend on trees (*kalpvriksa* providing fruits, vegetables and other needs) for their living. These humans are simple, sweet natured and

soft speaking. Souls taking birth by agglutination are humans only for the namesake; they are microscopic and born in excreta and urine of human beings in highly undeveloped state and have a very short span of life.

Human beings have the controlling role in this world. Humans are discovering nature generating vast amount of knowledge and information, and are inventing machines, and aids for their physical and mental help and pleasure. Human beings only, among all organisms, have the capacity and abilities to acquire super natural powers through meditation and spiritual efforts. The total population of human beings is less than the population of infernal beings or celestial beings. Life as a human being is a rare possibility and is highly valuable.

4. Celestial beings (*Devas*)

Celestial beings live in heavens. Their bodies are made from luminous material. Celestial beings enjoy high degree of pleasure and prosperity and possess super natural powers of many kinds. They have a long span of life; on expiry of life span a celestial being is not born in heaven again. Similarly an infernal being is not reborn in hells. That is, both of these kinds of souls are reborn in middle *loka* (Earth like planets). The human and animals that are found in middle *loka* can be reborn in any part of *loka*.

4.2.2 Six Classes of Souls

The six classes of souls are – earth body soul, water body soul, fire body soul, air body soul, plant body soul and mobile souls. This kind of classification of souls is unique to Jain philosophy. Lord Mahavira gave this classification from his "direct" observation of nature by his power of omniscience. He could see the minutest form of life. He could see that there are innumerable numbers of lives in a tiny particle of earth or a drop of water, that they all breathe, take food and have a life span. He offered a detailed description as to their birth, life after death, cognizance power, passions, etc.

1. Earth Body Soul

The earth is the body of earth body soul. The earth, salt, gold, mica and all other minerals etc. are earth body souls. The earth, minerals etc, according to Jain philosophy, have consciousness before processing. The total number of earth body souls is innumerable. Earth body souls mainly fall in two groups – subtle (*suksma*) and gross (*badara*). The subtle earth body souls are not visible to naked eyes and the gross souls have bodies made up of large visible aggregates. The minimum life span of earth body soul is less than one Indian hour (*muhurt*) and the maximum span is 42000 years. Earth body souls are destroyed by cold, heat, salt, acid, alkali and electric charge. Both groups of earth body souls can be present in developed or under developed form.

2. Water body Soul

The flowing water is the body of water body souls. Dew, ice, fog etc. are water body souls of gross type. Water body souls are also innumerable in *loka*. They are destroyed in the same way as earth body souls. Before processing water has consciousness, the minimum life span of water body soul is less than one Indian hour and the maximum span is seven thousand years. All subtle water body souls are alike and found all over *loka*. Gross water body souls are of various kinds as mentioned earlier. Both types can be present in developed and underdeveloped form.

3. Fire Body Soul.

Fire is the body of fire body souls. Some examples of fire body souls are burning fuel, sparks, flames, meteorites, etc. These souls are also innumerable in *loka*. They are destroyed in the same way as earth body souls and possess consciousness before destruction. Their minimum life span is less than one Indian hour and the maximum span is three days. All subtle fire body souls are alike and the gross souls are of different forms as mentioned. Both classes can be developed and underdeveloped types.

4. Air Body Soul

The flowing air is the body of air body souls. Hurricanes, typhoons and wind storms are some examples of gross air body souls. Air body souls are also innumerable in *loka* and have consciousness before processing. Both subtle and gross air body souls can be developed and underdeveloped type. The minimum life span is less than an Indian hour and the maximum span is three thousand years.

5. Plant Body Soul (*Vanaspatikaya*)

The plant and vegetation are bodies of plant body souls. Plant body souls are of two kinds' solitary body soul (*pratyeka vanaspati*) and common body soul (*sadharana vanaspati*). The soul who is the sole owner of the body is called solitary plant body soul. When more than one soul has a common physical body, the plant is called common body soul. In such cases the breathing process, food, age and body are common to all souls living in that body. It may be noted that there may also be many souls who depend on the body of a solitary body soul but in that case they enjoy individual independent lives and have no body in common. The examples of solitary body plant soul are:

Tree	Mango, banyan, etc.
Grass	Soft grass, etc.
Green vegetables	Spinach, etc.
Plants growing in water	Lofurs, etc.

All bulbous roots, roots of various sorts and sprouts are common body plant *jiva*s.

Plant body souls grow in eight ways:

1. Top seed	Plant in which the top is the seed.
2. Root seed	Plant in which the root is the seed e.g. carrot
3. Joint seed	Plant in which the joint is the seed e.g. sugar cane
4. Body seed	Plant in which the body is the seed e.g. potato
5. Seed plant	Plants growing from a seed e.g. wheat
6. Spontaneous plant	Plants which grow without sowing e.g. sprouts
7. Fodder	Vegetation like grass, etc.
8. Creepers	Plants like jasmine, watermelon, etc.

Plants are subtle and gross type. The above are all gross plants. The subtle plants called *nigod* are minutest form of microorganisms, we call them nano organisms. Microbiology also regards some types of virus as plant life. This finding of science is in agreement with the Jain belief. According to Jain philosophy infinite numbers of nano organisms, called *nigod*, live in a micro body. For instance, the tip of a needle is supposed to accommodate infinite divisions of a body and one division has infinite parts. Each part has infinite living places and each place contains infinite micro bodies. Each micro body has infinite nano organisms. All these nano

organisms are born together, die together, breathe together and eat together. Their physical body is common but the subtle bodies, *tejas* and *karman*, are individual. When an inactive nano organism comes out of *nitya nigod* as mentioned earlier, it is first born as a gross plant and becomes an active soul. The minimum life span of a plant body soul is less than one Indian hour and the maximum span is ten thousand years. All plant body souls have consciousness before processing.

Plant body souls have ten instincts.

1. Food instinct. All plants consume water etc. and so they possess food instinct. The parasitical creeper (*cassyta filiformis*) draws water from the trees it climbs on. Some trees are found to suck blood of mobile beings. These are signs of food instinct in plant body souls.
2. Fear instinct. Some plants like *mimosa pudica* contract when touched.
3. Sexual instinct. Some trees like *tilak* (small tree having bright red or orange flowers), *campa*, etc. bear flower and fruits on coming in contact with females. The tree *totesia asoka* feels pleasure in coming in contact with females. This shows sexual instinct in plants.
4. Attachment instinct. The roots of wood-apple tree, *dhak* tree (*butea frondosa*), etc. spread over hidden treasure. The Creepers hold the trees with their filaments.

5- 8. Anger, ego, deceit and greed instincts. The red water- lily plant shouts with anger. A kind of creeper (*sidati*) decays due to ego. Creepers cover their fruits with leaves etc, and try to deceive the observer. The attachment instinct of wood- apple tree and *dhak* tree are examples of greed.

9. Access instinct. Creepers decide their way up a tree.
10. Time (light) instinct. The lotus flowers close during nights. So plants have time instinct.

The earth body, water body, fire body and air body souls have three bodies- the physical, *tejas* and *karmana*. The air body souls also have fluid body (*vaikriya*). They possess four powers of development (*paryapti*), four vital powers (*prana*), and three attentive consciousnesses – empirical, articulate ignorance and non-visual perception. Their consciousness is so latent that we cannot detect the pleasure and pain they experience.

6. Mobile beings (*Trasakaya*)

All mobile beings with two to five senses are *trasakaya*. Mobile beings can move forward and backward, contract and expand, produce sound, move around and run in defense, get frightened, etc. All infernal beings, celestial beings, animals and humans are mobile beings. Mobile beings are found only in the *trasnadi*, the central region of *loka*.

Mobile beings having two to four senses are classed as deficient creatures.

Two- sense creatures – have the senses of touch and taste. Small insects, shell, conch shell, earthworm and other worms are some examples of two sense creatures.

Three- sense creatures – have the senses of touch, taste and smell. Ants, bed bugs, scorpions, pests, louse, etc. are some three-sense creatures.

Four sense creatures – have the senses of touch, taste, smell and vision. Flies, mosquitoes, black beetle, bee, locust etc. are four sense creatures.

Five sense beings. These beings are born either by womb or agglutination. Both of these kinds are aquatic, terrestrial, or aerial creatures. Fish, turtle, crocodile, etc. are aquatic creatures.

The terrestrial creatures are of two types - quadruped animals and reptiles. The quadruped animal are again of four types – (i) Single hoof animals like a horse (ii) Two hoof animals like an ox, (iii) Padded foot animals like an elephant and (iv) animals with paw like lions. The reptiles are of two types – reptiles with arms like lizard and creeping reptiles like snakes. The birds are of four types – (i) birds having skin feathers like a bat (ii) birds like goose (iii) birds having wavy feathers, and (iv) birds with big feathers (*vitat paksi*- these are not found on Earth). Based on the type of birth the mobile beings are of eight types.

1. Oviparous. They are born from eggs like birds.
2. Vertebrates- born without placenta such as elephants.
3. Viviparous. They are born with placenta e.g. cow, humans.
4. Fermentation origin. Worms and bacteria produced in curd, juice etc. by fermentation.
5. Sweat origin. Produced from sweat, e.g. louse etc.
6. Birth by agglutination. They have asexual birth e.g. flies, ants etc.
7. Sprouting animals. They are produced below earth surface e.g. locusts.
8. Instantaneously manifested body. They are non fetus beings e.g. celestial and infernal beings.

All creatures having one to four senses, five sense beings without mind and infernal beings are necessarily hermaphrodites. Celestial beings have male and female category (and no hermaphrodites). The human beings and animals have all three categories i.e. male, female and hermaphrodite.

In a land of action (*karma bhoomi*) the five sense animals have birth by womb as well as agglutination but in a land of enjoyment (*bhog bhoomi*) the birth takes place by womb only. The beings having non-fetus or fetus birth are matured but those having agglutination birth are non-matured (*aparyapta*).

4.3 Food (Nourishment)

Food is an essential need of all organisms. The food is of three types; luminous food (*ohja ahara*), skin food (*roma ahara*) and alimentary food (*kavala ahara*). The luminous food is the need of the subtle body and is received by *tejas and* karma bodies. The skin food is taken in every moment through skin in a continuous process. The alimentary food consists of eatables, drinks and other items we take by mouth.

1. Plants

Plants get their nourishment from the land they grow on. The constituents of the earth, water, sunlight, air (carbon-di-oxide) and the plant waste (manure) are the means of nourishment. The electric charge present in earth also provides nourishment to plants. Some trees also attract mobile creatures in their near vicinity for food. Such plants suck the fluid content of their prey and kill them. The colour, odour, taste and touch attributes of the earth influence the quality and growth of plants. For instance, a mango tree gives mangoes of different colour, taste, shape etc. when properties of earth, water, climate and seed etc. differ.

2. Human beings

The seed (first cell) and womb are governing factors determining the birth of human beings. The soul chooses his parents in accordance with his karmas. The karmas of a soul may also motivate parents to engage in sexual activity so that conception takes place. The karma and *tejas*

bodies of the soul occupy the first cell produced by the union of egg and sperm cells of parents. Thus a new birth takes place either in the form of male, female or hermaphrodite. The egg and sperm cells of parents thus provide the first food to soul. Thereafter the soul accepts a part of nourishment taken by mother. On completion of the pregnancy period the soul comes out of the womb and birth takes place. In the infant age the soul feeds on mother's milk. On growing up the cereals, vegetables, fruits, meat etc. become food for nourishment. In addition to this, soul also needs earth constituents – like minerals etc., water, sunlight, and air for his life and growth. All these inputs are converted into suitable products that become a part of body of the soul. The material contents of the bodies of human beings have different colour, smell, taste; touch and shape and therefore bodies exist in a wide variety of colours, shapes and forms.

The characteristic like male, female or hermaphrodite of humans is due to the karma of a soul. There is no rule that a female after death is reborn as female or male is reborn as male. The karma decides the first cell to be received from parents and the type of body in the next birth of soul. The necessary condition for birth is that the egg and sperm cells of parent are not deficient in any way and are suitable for birth. A male is born when sperm cells are more than egg cells, a female is born when egg cells are more than sperm cells and a hermaphrodite is born when the two cells are in equal quantity. Normally a male child is born when the fetus is on right side and a female child is born when fetus is on left side of womb. A hermaphrodite is born when the fetus is in the middle of the womb.

The infernal beings enjoy their bad deeds and the celestial beings enjoy their good deeds as food. Both of these beings take luminous food only for their nourishment. The luminous food of infernal beings consists of bad matter particles (*varganas*) and that of celestial beings consists of good matter particles. The luminous food is of two types – first which has a continuous input and the second that has a discontinuous input. The minimum input interval is four time segments and the maximum input interval is thirty three thousand years.

3. Five sense animals.

The birth and nourishment methods of five sense animals are similar to human beings except that the first nourishment varies with the kind of animal as follows.

(i) The aquatic beings have the first nourishment of water body souls.
(ii) The terrestrial animals receive the first nourishment of the sperm and egg cell of the parents.
(iii)The creeping reptiles have the first nourishment of air body souls.
(iv)The armed reptiles also have the first nourishment of air body souls.
(v) The birds get the first nourishment from the heat of the body of mother.

4. Deficient Mobile Creatures

These creatures have the first nourishment of excreta, urine, sweat, blood, pus etc. of the animals and that that is present in the surrounding areas they are born in.

4.4 Embryology

The species of a soul is pre decided. This means that the kind of body a soul is going to get is decided in his previous life. The *naam* karma of the soul bonded in the previous life determines the *gati*, the class of life viz., infernal, celestial, animal or human, *jati viz.* number of senses, the type of body that is species, and the structure of body in this life. In the transit period between two

lives the soul is equipped with psychical sense though it does not have sense organs. So, the soul has sense perceptions right from the time of conception when the physical organs are not formed.

The first nourishment of soul consists of the seed cell produced by the union of sperm and egg cells of parents. The life begins from this seed cell. The first nourishment is, in fact, considered to be a luminous type. The skin nourishment starts right in the womb when the body parts of the fetus are formed and afterwards it continues throughout the life. The fetus does not take in alimentary food; it depends for nourishments on mother for its growth. The fetus draws only the essential elements from the diet of mother and does not share food as such. The internal parts like stomach etc do not come in contact with air and so stool, urine and gas, are not produced (or produced in a negligible amount) in the body of a fetus. The breathing by fetus is connected to breathing of mother. The food elements and oxygen from mother's body are transported through placenta. The carbon dioxide, urea etc. produced in fetus are transported back to mother's body in the same way. The food and breathing activities of fetus are thus not independent, they are related to food intake and breathing by the mother.

Besides the process of natural conception Jain philosophy also describes methods of artificial conception. The Sthananga canon describes five such methods. All these methods essentially involve artificial means of transplanting sperm cells in the womb. It is said that up to nine hundred thousand souls can take birth at a time in the womb of a female. Most of them die before conception. The pregnancy period in human females varies from less than an Indian hour to a maximum of twelve years. The maximum period of pregnancy in animals is eight years.

4.5 Birthplaces (*Yoni*) and Species

There are 8.4 million birthplaces (*yoni*). The number of species is much greater as more than one species (*kula*) can take birth in one birthplace. For instance, dung is a birthplace. Species like worm, insect etc. can be born in dung. The total number of birthplaces and species are given below.

Soul Category	Birthplaces (Millions)	Species (Millions)
1. Earth body soul	0.7	1.2
2. Water body soul	0.7	0.7
3. Fire body soul	0.7	0.7
4. Air body soul	0.7	0.7
5. Common body plants	1.0	
6. Solitary body plants	1.4	2.8
7. Two sense organisms	0.2	0.7
8. Three sense organisms	0.2	0.8
9. Four sense organisms	0.2	0.9
10. Five sense animals	0.4	
Aquatic creatures		1.25
Birds		1.20
Terrestrial animals		1.00
Creeping reptiles		0.90
Armed reptiles		0.90
11. Human beings	1.4	1.2

12. Infernal beings	0.4	2.5
13. Celestial beings	0.4	2.6
Total	8.4	20.05

4.6 Biopotential (*Paryapti*)

Biopotential is the power for development acquired by a soul at the beginning of life cycle. When soul takes rebirth a new body is to be built using suitable materials. The power to develop this new body is called biopotential. These bio potentials exist due to fruition of bio potential naam karma. Biopotentials are of six kinds.

1. Food biopotential. Food biopotential is the power for soul to receive food, convert this food into appropriate constitutes like solids and fluids useful for body, and discharge the residue. This potential power is used in building the physical body, fluid body (*vaikriya sarira*) and migratory body (*aharaka sarira*).
2. Body biopotential. Body biopotential is the power to use the fluid and solids for building the body components. The fluids make seven elements like liquid components, blood, flesh, fat, marrow, and sperm / egg. The solids make bones and other strong components.
3. Sense organ biopotential. This biopotential is used to form the sense organs from the seven fluid elements.
4. Respiration biopotential. This biopotential assists in making the respiration system.
5. Speech biopotential. This biopotential develops the system for speech production and transmission.
6. Mind biopotential. This biopotential enables receipt of subtle matter for making the mind (i.e. *mano vargana* and perhaps also *tejas vargana*) and rejecting the useless subtle matter. This biopotential also develops the power of thinking, imagination and analysis.

All bio potential powers start developing simultaneously, that is, all powers develop in parallel. The process is fast and the development is completed in less than one Indian hour. However, the time of completion of development of each power is different, but it is within one Indian hour. The food bio potential is completed in the first instant and the cell produced by union of sperm and egg cells becomes the body of the soul.

A soul who develops all the six powers completely is called fully developed (*paryapta*). Otherwise the soul remains undeveloped (*aparyapta*). The two to four sense creatures and five sense organisms without mind have first five biopotential powers and the five sense beings having mind have all the six powers.

4.7 Vital Power (*Prana*)

Vital power is essential for life. Association of vital power keeps the body live and its disassociation causes death. There are ten vital powers.

1. Touch sense vital power.
2. Taste sense vital power.
3. Smell sense vital power.
4. Vision sense vital power
5. Hearing sense vital power.
6. Mind vital power.
7. Speech vital power.

8. Body vital power.
9. Respiration vital power
10. Age vital power.

These are physical vital powers (*dravya prana*) possessed by all mundane souls. The eternal existence, consciousness, bliss and perception are the metaphysical vital powers (*bhava prana*). These are the real powers without which there is no existence of the soul. Mundane souls possess physical vital powers and metaphysical vital powers in impure state. Liberated souls have pure metaphysical vital powers.

The vital powers are the fundamental basis for life. The vital powers and biopotentials have the cause and effect relationship. Without vital powers the biopotential powers cannot develop. Vital powers in sufficient measure are needed for full development of biopotential powers A soul lacking in vital powers can not develop all biopotential powers and remains undeveloped. All the body processes like nourishment of various kinds, and others, mind processes etc. are accomplished with the help of both the vital powers and biopotential powers. Vital powers remain ineffective in the absence of bio potential powers. Thus both kinds of powers are essential to soul.

The vital powers in different kinds of souls are as follows.

1. One-sense souls – Touch, body, respiration and age vital powers.
2. Two-sense creatures – Touch, taste, body, respiration, age and speech vital powers (6 vital powers)
3. Three-sense creatures – 6 vital powers and smell vital power (7)
4. Four-sense creatures – 7 vital powers and vision vital power (8)
5. Five-sense beings without mind – 8 vital powers and hearing vital power (9)
6. Five-sense beings with mind – 9 vital powers and mind vital power (10).

4.8 Concept of consciousness in west

Consciousness is a quality of mind generally regarded to comprise qualities such as subjectivity, self-awareness, sentience, sapience, and the ability to perceive the relationship between oneself and one's environment. It is a subject of much research in philosophy of mind, psychology, neuroscience, and cognitive science.

Some philosophers divide consciousness into phenomenal consciousness, which is experience itself, and access consciousness, which is the processing of the things in experience. Phenomenal consciousness is the state of being conscious, such as when we say "I am conscious." Access consciousness is being conscious of something in relation to abstract concepts, such as when we say, "I am conscious of these words". Various forms of access consciousness include awareness, self – awareness, conscience, stream of consciousness, Husserl's phenomenology, and intentionality. The concept of phenomenal consciousness is closely related to the concept of qualia. In common parlance, consciousness denotes being awake and responsive to one' environment, this contrasts with being asleep or being in coma. The term 'level of consciousness' denotes how consciousness seems to vary during anesthesia and during various states of mind, such as day dreaming, lucid dreaming, imagining, etc. Non-consciousness exists when consciousness is not present. Phenomenal consciousness (P- consciousness) is simply experience it is moving, coloured forms, sounds, sensations, emotions and feelings with our bodies and responses at the center. These experiences, considered independently of any impact on behaviour, are called qualia.

Access consciousness (A-consciousness) is the phenomenon whereby information in our mind is accessible for verbal report, reasoning, and the control of behaviour. So, when we perceive information about what we perceive is often access consciousness; when we introspect, information about our thoughts is access consciousness, when we remember, information about the past (e.g. something that we learned) is often access consciousness, and so on. Chalmers thinks that access consciousness is less mysterious than phenomenal consciousness, so that it is held to pose one of the easy problems of consciousness. There have been numerous approaches to the processes that act on conscious experience from instant to instant. Daniel Dennett (1988) suggests that what people think of as phenomenal consciousness, such as qualia, are judgments and consequent behaviour. He extends this analysis (1996) by arguing that phenomenal consciousness can be explained in terms of access consciousness, denying the existence of qualia. Events that occur in the mind or brain that are not within phenomenal or access consciousness is known as subconscious events.

When we look around a room or a have a dream, things are laid out in space and time and viewed as if from a point. However, when philosophers and scientists consider the location of the form and contents of this phenomenal consciousness, there are fierce disagreements. As on example, Rene' Descartes proposed that the contents are brain activity seen by a non- physical place without extension, which, he identified as the soul. This idea is known as Cartesian Dualism. Another example is found in the work of Thomas Reid who thought the contents of consciousness are the world itself, which becomes conscious experience in some way. This concept is a type of direct realism. Other philosophers, such as George Berkeley, have proposed that the contents of consciousness are an aspect of minds and do not involve matter at all. This is type of Idealism. Yet others, such as Leibniz, have considered that each point in universe is endowed with conscious content. This is a form of Panpsychism. Panpsychism is the belief that all matter including rocks for example, is sentient or conscious. The concept of the things in conscious experience being impression in the brain is a type of representational and representational is a form of direct realism. Some philosophers, such as David Armstrong and Daniel Dennett, believe that qualia exist in terms of judgments or beliefs about things in the world, and are therefore meaningless when separated from behaviour, while other philosophers insist that qualia cannot be understood in terms of belief. Dennett believes that "ineffable, intrinsic, private" qualia do not exist however; he does not believe that we lack conscious, phenomenal experience.

It is sometimes held that consciousness emerges from the complexity of brain processing. The general label 'emergence' applies to new phenomena that emerge from a physical basis without the connection between the two explicitly specified. Some theorists held that phenomenal consciousness poses an explanatory gap. Colin McGinnis takes the New Mysterianism position that it can't be solved; the Chalmers criticizes purely physical accounts of mental experiences based on the idea that philosophical zombies are logically possible and supports property dualism. But others have proposed speculative scientific theories to explain the explanatory gap, such as quantum mind, space-time theories of consciousness, the Electromagnetic theories of consciousness to explain the correspondence between brain activity and experience. Parapsychologists sometimes use the unproven concepts of psycho kinesis or telepathy to support the dualism belief that consciousness is not confined to the brain.

Modern physical theories of consciousness can be divided into three types; theories to explain behaviour and access consciousness, theories to explain phenomenal consciousness and theories to explain the quantum mechanical (QM) Quantum mind. Theories that seek to explain behaviour are an everyday part of neuroscience, some of these theories of access consciousness, such as Edelman's theory, contentiously identifies phenomenal consciousness with reflex events in the brain. Theories that seek to explain phenomenal consciousness directly, such as space – time theories of consciousness and Electromagnetic theories of consciousness, have been available for almost a century, but have not been confirmed by experiment. Theories that attempt to explain the QM measurement problem include Pribram and Bohm's Holonomic brain theory, Hameroft and Penrose, Orch-OR theory, Spin – Mediated Consciousness Theory and the Many-minds interpretation. Some of these QM theories offer descriptions of phenomenal consciousness, as well as QM interpretations of access consciousness. None of the quantum mechanical theories has been confirmed by experiment and there are philosophers who argue that QM has no bearing on consciousness. There is also a concerted effort in the field of Artificial Intelligence to create digital computer programs that can simulate consciousness.

Chris King (2003) states, that all quantum objects are constantly faced with bifurcations, which force the system to operate choices. According to King, a new and innovative description of the relation between mind and brain derives from this constant state of choice in which living structures are immersed. This constant state of choice would force living systems into a free will, which would be common to all the levels and structures of life, from molecules to macrostructures, and organisms. This constant state of free will, would originate chaotic dynamics, which organize in fractal structures. Starting from these premises King suggests two separate levels of explanations of consciousness. In first level, information flows from mind to the brain, through free will; in the second level, information flows from the brain to the mind. King considers mind to be immaterial, and its organization would be the consequence of the cohesive properties of – E (syntropy).

People generally agree that our fellow human beings are conscious, and those much simpler life forms, such as bacteria, are not. Many scholars attribute consciousness to higher – order animals such as dolphins and primates; academic research is investigating the extent to which animals are conscious. This suggests the hypothesis that consciousness has co-evolved with life, which would require it to have some sort of added value, especially survival value. People have therefore looked for specific functions and benefits of consciousness. Bernard Boars (1997), for instance, states that "consciousness is a supremely functional adoption" and suggests a variety of functions in which consciousness plays an important, if not essential, role; prioritization of alternatives, problem solving, decision making, brain processes recruiting, action control, error detection, planning, learning, adoption, context creation, and access to information. Autonio Damasio (1999) regards consciousness as part of an organism's survival kit, allowing planned rather than instinctual responses. He also points out that awareness of self allows a concern for one's own survival, which increases the drive to survive, although how far consciousness is involved in behaviour is an actively debated issue. Many psychologists would maintain that behaviour can be explained by consciousness processes akin to artificial intelligence, and might consider consciousness to be epiphenomenal or only weakly related to functions.

Ervin Laszlo argues that self – awareness, the ability to make observations of one self, evolved. Emile Durkheim formulated the concept of so called collective consciousness, which is essential for organization of human, social relations. The accelerating drive of human race to explorations, cognition, understanding and technical process can be explained by some features of collective consciousness and collective intelligence.

4.9 Biological Classification of life

According to biology living organism is qualitatively distinct from the non-living matter. Some unique biological laws govern functioning of the former. The essence of living organism is the set of principles determining the transmission of genetic information from one generation to next. Living organisms are composed of the same constituents as rest of earth, but it possess, besides free will, which is the characteristic of life, all of the following attributes; organization, excitability, conductivity, contractibility, metabolism, growth and reproduction. Non-living matter may possess one or more of these, but not all, also. In biology the life has been classified on the basis of origin and body structure processes etc. Biological sciences have broadly been divided into Botany dealing with plants, and Zoology dealing with animals. Animal life again has two divisions (i) protozoa, which are multi cellular organisms and (ii) metozoa which are single cellular organisms not visible to eye. On the basis of spinal column the animals are classified as (i) vertebrates like marine animals, amphibians, birds and mammals, and (ii) invertebrates like amoeba, hydra, insects, star fish, shells etc. The animals are also classified on the basis of body structures like, eumetazoa bilaleria, deuterostomia, chordata, echinodermata, protostomia, lophotrochozoa, lophophorates, nemertea, trochozoa, platyhelminthes, mollusea, ecdysozoa, arthropoda, nematoda, ctenophora, chidaria and porifera.

Vertebrata is a subphylum of chordates, specifically, those with backbones or spinal columns. Vertebrata contains most animals with which people are generally familiar (except insect). Fish, amphibians, reptiles, birds and mammals are vertebrates. Defining characteristics of a vertebrate are backbone or spinal cord, a brain case, and an internal skeleton. The skull is thought to have facilitated the development of intelligence as it protects vital organs such as the brain, the eyes and the ears. The central nervous system of a vertebrate consists of the brain and the spinal cord. Both of these are characterized by being hollow. In lower vertebrates the brain mostly controls the functioning of the sense organs. In higher vertebrates the size of the brain relative to the size of the body is greater. This larger brain enables more intensive exchange of information between different parts of the brain. Vertebrates are called *samanaska* beings in Jain philosophy.

Plants also form a large part of life in nature. On the basis of body structures the plants are of two types (1) flowering plants and (2) non flowering plants. The flowering plants called angiosperms form the largest section and make up around 80 percent of all the living plant species on Earth. They are divided in seventeen orders: apiales, asterales, ericales, fagales, hamamelidales, juglandales laurales, magnoliales, malvales, papaverales, piperales, primulales, ranunculales, rosales and salicales. The non-flowering plants fall in four groups:

i. Mosses and Liverworts – These types of plants have no roots, leaves or stems.
ii. Tracheophytes – this group of plants has roots, stems and leaves.
iii. Ferns – Ferns do not have seeds. They have spores.
iv. Conifers and Cycads – These plants are gymnosperms. They have seeds, but no flowers.

4.10 Nutrition and Respiration

Nutrition

The process of nutrition involves the taking of food inside the body and converting it into smaller molecules, which can be absorbed by the body. Food is kind of fuel which provides energy to all the living organisms. Nutrition is a process of intake of nutrients, like carbohydrates, fats, proteins, minerals, vitamins and water, by an organism as well as the utilization of these nutrients by the organism.

Basically these are two modes of nutrition, autotrophic and heterotrophic

Autotrophic Nutrition

It is a type of nutrition in which the living organism manufactures their own organic food from simple inorganic raw materials like carbon dioxide and water present in the surroundings with the help of sunlight. The green plants have an autotrophic mode of nutrition. The autotrophic bacteria also obtain their food by this mode. Green plants obtain the energy from solar radiation. The process is called photosynthesis and occurs in the presence of chlorophyll. The organisms capable of photosynthesis are termed phototrophs. Certain bacteria obtain energy from exergonic chemical reactions for the synthesis of organic substances. These organisms are called chemoautotrophs. The process of preparing organic food with the help of energy from chemical reactions is known as chemosynthesis.

Heterotrophic Nutrition

Animals, fungi, some protists (amoeba) and many bacteria lack chlorophyll and cannot utilize sun energy. They use chemical bond – energy of organic molecules synthesized by other organisms in building their own organic molecules. This is called heterotrophic nutrition. They get organic molecules by taking plants or animals (living or dead) or their products, and obtain energy by "burning" these molecules in their body.

Heterotrophic nutrition is of three types.

1. Saprotrophic Nutrition (*Roma ahara*). Many organisms absorb fluid food through the body surface. This is called saprotrophic or absorptive nutrition. Bacteria and fungi (like moulds, mushrooms, yeast) flourish on dead, decaying organic matter both plant and animal origin. Some parasitic protists, such as trypanosoma, and a few invertebrates, such as tapeworms, live in a medium that contains simple organic compounds ready for absorption and straight away absorb them.

2 Holotrophic Nutrition (*Kavala ahara*). – Majority of invertebrates and all vertebrates take plants, animals or their products through the mouth and break up the large organic molecules into smaller ones in their own body with the help digestive enzymes. This mode of taking solid or fluid organic food via mouth is called holotrophic or ingestive nutrition. The animals may take plants, or other animals, or both as food, and are respectively called herbivores (rabbit, cow), carnivores (lion, tiger) and omnivores (sparrow, man). Some animals take one type of food when young and a different type when adult. For example, frog is herbivores in the larval stage and carnivores in the adult stage. Amoeba is a unicellular animal. In unicellular animals, the single cell performs all the processes of nutrition. Amoeba eats tiny (microscopic) plants and animals as food that floats

in water in which it lives. Amoeba has no mouth and ingests food by using its pseudopodia. The mode of nutrition in Amoeba is holozoic.

3 Mixotrophic Nutrition.

Euglena carries on autotrophic and soprotrophic nutrition at the same time. This is called mixotrophic nutrition.

Heterotrophic plants are broadly categorized into three main groups, depending upon the source from which they get their nourishment – saprophytes, parasites and insectivores (or carnivores) plants.

1. Saprophytes – These plants grow and live on dead decaying organic matter including animal and plant remain. The saprophytes include a large number of fungi, bacteria, a few algae, mosses, peteridophytes and some angiosperms

2. Parasites-

The parasitic plants grow and obtain their nutritional requirements from other living organisms (hosts). There are two main categories of parasitic angiosperms.

(i) Total or holoparasites. The parasites, which are non-green and obtain their total food from hosts, are called holoparasites.

(ii) Partial or semi-parasites. They are green and can synthesize their own food but depend on host for water and mineral supply.

3. Insectivores (or carnivores) plants.

Most green plants derive their nitrogen – from the soil as solutes conducted through the root system. However, some of them obtain nitrogen from captured animal prey. Such plants are called carnivores or insectivores plants. In fact, these plants do not live solely on the captured animals as they can manufacture their own organic food with the aid of chlorophyll present in their leaves and stems. They are therefore, partly autotrophic and partly heterotrophic.

Respiration

The process of respiration involves taking in oxygen into the cells, using it for releasing energy by burning food, and then eliminating the waste products, carbon dioxide and water, from the body. Respiration is essential for life because it provides energy for carrying out all the life processes, which are necessary to keep the organism alive. Respiration includes breathing as well as the oxidation of food in the cells of the organism.

Most of the earth's oxygen occurs in the air, but some is dissolved in water. Thus, air or water may serve as the source of oxygen for the animals.

Aerobic respiration: In most animals and plants, respiration involves use of molecular oxygen and release of carbon dioxide simultaneously. Such a respiration is called aerobic respiration. The organisms, which carry on aerobic respiration, are termed aerobes.

Anaerobic respiration: The process of releasing energy without the use of oxygen is called anaerobic metabolism. It is also termed fermentation. The organisms, which carry on anaerobic respiration, are termed anaerobes. The microscopic organisms like yeast and some bacteria obtain energy by anaerobic respiration. Anaerobic respiration takes place in our muscles also during vigorous physical exercise when oxygen gets used up faster in the muscle cells than can be supplied by the blood.

Direct and Indirect Respiration

Direct respiration: It is the exchange of environmental oxygen with the carbon dioxide of the body cells without special respiratory organs and without the aid of blood. It is found in acrobic bacteria, protists, plants, sponges, coelenterates, flatworms, roundworms and most arthropods. All the parts of a plant perform respiration individually. It occurs at a slow rate. Amoeba and Planaria breathe through their cell membranes. The earthworm absorbs the oxygen needed for respiration through its moist skin.

Indirect Respiration: It involves special respiratory organs, such as skin, buccopharyngeal lining, gills and lungs, and needs the help of blood. The respiration in the skin, buccopharyngeal lining, gills and lungs is respectively called cutaneous, buccopharyngeal, bronchial and pulmonary respiration. Cutaneous respiration takes place in annelids, some crustaceans and amphibians. It occurs both in water and air. Buccopharyngeal respiration is found in certain amphibians such as frog and toad. It occurs in the air. Bronchial respiration is found in many annelids, most crustaceans, and mollusks, some insect larvae, echinoderms, all fishes and some amphibians. It occurs in water only. Pulmonary respiration is found in snails, some amphibians and in all reptiles, birds and mammals. It takes place in air only.

Photosynthesis is an anabolic process. It produces organic molecules (glucose), having in their bonds chemical energy transformed from the radiant energy of the sun. It occurs in the green cells, during the daytime, and leads to increase in weight. Respiration is a catabolic process. It breaks organic molecules, releasing their bond energy. It occurs in all organisms, at all times, and leads to decrease in weight.

Metabolism

The transformation of energy and matter within the body is called metabolism. Metabolism is of two kinds, (1) catabolism, and (2) anabolism. Catabolism is destructive process in which large organic molecules are broken down into smaller constituents. This usually occurs with the release of energy (usually as ATP)

$C_6H_{12}O_6$ (glucose) + O_2 $\rightarrow$ Usable energy (ATP) + CO_2 + H_2O

Catabolism is characteristic of heterotrophs.

Anabolism is constructive metabolism in which small precursor molecules are assembled into larger organic molecules. This always requires the input of energy (often as ATP). Photosynthesis is anabolic metabolism.

CO_2 + H_2O + Light (energy) $\rightarrow$ $C_6H_{12}O_6$ (glucose) + O_2

4.11 DNA and Genes

The cell is the fundamental structural and functional unit of all living organisms. There are certain differences between the cells of different living beings as well as cells in the different parts of the same organism. All cells contain a fluid called cytoplasm and a nucleus, which are generally enclosed in a cell membrane. Operations within the cells and the coordination among various cells make the being lived. The life of all the living beings is, therefore, based upon the working of the cells.

The nucleus of a cell contains a chemical DNA (deoxyribonucleic acid). All the instructions needed to direct the activities of cell are contained within the DNA. DNA is a

polymer; the monomer units of DNA are nucleotides, and the polymer is known as a "polynucleotide." There are four different types of nucleotides found in DNA, differencing only in the nitrogenous base. The four nucleotides are adermine (A), guanine (G) cytosine (C) and thymine (T). DNA from all organisms is made up of the same chemical and physical components. The DNA sequence is the particular side-by-side arrangement of bases along the DNA strand (e.g. ATTCCGGA). This order spells out the exact instructions required to create a particular organism with its own unique traits. The DNA is normally in the form of a double strand (double helix) where the second strand is complementary to the first strand. That is, in the second strand a sequence such as AGCTTT is replaced by TCGAAA which carries the same information.

The genome is an organism's complete set of DNA. Genomes vary widely in size: the smallest known genome for a free-living (a bacterium) contains about 600000 DNA base pairs, while human and mouse genomes have some 3 billion. Except for mature red blood cells, all human cells contain a complete genome.

DNA in the human genome is arranged into 24 distinct chromosomes, physically separate molecules that range in length from about 50 million to 250 million base pairs. Each chromosome contains many genes, the basic physical and functional units of heredity. Gregory Mendel was the first to realize through extensive experiments with breeding of peas that at the lowest level, inheritance is binary and that there is a minimum unit of inheritance now known as a "gene". Genes are specific sequences of bases that encode instructions on how to make proteins. Genes comprise only about 2% of the human genome; the remainder consists of non-coding regions, whose functions may include providing chromosomal structural integrity and regulating where, when and in what quantity proteins are made. The human genome is estimated to contain about 30000 to 40000 genes.

Gregory Mendel showed that the characteristics of parents are passed on-to their offspring through genes. These genes might produce visible characteristics in offspring, or might be carried for possible transmission to another generation. The children of one set of parents do not inherit all the same characteristics.

The union of two cells, the egg from the mother and the sperm from the father is the beginning, of new individual. These two cells like all other carry within them material that form a definite number of chromosomes. These chromosomes carry heredity factors or genes. Chromosomes are pairs and each chromosome contains 1000 or so genes that also occur in pairs.

The two members of a chromosome appear almost identical in size and shape when they are viewed under a microscope, except for the twenty third pair in the human male. This pair has one large member, called X and one small member, called Y. Every normal male has XY chromosome pair whereas female has XX pair. The normal human sperms are of two types, X and Y. If Y sperm fertilizes an egg, the result will be XY and a male fetus will develop. If an X sperm fertilizes egg, as XX individual or female fetus will develop.

The process of inheritance is based upon the process in which the offspring receives one of each gene pair from each parent. Some genes are dominant and some are recessive. An individual with dominant gene, for a particular characteristic, displays that characteristic whether only one or both genes in the pair are dominant. If a gene is recessive, however, the characteristic associated with it does not show up unless both genes in the gene pair are recessive. In case only one gene in

a pair is recessive, its dominant partner will mark its effect, but the recessive gene may still be passed on to the individual's offspring. A single gene or gene pair produces some characteristics, whereas multiple factor inheritance involves the action of several genes.

Genes are now known to be implemented as sequences of genetic code that direct specific cells to produce a particular protein at a particular time. An essentially infinite number of possible different protein molecules can be produced depending on the particular order of amino acid molecules used in their construction. The code for protein production has been "broken" so that we now know that a three-letter sequence (a codon) is used to specify a particular amino acid (there are 20 amino acids). For instance, the sequence GGC specifies that the amino acid glycine be added to a protein molecule. Start and stop codons mark the beginning and end of a protein coding sequence in a manner startlingly like modern data communications schemes. There are 64 possible codons and only 20 possible amino acids so some redundancy and error correction exists. The regulatory code sequences in genes that specify in which parts of the body and/or at which time a protein will be produced are much more complex and less well understood.

The genetic code has been compared to a blueprint specifying the design of an organism. In fact the genetic code specifies not only the design of the organism but provides for the mechanisms needed to "read" the code and manufacture the components of the organism as well as specifying the procedures needed for the life processes of the finished organism. Simple organisms are completely defined genetically. Each tiny nematode worm has exactly 958 cells. Humans, on the other hand, have trillions of cells and 30000 genes so the genetic code is more of a general plan. For example, major blood vessels are genetically specified. Everybody has an aorta. But minor blood vessels grow where needed according to genetically defined rules.

Although all the somatic cells in an organism contain the complete code, in any given cell only a relatively few genes are active. The difference in the genes that are active determines the difference between, say, liver and brain cells. A complex gene logic determines when and where a particular gene will be "turned on". The gene logic can accommodate varying amounts of positional detail. The gene logic also controls when various activities will take place. Cells divide rapidly in growing organisms but do not divide in adults unless needed to replace dead or discarded cells. (Cancer involves a major breakdown in the gene logic in which cells grow in both an inappropriate position and at an inappropriate time. Cancer is thought to require multiple mutations, some of which can be inherited.)

The early insight from human DNA sequence is summarized below: -

1. Human genome contains 3 billion bases.
2. An average gene consists of 3000 bases.
3. The functions are unknown for more than 50% of discovered genes.
4. The human genome sequence is almost (99.9%) exactly the same in all people.
5. About 2% of the genome encodes instructions for the synthesis of proteins.
6. Repeat sequences that do not code for proteins make up at least 50% of the human genome.
7. Repeat sequences are thought to have no direct functions. But they shed light on chromosome structure and dynamics. Over time more repeats reshape the genome by rearranging it, thereby creating entirely new genes or modifying and reshuffling existing genes.

8. The human genome has a much greater portion (50%) of repeat sequences than the mustard weed (11%), the worm (7%) and the fly (3%).
9. Over 40% of the predicted human proteins share similarity with fruit fly or worm proteins.
10. Genes appear to be concentrated in random areas along the genome, with vast expenses of non-coding DNA between.
11. Chromosome 1 (The largest human chromosome) has the most genes (2968), and the Y chromosome has the fewest (231).
12. Genes have been pinpointed and particular sequences in those genes associated with numerous diseases and disorders including breast cancer, muscle disease, deafness and blindness.
13. Scientists have identified about 3 million locations where single base DNA differences occur in humans. This information promises to revolutionize the processes of finding DNA sequences associated with such common disease as cardiovascular diseases, diabetes, arthritis, and cancers.

Scientists suggest that the genetic key to human complexity lies not in a gene number but in how gene parts are used to build different products in a process called alternative splicing. Other underlying reasons for greater complexity are the thousands of chemical modification made to proteins and the repertoire of regulatory mechanisms controlling this process.

The HGP project is complete many questions still remain unanswered; including the function of most of estimated 30000 genes. Researchers also do not know the role of Single Nucleotide Polymorphisms (SNPs), single DNA base changes within the genome or the role of non-coding regions and repeats in the genome.

Mice and humans (indeed, most or all mammals including dogs, cats, rabbits, monkeys and apes) have roughly the same number of nucleotides in their genomes - about 3 billion base pairs. This implies that all mammals contain more or less the same number of genes.

Table: Comparative genome sizes of humans and other organisms

Organism	Estimated Size Million bases	Estimated gene number	Average gene density	Chromosome Number
Human	3000	~30000	1 gene per 100000 bases	46
Rat	2750	~30000	-- do --	42
Mouse	2500	~30000	-- do --	40
Fruit Fly	180	~13600	1 gene per 9000 bases	8
A type of Plant	125	25500	1 gene per 4000 bases	5
Round worm	97	19100	1 gene per 5000 bases	6
Yeast	12	6300	1 gene per 2000 bases	6

E- Coli (Bacteria)	4.7	3200	1 gene per 1400 bases	1
H-influenza (bacteria)	1.8	1700	1 gene per 1000 bases	1

Gene duplication occurs frequently in complex genomes; sometimes duplicated copies degenerate to the points where they no longer are capable of encoding a protein. However, many duplicated genes remain active and over time may change enough to perform a new function. Since gene duplication is ongoing process, mice may have active duplicates that humans do not posses, and vice versa. These appear to make up a small percentage of the total genes, not larger than 1% of the total. Nevertheless, these novel genes may play an important role in determining species, specific traits and functions.

What really matters is that subtle changes accumulated in each of the approximately 30000 genes add together to make quite different organisms. Further, genes and proteins interact in complex way that multiplies the functions of each. In addition, a gene can produce more than one protein product through alternative splicing or post-translation modification; these events do not always occurs in an identical way in the two species. A gene can produce more or less proteins in different cells at various times in response to developmental or environmental cues, and many proteins can express disparate functions in various biological contexts. Thus the more than 30000 estimated genes multiply subtle distinctions.

Some nucleotide changes are neutral and do not-yield a significantly altered protein. Others, but only a relatively small percentage, would introduce changes that could substantially alter what the protein does. Put these alterations in the context of known inherited diseases, a single nucleotide change can lead to inheritance of sickle cell disease, cystic fibrosis or breast cancer. A single nucleotide difference can alter protein function in such a way that it causes a terrible tissue malfunction. Single nucleotide changes have been linked to hereditary differences in height, brain development, facial structure, pigmentation and many other striking morphological differences; due to single nucleotide changes, hands can develop structure that look like toes instead to fingers, and a mouse's tail can disappear completely. Many of the average 15% nucleotide changes that distinguish humans and mouse genes are neutral, some lead to subtle changes, where as others are associated with dramatic differences. Add them all together, and they can make quite an impact, as evidenced by the huge range of metabolic, morphological, and behavioural difference we sea among organisms.

Although genes get a lot of attention, it is the proteins that perform most life functions and even make up the majority of cellular structures. Proteins are large, complex molecules made up of smaller subunits called amino acids. Chemical properties that distinguish the 20 different amino acids cause the protein chain to fold up into specific three dimensional structures that define their particular functions in the cell.

The constellation of all proteins in a cell is called its proteome. Unlike the relatively unchanging genome, the dynamic proteome changes from minute to minute in response to tens of thousands of intra-and-extra cellular environmental signals. The number and identities of other proteins made in the same cell at the same time and with which it associates and reacts specify by

the gene sequence and a protein's chemistry and behaviour. Studies to explore protein structure and activities, known as proteomics, will be the focus of much research for decades to come and will help elucidate the molecular basis of health and disease.

Most genes contain a switch called promoter. This switch regulates the activities of the gene and decides when and how the gene should become or not become active. An enhancer also works in the gene. The promoter and enhancer work only when the transcription factors responsible for mutation are operating. The genes are our active partners and are sensitive to the changes taking place in our body and mind and they register these changes by making suitable changes in their structure. By channeling our thoughts in a specific direction the genes can be changed, thus enabling us to progress in a desired way. This supports the view that spiritual persons can increase their power by sacred thoughts and determination. The genes are not our masters but are our servants; they are governed by our thoughts and influenced by our environment.

Studies in behavioural genetics have shown that both genetic and environmental factors influence the normal and deviant behavior of human beings. Only a few decades ago, psychologists believed that characteristics of human behavior were almost entirely the result of environmental influences. These characteristics now are known to be genetically influenced, in many cases to a substantial degree. Intelligence and memory, novelty seeking and activity level, and shyness and sociability all show some degree of genetic influence.

4.12 Evolution and Biodiversity

All populations of the same kind of organisms form a species. A group of individuals of the same species living together in a common area at a particular time form a population of that area. The process by which an existing species gives rise to one or more new species is called speciation. Speciation may occur by accumulation of variation, migration, natural calamity, mutation, hybridization and polyploidy.

In biology, evolution is the process by which populations of organisms acquire and pass on novel traits from generation to generation. Its action over large stretches of time explains the origin of new species and ultimately the vast diversity of the biological world. The living species of today are related to each other through common descent, products of evolution and speciation over billions of years. The modern theory of evolution is based on the concept of natural selection proposed by Charles Darwin in 1859. Natural selection is the idea that individuals who possess advantageous heritable traits are more likely to survive and reproduce. In doing so, they increase the frequency of such traits in subsequent generations.

In the 1930 scientists combined Darwinian natural selection with the theory of Mendelian heredity to create the modern evolutionary synthesis. The modern synthesis understands evolution to be a change in the frequency of alleles within a population from one generation to the next. The mechanisms that produce these changes are the basic mechanisms of population genetics: natural selection and genetic drift acting on genetic variations created by mutation, sex, and gene flow. This theory has become the central organizing principle of modern biology. It helps biologists understand topics as diverse as the origin of antibiotic resistance in bacteria, eusociality in insects, and the staggering biodiversity of the living world. Because of its potential implications for the

origin of humankind, the theory of evolution has been at the center of many social and religious controversies since it was first introduced.

Evolution consists of two basic types of process; those that introduce new genetic variation into population, and those that affect the frequencies of existing variation. The mechanisms of evolution include mutation, linkage, heterozygosity, recombination, gene flow population structure, drift, natural selection, and adoption. Speciation is the creation of two or more species from one. This may take place by various mechanisms like allot speciation, sympatric speciation, peripatric speciation etc.

Biodiversity found on Earth today is the result of 4 billion years of evolution. The origin of life is not well known to science, though limited evidence suggests that life may already have been well - established a few 100 million years after the formation of the Earth. Until approximately 600 million years ago, all life consisted of bacteria and similar single- celled organisms.

The history of biodiversity during the Phanerozoic (the last 540 million years), starts with rapid growth during the Cambrian explosion - a period during which nearly every phylum of multi cellular organisms first appeared. Over the next 400 million years or so, global diversity showed little overall trend, but was marked by periodic, massive losses of diversity classified as mass extinction events.

The apparent biodiversity shown in the fossil record suggests that the last few million years include the period of greatest biodiversity in the Earth's history. However, not all scientists support this view, since there is considerable uncertainty as to how strongly the fossil record is biased by the greater availability and preservation of recent geologic sections. Some argue that corrected for sampling artifacts; modern biodiversity is not much different from biodiversity 300 million years ago. Estimates of the present global macroscopic species diversity vary from 2 million species to 100 million species, with a best estimate of somewhere near 10 million.

Most biologists agree however that the period since the emergence of humans is part of a new mass extinction, the Holocene extinction event, caused primarily by the impact humans are having on the environment. At present, the number of species estimated to have gone extinct as a result of human action is still far smaller than are observed during the major mass extinctions of the geological past. However, it has been argued that the present rate of extinction is sufficient to create a major mass extinction in less than 100 years. Others dispute this and suggest that the present rate of extinction could be sustained for many thousands of years before the loss of biodiversity matches the more than 20% losses in past global extinction events.

New species are regularly discovered (on average about three new species of birds each year) and many, though discovered, are not yet classified. Biodiversity is not distributed evenly on Earth. It is consistently richer in the tropics and in other localized regions. As one approaches polar region one generally finds fewer species. Flora and fauna diversity depends on climate, altitude, soils and the presence of other species. For example, Brazil's Atlantic Forest contains roughly 20000 plant species, 1350 vertebrates, and millions of insects, about half of which occur nowhere else in the world. The island of Madagascar possess a very high ratio of species endemism and biodiversity, since the island separated from mainland Africa 65 million years ago, most of the species and ecosystems have evolved independently producing unique species different than other parts of Africa.

Biodiversity is most closely known to the public as animals with a backbone when in fact there exist 20 times that number of insects 5 times as many flowering plants. In fact it is often estimated that less than half and perhaps less than two- thirds of earth organisms have been identified. As a soft guide, however, the number of identified modern species as of 2004 can be broken down as follows.

1. 287,655 plants, including;
   15000 mosses,
   13025 ferns,
   980 gymnosperms,
   199,350 dicotyledons,
   59300 monocotyledons;
2. 4000 bacteria
3. 80000 protists (algae, protozoa)
4. 74000-120000 fungi;
5. 10000 lichens;
6. 1250000 animals, including
   (a) 1190200 invertebrates:
      - 950000 insects,
      - 70000 mollusks,
      - 40000 crustaceans
      - 130200 others;
   (b) 58 808 vertebrates:
      - 29300 fish,
      - 5743 amphibians,
      - 8240 reptiles,
      - 10234 birds,
      - 5416 mammals.

However the total number of species for some phyla may be much higher

5-10 million bacteria;

1.5 million fungi

There are over 250000 species of flowering plants, Angiosperms as shown in Table 4.1

Table 4.1 Flowering Plants

S.No.	Plant order	No. of Species	Species
1.	Apiales order	3700	Carrot family, Ginseng family: trees, shrubs, vines, and herbs.
2.	Asterales order	20000	The Daisy family: herbs, shrubs, flowers
3.	Ericales order	4500	Shrubs, small trees
4.	Fagales order	1200	Trees, shrubs, catkins; alder, birch, hazelnut, filbert tree, chestnut, oak etc.

5.	Hamamelidales order	150	Trees, shrubs
6.	Juglandales order	61	Walnut family
7.	Laurales order	2800	Herbs, vines, shrubs
8.	Magnoliales order	1800	Trees, herbs: pawpan patch, tulip, yellow polar, cucumber, mangolia
9.	Malvales order	3000	Cotton, cacao, crop plants, vegetable okra, marshmallow, hibiscus, kapok tree
10.	Papaverales order	600	Herbs
11.	Piperales order	1500	Herbs
12.	Primulales order	1900	
13.	Ranunculales order	3000	
14.	Rosales order	6700	Trees, shrubs, vines, herbs
15.	Salicales order	350	Trees, shrubs
16.	Sapindales order	6200	Trees, shrubs, vines
17.	Urticales order	2200	Herbs, trees, stinging nattles, mulberry, fig trees, elm trees, hob vines and hemp plant.

Threats

During the last century, erosion of biodiversity has been increasingly observed. Some studies show that about one of eight known plant species is threatened with extinction. Some estimates put the loss at up to 140000 species per year. This figure indicates unsustainable ecological practices, because only a small number of species come into being each year. Almost all scientists acknowledge that the rate of species loss is greater now than at any time in human history, with extinctions occurring at rates hundreds of times higher than background rates. Factors contributing to loss of biodiversity are; over population, deforestation, pollution (air pollution, water pollution, soil contamination) and global warming or climate change, driven by human activity. These factors, while stemming from over population, produce a cumulative impact upon biodiversity.

The rich diversity of unique species across many parts of the world exist only because they are separated by barriers, particularly large rivers, seas, oceans, mountains and deserts, from other species of other land masses, particularly the highly fecund, ultra-competitive, generalist "super - species". These are barriers that could never be crossed by natural processes, except for many millions of year in the future through continental drift. However humans have invented ships and airplanes, and now have the power to bring into contact species that never have met in their evolutionary history, and on a time scale of days, unlike the centuries that historically have accompanied major animal migrations.

The widespread introduction of exotic species by humans is a potent threat to biodiversity. The exotic organisms may be either predator parasites, or simply aggressive species that deprive

indigenous species of nutrients, water and light. As a consequence if humans continue to combine species from different eco regions, there is the potential that the world's ecosystems will end up dominated by relatively a few, aggressive, cosmopolitan "super - species".

Purebred naturally evolved region specific wild species can be threatened with extinction in a big way through the process of Genetic Pollution i.e. uncontrolled hybridization, introgression and Genetic swamping which leads to homogenization or replacement of local genotypes as a result of either a numerical and/ or fitness advantage of introduced plant or animal. These phenomena can be especially detrimental for rare species coming into contact with more abundant ones where the abundant ones can interbreed with them swamping the entire rarer gene pool creating hybrids thus driving the entire original purebred native stock to complete extinction. Some degree of gene flow may be a normal, evolutionarily constructive process, and all constellations of genes and genotypes cannot be preserved however, hybridization with or without introgression may, nevertheless, threaten a rare species existence.

In agriculture and animal husbandry, green revolution popularized the use of conventional hybridization to increase, yield many folds by creating "high-yielding varieties". Often the handful of breeds of plants and animals hybridized originated in developed countries and were further hybridized with local varieties, in the rest of the developing world, to create high yield strains resistant to local climate and diseases. Local governments and industry since have been pushing hybridization with such zeal that several of the wild and indigenous breeds evolved locally over thousands of years having high resistance to local extremes in climate and immunity to diseases etc. have already become extinct or are in grave danger of becoming so in the near future. Due to complete disuse because of un-profitability and uncontrolled intentional, compounded with unintentional cross-pollination and cross breeding (genetic pollution) formerly huge gene pools of various wild and indigenous breeds have collapsed widespread genetic erosion and genetic pollution resulting in great loss in genetic diversity and biodiversity as a whole. Genetically Modified crops today have become a common source for genetic pollution, not only of wild varieties but also of other domesticated varieties derived from relatively natural hybridization. It is being said that genetic erosion coupled with genetic pollution is destroying that needed unique genetic base thereby creating an unforeseen hidden crises which will result in a severe threat to our food security for the future when diverse genetic material will cease to exist to be able to further improve or hybridize weakening food crops and livestock against more resistant diseases and climate changes.

Monoculture, the lack of biodiversity, was a contributing factor to several agricultural disasters in history. Higher biodiversity also controls the spread of certain diseases e.g. viruses will need to adapt itself with every new species. Biodiversity provides food for humans. Although about 80% of our food supply comes from just 20 kinds of plants, humans use at least 40000 species of plants and animals a day. Many people around the world depend on these species for their food, shelter, and clothing. There is vast untapped potential for increasing the range of food products suitable for human consumption, provided that the high present extinction rate can be stopped.

A significant proportion of drugs are derived, directly or indirectly, from biological sources; in most cases these medicines cannot presently be synthesized in a laboratory setting.

About 40% of the pharmaceuticals used in the USA are manufactured using natural compounds found in plants, animals and microorganisms.

Biodiversity provides many ecosystem services that are often not readily visible. It plays a part in regulating the chemistry of our atmosphere and water supply. Biodiversity is directly involved in recycling nutrients and providing fertile soils. Experiments with controlled environments have shown that humans cannot easily build ecosystems to support human needs; for example insect pollination cannot be mimicked by human- mode construction, and that activity alone represents tens of billions of dollars in ecosystem services per annum to humankind. Many cultural groups view themselves as an integral part of the natural world and show respect for other living organisms (*parasparopgraho jivanama*).

Chapter 5
The Vargana (Energy Fields)

5.1 *Vargana*

Acharya Malayagiri has defined *vargana* as a group of similar things of the same kind. Acharya Mahaprajna says that a *pudgala* aggregate made up of similar *paramanus* is a *vargana*. According to Acharya Kanaknandhi a *vargana* is a cluster of *paramanus*, which are in unbound state. It will be seen later that all these definitions appear to be true under different conditions.

There are infinite numbers and types of *varganas* according to Bhagwati Sutra but the following eight types are important from the point of view of their association with soul.

1. *Audarik* (Gross Body) *Vargana* - These *varganas* are of gross type and are suitable for making bodies of immobile and mobile organisms.
2. *Vaikriya* (Protean Body) *Vargana* - These *varganas* constitute the protean (*Vaikriya*) body that can exist in various forms like small or huge, light or heavy, visible or invisible, etc. Such bodies are possessed by celestial and infernal beings.
3. *Aharka* (Migratory Body) *Vargana* - These *varganas* constitute a special kind of migratory body using yogic powers.
4. *Tejas* (Fiery Body) *Vargana* - The fiery or energy (*tejas*) body of an organism is made from *tejas varganas* which are supposed to have electrical quality.
5. *Karman* (Karma Body) *Vargana* - These *varganas* constitute the karma in the karma body of organism.
6. *Swasochhavas* (Respiration) *Vargana* - These *varganas* are source of bioenergy to organisms.
7. *Bhasha* (Sound) *Vargana* - These *varganas* are supposed to produce and transmit the sound and speech in organisms and inanimate objects.
8. *Mano* (Mind) *Vargana* - These *varganas* support the thought process in the mind.

All these *varganas* are subtle and exist all over *loka*. Change of one type of *vargana* into another type is possible. Unless organized into a meaningful form by soul, these *varganas* remain in their natural state. It is only when soul organizes and uses them; they discharge meaningful functions as described above.

The *audarik, vaikriya, aharaka* and *tejas varganas* are supposed to exist as gross aggregates having attributes of eight- touch (including light, heavy, soft and hard touch). The *karman*, *bhasha* and *mano varganas* possess four touch attributes only (cold, hot, positive and negative), and exist in subtle form. The *swasochhavas varganas* exist both as four-touch (subtle) and eight touch (gross) *varganas*.

Gommatsara Jivakanda provides another type of classification of *varganas*. According to it there are 23 types of main *varganas* found all over *loka*. These *varganas* are classified on the basis of number of *paramanus* present in the cluster. In the order of increasing number of *paramanu* in the cluster the *varganas* are classified as follows.

1. *Anu* (smallest) *Vargana* - consisting of a single *paramanu*.
2. *Sankhyatanu* (Countable *Anu*) *Vargana* - Comprising of countable number of *paramanus* in the cluster. Obviously, there is a range of number of *paramanus* in this type of *vargana* starting from two to maximum countable number.
3. *Asankhyatanu* (Innumerable) *Vargana* - Contains innumerable *paramanus* in the cluster. Here again the range of number of *paramanus* in the cluster is large.
4. *Anantanu* (Infinite *Anu*) *Vargana* - This type of *vargana* has infinite number of *paramanus* in the cluster and there is a range. The lowest number in the range is one more than the highest number in the lower *asankhyatanu vargana* and the highest number is more than the lowest in the range by a number equal to some multiple of the Infinitely Small Fraction of The total Number of Liberated Souls (ISFTNLS)

All the four types of *varganas* are non associable by soul and are not useful in that sense.

5. *Ahara Vargana* - *Ahara Vargana* constitutes the gross, protean (*vaikriya*) and migratory (*aharaka*) bodies of organisms. There is a range of number of *paramanus* in this *vargana* also. The lower limit in the range is one *paramanu* more than the highest number in the last *vargana* and the upper limit is more than the lower limit by a factor equal to ISFTNLS.
6. Non-Associable (*Agrahya*) *Vargana*. The range of *paramanu* in this *vargana* starts with one more than the higher limit in the last *vargana*. The upper limit exceeds the lower limit by a factor equal to ISFTNLS.
7. Fiery (*Tejas*) *Vargana*. The range of this *vargana* starts after the upper limit of the last *vargana*. The upper limit exceeds the lower limit by a factor equal to ISFTNLS.
8. Non-Associable *Vargana* (Second). The range of this *vargana* starts after the upper limit of last *vargana*. The upper limit exceeds the lower limit by a factor equal to the multiple of the lower limit and the factor ISFTNLS.
9. Sound (*Bhasha*) *Vargana*. The range starts after the upper limit of the last *vargana*. The upper limit exceeds the lower limit by a factor equal to ISFTNLS.

The sound *vargana* is suitable for producing all kinds of sound including the sound produced by inanimate objects like musical instruments and natural phenomena like thundering of clouds and sound produced by living organisms including speech by humans. An organism attracts sound *varganas* before producing sound. These *varganas* may remain with the organism for a period of one *samaya* to innumerable *samayas*, being the period of sound production. The sound *varganas* may have one or more colour, smell and taste and two or four touch. We know that a *paramanu* has one colour, one smell, one taste and two- touch. The *vargana* cluster may contain *paramanus* of various kinds having different colour, smell, taste and touch and so the cluster has more than one colour, smell and taste and four touch viz cold, hot, positive and negative. It may be noted that like sound *vargana*, all other kinds of *varganas* have more than one colour, smell and taste and four- touch. An organism attracts *varganas* from all six possible directions. These *varganas* may flow in for a certain period and intermittently for more periods. The flow period can be of minimum two *samaya* and maximum innumerable *samaya*. The organism discharges these *varganas* intermittently and not continuously, that is the discharge pattern is similar to the inflow pattern.

There are two kinds of speakers, powerful and weak. The *varganas* discharged by a powerful speaker are broken down to smaller groups and ultimately to *paramanus*, which travel to the end of *loka*. These *paramanus* also activate other *paramanus*, which travel in different directions, and thus the sound *vargana* is spread out in the entire *loka*. The *varganas* discharged by a weak speaker remain in unbroken state and travel a finite distance equal to that occupied by innumerable *varganas.* The *varganas* then break down and each group travels another finite distance before losing its power. Thus the sound *vargana* discharged by a week speaker does not travel to the end of *loka*.

10. Non-Associable *Vargana* (Third). A cluster having one *paramanu* more than the upper limit of the last *vargana* provides the lower limit of this *vargana*. The upper limit is infinite times greater than the lower limit.
11. *Mano* (Mind) *Vargana*. The lower range of this *vargana* is one *paramanu* more than the upper limit of last *vargana*. The upper range exceeds the lower range by a factor equal to ISFTNLS. *Mano vargana* constitutes the physical mind (*dravya munah*) of organisms.
12. Non-Associable *Vargana* (Fourth). The lower range of this *vargana* is one *paramanu* more than the upper limit of last *vargana*. The upper range is infinite times greater than the lower range.
13. *Karmana Vargana*. The range of this *vargana* starts after the upper limit of last *vargana*. The higher range exceeds the lower range by a factor equal to ISFTNLS. Organisms for constituting their karma bodies use this vargana.
14. Permanent/Regular (*Dhruva*) *Vargana*. The range of this *vargana* starts after the upper limit of last *vargana*. The higher range is infinite times greater than the lower range.

    All the above fourteen *varganas* are regular in the sense that clusters are formed for every number in the range.

    All subsequent *varganas* may be regular or irregular, that is, the clusters are formed for some numbers of *paramanus* and may or may not form for other numbers in the range.
15. Intermittent regular (*Santar -Nirantar*) *Vargana*. The range of this *vargana* starts after the upper limit of the last *vargana*. The upper range is infinite times greater than the lower range. The *vargana* clusters are formed for small range intermittently dispersed between the non-forming ranges over the full range. This *vargana* is also non associable with soul.
16. Permanent Nil (*Sunya*) *Vargana* (PNV). This *vargana* starts with one *paramanu* more than the upper range of last *vargana*. The upper range is infinite times greater than the lower range. The meaning of adjective nil is not clear. One possibility is that the *paramanus* in this *vargana* rapidly assemble and dissemble so that the *vargana* is always in a transient state. At any given instant the *vargana* of any number in the range is not stable. The other possibility is that the aggregates formed by this *vargana* are not detectable. The later possibility has an important significance in physics.
17. Individual Body (*Pratyek Sarira*) *Vargana* (IBV) The range for this *vargana* starts with one *paramanu* more than the upper limit of the last *vargana*. The upper limit is some multiple of the lower limit.

In the living world one soul may have one body or many souls may share a common body. The former is called *pratyek* or individual body soul and the later is called common

body soul as described in chapter 4. The body of an individual body soul consists of individual body *vargana*. The earth body, water body, fire body, air body, celestial, and infernal beings, the *aharaka* body and the bodies of monks in 13th and 14th stages of spiritual development are supposed to be individual bodies because in these cases the body does not contain any micro and nano organism. In some cases the individual bodies of many organisms of the same kind may cluster together, but this does not form a common body. In a common body many organisms share the same body.

18. Permanent Nil (*Sunya*) *Vargana* (Second PNV). The range of this *vargana* starts after the range of last *vargana*. The upper limit in the range is some multiple of the lower limit. This *vargana* is similar to last PNV.
19. Large (*Badar*) *Nigod Vargana* (LNV). The range of this *vargana* starts after the range of last *vargana*. The upper limit is innumerable times more than the lower limit. This *vargana* forms the *karman* and gross body of large nigod/nano organisms. Carrot, radish, spurgewort, green ginger, creepers, etc. are examples of LNV. Each one of them has innumerable micro bodies and one micro body contains infinite number of nano organisms.
20. Permanent - Nil *Vargana* (Third PNV). The higher limit of this *vargana* is innumerable times its lower limit.
21. Small (*Suksma*) *Nigod Vargana* (SNV). This *vargana* starts with one *paramanu* more than the higher limit of the last *vargana*. The LNV has limited occurrence but SNV is found all over in water, land and sky. This *vargana* constituents the gross as well as the luminous and karma bodies of small nano organisms.
22. Permanent Nil *Vargana* (Fourth PNV). This is the next *vargana* in order. The upper limit in the range is innumerable times the lower limit.
23. Gross Matter (*Maha Skandha*) *Vargana* (GMV). This is the last *vargana*. All gross matter, visible or invisible, in the *loka* is made of GMV.

It is seen from above that each kind of *vargana* has specific use and application. The *paramanus* in a *vargana* have some kind of affinity and perhaps because of this a *vargana* having larger number of *paramanus* occupies proportionately less space than a *vargana* of less number of *paramanus*. That is, the *paramanu* density increases as we go from lower to higher *vargana*. This property of *vargana* has important significance as described later in this Chapter. A comparison of approximate range of *varganas* is shown in fig. 5.1. Note the small range of associable *varganas* used by the soul.

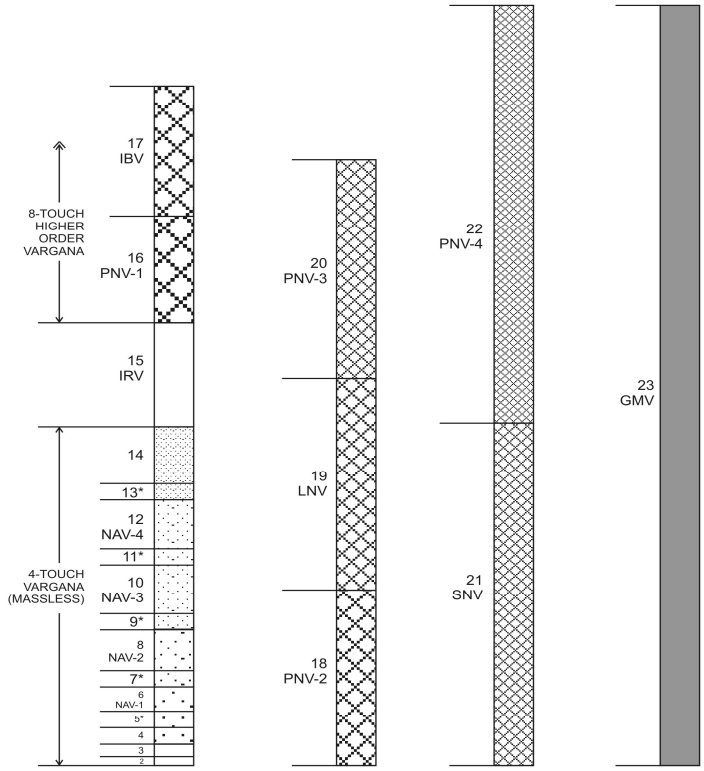


Fig 5.1 VARGANA RANGES (APPROXIMATE, NOT TO SCALE)
SHADES INDICATE PARAMANU DENSITY. * - ASSOCIABLE VARGANA

5.2 Origin of *Vargana*

The *varganas* fall into two broad categories, one has four- touch and the other having eight-touch. The 2nd to 14th order *varganas* are four-touch type and mass less. The 16th to 23rd order *varganas* are eight- touch type and are supposed to have weight. The first *anu vargana* consisting of a single *paramanu* has two-touch. The 15th intermittent regular *vargana* is perhaps a mixed type. The four-touch and the eight- touch *varganas* have separate existence and inter conversion among them are limited.

The smallest *anu vargana* consisting of one *paramanu* is produced by disintegration of higher *varganas*. That is, a *paramanu* separated from any *vargana* forms an *anu vargana*. All *varganas* in the four-touch category, from the 2^{nd} to 14^{th} kind, are produced by disintegration of higher order *varganas*, integration of lower order *varganas* and by integration and disintegration of *varganas* of the same order. For example, disintegration of 10th order non-associable *vargana* can produce two or more kinds of lower order *varganas* say 4th and 9th order or 4th, 6th and 8th order, etc. Conversely, integration of 4th and 9th order or integration of 4th, 6th and 8th order *varganas* can produce one 10th order *vargana*. It is also possible that a 10th order *vargana* of higher range disintegrates into two or more *varganas* of lower range of the same order. Thus the 2nd to 14th order *varganas* belonging to four- touch category are freely formed and deformed by union and separation of *paramanus* of group or *paramanus*. Inter and intra conversion between them is common.

Division and union of the same order vargana produce the 15th intermittent regular varganas. Similarly, the *varganas* of 17th, 19th, 21st and 23rd order are also exclusive (when part of body of organisms) and not produced by other order *varganas*. In these five types, *varganas* of the same order can inter convert among themselves but conversion into another order does not take place (when these *varganas* are part of a body). For example a higher range *vargana* of 21st order can break up into two or more *varganas* of lower range in the same order. However, in all above cases a single *paramanu* separated from any order *vargana* can unite with any other *vargana* irrespective of category. In this sense, all kinds of *varganas* have a limited inter convertibility.

Any one kind of *vargana* of a particular order is innumerable fraction of total *varganas* present in the *loka* at anytime. This means that *vargana* of no order becomes excessive and there is a fair distribution of *paramanus* in different kinds and order of *varganas*. The IBV, LMV and SMV order of *varganas* are supposed to be live (when part of a body) and this is another reason for their non-convertibility into another order *vargana*.

5.3 Scientific Identity of *Varganas*

We now proceed to find out what are *varganas* in scientific terms. The interpretation of *varganas*, which is commonly made, has many ambiguities from the scientific perspective. For example, it is said that *ahara vargana* constitutes the gross, fluid and migratory bodies of organisms. According to science the physical body of any organism is made up of organic molecules which contain elements like carbon, hydrogen, oxygen, nitrogen, sodium, potassium, calcium, phosphors, iron, etc. These elements are also found in inorganic matter, which is not made from *ahara vargana*. The bodies of higher mobile beings, microorganisms and plants are said to be made from different order *varganas* (*ahara vargana*, LMV and SMV, and IBV respectively) but according to science they are made from similar organic molecules containing common elements. Thus the common impetration offered by scholars of Jain philosophy is not in agreement with scientific view.

Consider the case of sound *vargana*. It is said that an organism attracts sound *vargana*. The sound spreads out and travels to the end of *loka* when the speaker is powerful and travels only a finite distance when the speaker is weak. If it is so then what is sound *vargana* in scientific sense.

Many of the above ambiguities and difficulties can be overcome if we rightly understand what the *varganas* are. Let us begin with a *paramanu*. A *paramanu* has one colour, one smell, one taste and two- touch. Referring to §3.5 we find that the colour and smell attributes of a *paramanu* can be described in terms of vibrations. We leave out the taste for the time being, it does not make much difference in our analysis. The *paramanu* has either positive or negative charge, and it can be either cold or hot which indicates its thermal state. The *paramanu* is in a state of random motion of various kinds. Thus a *paramanu* has vibrations, potential energy in the form of charge and heat and kinetic energy in the form of various kinds of motions. So a *paramanu* is a vibrating and moving energy point.

Lord Mahavira said that *paramanu* might exist either as a particle or as a wave. It is astonishing to find such a statement in Jain philosophy, a fact that was discovered in science by Loeus de Broglie as late as 1924. The *paramanu* is so small, and invisible to common man, that it can be detected only by omniscient and persons having high power of clairvoyance (*parmavadhi jnan*). It is also known that infinite number of *paramanus* can occupy one space point. This shows

that a *paramanu* is bosonic in character and mass less. This establishes the energy characteristic of *paramanu*. Further, a *paramanu* occupies only one space point; it does not extend to other space points. From this consideration it would be logical to assume the *paramanu* as an energy point. Though the energy in a *paramanu* exists as potential energy or kinetic energy or both but such fractions of energy are not realized outside *paramanu* as the *paramanu* is indivisible. So the energy of a *paramanu* is the smallest amount of energy that can exist in Free State and therefore can be regarded as a quantum of energy. The energy of *paramanu* exists as charge, thermal energy and kinetic energy, and a random motion. The charge, thermal energy and kinetic energy do not inter convert but undergo continuous changes due to intrinsic modifications, so that the total quantum energy of the *paramanu* is held constant.

The *paramanu* as a 'quantum' energy is called *dravya paramanu*. Three more types of *paramanus* are defined in Jain philosophy. The second is *ksetra paramanu* which is the space occupied by a *paramanu* called '*pradesa*'. A *pradesa* is the smallest measurable space and, therefore, is the quantum of space. The third is *kala paramanu* which has been defined as a '*samaya*' earlier. *Samaya* is the smallest unit of measurable time and therefore, is the quantum of time. The fourth is *bhava paramanu*. The *paramanu* possesses qualities of colour, smell, taste and touch, which are called *bhava*. The smallest measurable unit of colour, smell and taste is the colour, smell and taste of a *paramanu, which* are corresponding quantum of qualities. Similarly the charge of a *paramanu* is quantum charge and the heat of a *paramanu* is the quantum heat. Thus a *paramanu* provides the smallest standard for measurement of matter, space and time; this may also imply a possible interrelationship between these three important units of science.

Paramanus exist with different colour, smell, taste and touch. These attributes of a *paramanu* also vary in degree. Such variations and their combinations provide in infinite types of *paramanus*. The frequency of vibration varies with colour, smell (and perhaps also taste) and touch. Two *paramanus* of similar attribute, say having same frequency, may flock together because of some kind of affinity between them. This forms a *vargana* of two *paramanus*. The two *paramanus* may have similar or dissimilar charge. As more *paramanus* join the group, the *vargana* gets bigger in size. When the number of *paramanus* is countable the *vargana* is called *sankhyatanu vargana* of the 2nd order. Increasing number of *paramanus* provides higher order *vargana* and so on. As mentioned above as the number of *paramanus* in the *vargana* increases the *vargana* occupies proportionately less space. For example, 10 *paramanus* may occupy 8 *pradesas*, 100 *paramanus* 60 *pradesa*s, 1000 *paramanus* 400 *pradesa*s, and 10000 *paramanus* 2000 *pradesa*s and so on. Thus with increase in number of *paramanus* the number of *paramanus* per *pradesa* i.e. energy density, also increases. The energy density in a higher order *vargana* is more than that in a lower order *vargana*. What is the effect of energy density on *vargana*? It appears that when the energy density reaches a critical level the *paramanus* start bonding.

The *varganas* up to the 14th order have four- touch. Consider a 4-paramanu *vargana* of a particular frequency. Let the first *paramanu* have positive charge and cold touch, the second *paramanu* positive charge and hot touch, the third *paramanu* negative charge and hot touch and the fourth *paramanu* negative charge and cold touch. The four *paramanus* together have all the four touches and behave as a unit. The *vargana* can have other combination of *paramanus* and still have four- touch. When the number of *paramanus* is great clearly there are large numbers of ways

in which a *vargana* can be formed. A particular combination of colour and smell (and also taste) decides the frequency of *paramanu*. A four-paramanu *vargana* can have varying frequencies depending upon the colour, its degree, etc. of the *paramanus*. Similar frequencies are also possible when the number of *paramanus* in the *vargana* is 5, 6 and more. Therefore, for a *vargana* of a given order as the numbers of *paramanus* vary in a range there will also be a range of frequency. So each order of *vargana* has a frequency range.

It has been mentioned that *varganas* from 2nd order to 14th order are produced by integration of lower order *varganas*, disintegration of higher order *varganas* and / or integration / disintegration of *varganas* of the same order. All *varganas* up to 14th order are also permanent. This happens perhaps because the *paramanus* in these *varganas* loosely cluster and there is no bonding between them. A *paramanu* or a group of *paramanu* can easily break away from one *vargana* and join another *vargana*. A *paramanu* may separate out when its frequency changes due to intrinsic modification. This *paramanu* may join another *vargana* having its new frequency. Thus integration and disintegration is a continuous process in lower order *varganas* but no *vargana* becomes extinct at any time; all order *varganas* continue to exist all the time and are therefore permanent.

A *vargana* has both positive and negative *paramanus.* In a *vargana* having infinite number of *paramanus* the number of positive and negative *paramanus* is not likely to be equal. Therefore, a *vargana* has a net charge either positive or negative. This charge produces an electric field. A moving *vargana* with an electric charge also produces a magnetic field. So a moving *vargana* is an electromagnetic field. Variation in the speed of *vargana* produces electromagnetic waves, which travel through the space.

A *vargana* is a bundle or packet of energy. The energy density or energy intensity increases with the order of *vargana*. *Varganas* of varying energy intensity have different application. Soul makes suitable use of different intensity *varganas*. The *ahara vargana*, luminous *vargana*, sound *vargana*, *mano vargana* and *karman vargana* fulfill different needs of soul. The non-associable *varganas* although not directly useful to soul, are source of *varganas* useful to soul besides taking part in other natural processes.

Varganas of 15th and higher order are supposed to have eight- touch. So in addition to four basic touches, namely cold, hot, positive and negative charge, other four secondary touches - light, heavy, soft and hard are also present. We have seen that the lower order *varganas* have the four basic touches. How the higher order *varganas* acquire the other four touches? One plausible explanation is that this happens due to bonding of *paramanus*. We know that the energy intensity increases with the order of *vargana*. The energy intensity in the 15th order *vargana* reaches a critical level which perhaps is enough to cause condensation of energy to corpuscular form or in other words, the energy converts to matter form and this happens because of bonding between *paramanus*. It may be noted that according to present scientific concept also the elementary particles of matter are, in their essence, nothing else then, condensation of the electromagnetic field. The *paramanus* bond according to the rules given in §3.1.3. Bonding between two negative *paramanus* produces light touch and bonding between two positive *paramanus* produces heavy touch. Bonding also takes place between positive and negative *paramanu*. The bonding may take place between two *paramanus* or between an aggregate of *paramanus* and a *paramanu*. The

existence of light and heavy touch produces another property called mass. The act of bonding requires energy. When two *pramanus* bond a good part of their energy (potential energy) is used up in bonding reducing the free energy of the *vargana*, this free energy exists as kinetic energy of motion and vibration. This shows that the maximum velocity a two *paramanu-bonded vargana* will be less than the maximum velocity of a *paramanu* or a two *paramanu* unbound *vargana*. We therefore can see that lower order *varganas* having four- touch must have higher maximum velocity than eight touch *varganas* of higher order. The *paramanu* having two- touch has the highest maximum velocity.

A question may be raised why the energy of lower order *varganas* does not exist as mass (corpuscular form). The Einstein equation giving relation between energy and mass does not say anything about the condition required for conversion of energy to mass. It appears that if the energy intensity is less than critical value energy always exists in that form. The lower order *vargana*, though have a mass equivalent, are free of gravitational effect and are said to be weightless. The higher order *vargana* in which a good part of total energy exists as mass have gravitational property. Thus the total matter in the universe (*loka*) exists in three forms (1) *paramanu* having two- touch, (ii) mass less low order *vargana* having four touches and (iii) higher order *vargana* having eight touches and mass.

The first two categories of matter exist in weightless energy form (gravity free) and the third category exists as energy or matter (may be as waves) having gravitational property. The bonding between *paramanus* produces a localized concentration of energy. Is mass then a condensation of localized concentrated energy?

The bonding between *paramanus* also produces the other two secondary touches, soft and hard. We know that abundance of cold and positive charge produces the soft touch and the hard touch is produced by abundance of hot and negative charge. This shows that bonding between similar charges paramanus produces soft and hard touches. Both heat and charge are forms of potential energy of *paramanu*. A high positive charge and cold state means high electric energy and low heat energy. In this case the kinetic energy i.e. velocity of the *paramanu* can be comparatively high for a given quantum energy of *paramanu*. A high negative charge in hot state implies that both the electric energy and heat energy are high and therefore the velocity of the *paramanu* should be comparatively low. When the *paramanus* belonging to former case bond together, soft touch is produced and when *paramanus* corresponding to second case combine a hard touch is produced. What do soft touch and hard touch mean in scientific terms? Perhaps this refers to the strength of the bond. A soft touch may signify high bonding strength. It means that once bonded it would be relatively difficult to disintegrate the positive aggregates than the negative aggregates. This is in fact so as we shall see later. In a *vargana* of infinite *paramanus* bonding of some *paramanus* may produce soft touch and the others may produce hard touch. Similarly, the light and heavy touch is produced and the *vargana* has all the eight touch. This is true for all higher order *varganas*. The 15th Intermittent Regular *vargana* is the boarder between the lower order four touch *varganas* and the higher order eight touch *varganas*. In this *vargana* perhaps there is a mix of two categories that is some *paramanus* bond and some do not.

We now study the characteristics and application of different order *varganas*. We first take up the last Gross Matter *Vargana*.

5.4 Gross Matter *Vargana* (GMV) and Matter.

All matter (visible or invisible) is made up of GMV according to Jain philosophy. Science has discovered various kinds of sub atomic particles, which, according to present knowledge, are the smallest constituents of matter. We examine how these sub atomic particles are produced from GMV. Consider the case of leptons first. The neutrino is the smallest lepton having negligible mass and no charge. If neutrino is made of GMV then it must be a combination of at least two GMV, one having positive charge and the other a negative charge. This will be the case when the two GMV have equal and opposite charge. As *varganas* exist with differing charges it is very likely that more than two GMV combine to produce a neutral charge in neutrino. So a neutrino of negligible mass should be made up of more than two GMV. There are three types of neutrinos. The mass of all three types is negligible but still there is a minor difference between them. Such minor variation in mass is obtained by variation in number of GMV in the three types of neutrinos. This indicates that the neutrino must contain a large number of *vargana*. It may be noted that when the mass of a neutrino is considered to be negligible, the mass of GMV is truly negligible.

We now consider another lepton, the electron. The mass of electron is 0.511 MeV, which is millions of times greater than the mass of a neutrino. This means that an electron is made of millions of GMV. Some of these GMV may have negative charge and others positive charge. In an electron the number of negative charge GMV exceeds the positive charge GMVs giving a net negative charge (-1). This also shows that the charge of one GMV is millions of times smaller the charge of an electron. And since a GMV contains infinite *paramanus*, the quantum charge of a *paramanu* is really unimaginable. The lepton muon is more than 200 times heavier, and tau is about 3500 times heavier than electron and therefore, they must contain more GMV in the same proportion. These particles are unstable and so the GMVs shed off till a stable configuration is obtained.

Next consider the stable baryon particles proton and neutron. These particles are supposed to be made up of quarks. The mass of a proton is 1836.12 times greater them that of the electron and neutron is very slightly heavier than proton. The mass of a quark is uncertain but it is many times more than that of the electron. So a quark is made from that many times more GMV than an electron. There are six types of quarks having fractional charges, both positive and negative, and masses ranging from 2 MeV to 18000 MeV. According to Jain philosophy the fractional charges of quarks are possible by appropriate combination of positive and negative GMV comprising them. Another thing we observe is that the charges of up quark, charm quark and top quark are same but their masses vary considerably. Similar is the case with down quark, strangeness quark and bottom quark. Synthesis of these quarks is clearly possible with suitable combination of GMV. Many more types of particles can be formed, including about 200 discovered so far.

We know that fission of uranium nucleus produces enormous amount of energy. This energy is mainly obtained by conversion of a fraction of nucleus mass into energy in the fission reaction. The fission process releases only about one percent of energy equivalent to the mass of nucleus. One hundred percent conversion of mass into energy takes place where a particle meets its antiparticle and the two annihilate each other. For this to happen all bonds between the *paramanus* must be broken so that the *paramanus* are restored to their free state producing almost infinite amount of energy. The process of synthesis of a particle from GMV is a fusion process.

Here energy of infinite number of *paramanus* combines to produce a sub atomic particle. This is truly the statement of Einstein equation. Jain philosophy can, therefore, claim that the energy - mass relationship was known to the omniscient and this was later derived mathematically by Einstein in 20^{th} century.

There are four fundamental forces in nature. The strong nuclear force binds quarks in protons and neutrons and holds protons and neutrons together. The weak nuclear force is responsible for radioactivity and in a way holds the particles with negative charge together. The electromagnetic force holds oppositely changed particles together. Scientists assume the existence of imaginary particles like gluon, boson and photon for the operation of these three types of forces respectively. Jain philosophy has described attributes of touch qualities for similar functions. We know that bonding between positive *paramanu* produces heavy touch and bonding between negative *paramanus* produces light touch. This means that heavy touch holds positive *paramanus* together and light touch holds negative *paramanus* together. Thus there is a clear similarity between strong nuclear force and heavy touch and between weak nuclear force and light touch. The bonding between positive and negative *paramanus* is similar to electromagnetic force. We see that the three types of bonding described in Jain philosophy are equivalent to the three kinds of basic forces known to science.

Gravitation is a different kind of force. Some Jaina scholars have equated gravitation with *adharma* but this does not seem to be correct. *Adharma* passively helps the motion of both the soul and *paramanu* (and its aggregates) whereas gravitation affects the motion of matter only. If gravitation had any influence on the motion of soul then a liberated soul could not travel from Earth to end of *loka* in one *samaya* as proclaimed by Jain philosophy. A soul migrates from one body to another, irrespective of the distance between the two, in one to four *samaya*. The migrating soul has karma body and fiery body, which are made up of four-touch *vargana*. So there should be no influence of gravity on karma and fiery bodies too. This shows that four touch *varganas* are gravity free. So what is gravitation? We see that gravitation is concerned with eight touch *varganas* only like the other three forces. The gravitation as an attractive force appears to be a direct consequence of mass.

The mass is produced by condensation of energy as a consequence of bonding between *paramanus*. The three basic forces viz., strong nuclear force, weak nuclear force and electromagnetic force were equated with three kinds of bonds between *paramanus*. But gravitation may perhaps be due to the combined effect of all kinds of bonding, and so due to the four secondary touch attributes together. Since the four secondary touches do not exist in a *paramanu* or lower order *vargana*, the four basic forces assumed by science are not the basic characteristic of matter; they are in fact derived characteristics.

The fundamental forces can be explained with one example. Husband and wife make a family and families constitute the society. The character of husband and wife determines the family bond. It both have positive thinking and one loves and cares for the other, and relegates the self interest to the background the family bond is strongest. If one partner has positive thinking and the other has negative thinking and gives priority to his/her self-interest, the family bond is of medium strength. If both partners have negative thinking, self interest of each is above the good of

the other, the bond is weakest. It means that the bond between positive and positive is strongest and that between negative and negative is weakest.

The family has relationship with the society. The social bond is presumably weaker than the family bond in all cases. The social bond exists only when families exist, so family is prerequisite to society. The social bond is stronger with positive – positive family, because both partners have concern for others, and weaker in case of negative – negative family, as none of them cares for others.

The strong nuclear force is like positive – positive family and the weak force is like negative – negative family. The electromagnetic force is liked positive – negative family, which is intermediate between the above, two types. The gravity is like social bond; it exists only when the other three forces exist. Like social bond gravity has strongest relation with nucleus where positive – positive bond exists and has weakest relation with electron where negative – negative bond exists.

In all three types of bonding there exists attraction between *paramanus* that may manifest as gravitational force. Hence the gravitational force is always attractive. Assuming that a part of bonding energy provides the force of attraction, the positive – positive bonding must contribute more towards the gravitational force than bonding between negative – negative *paramanus* and positive negative *paramanus*. Thus protons and neutrons contribute more to gravitational force than electrons. It is also clear that strong nuclear force, weak force and electromagnetic force are primary forces and the gravitational force is a secondary force depending upon the primary forces.

The soft and hard touch offer possible explanation to some observed behaviour of sub atomic particles. The protons carry a majority of positive *paramanus* held together by soft touch signifying high bonding strength. The electrons carry a majority of negative *paramanus* held together by hard touches signifying low bonding strength. Thus protons are strongly bonded and electrons are loosely bonded particles. This is the reason why proton decay is not observed in practice. Neutron bond is not as strong and so neutrons decay. The electrons can easily disintegrate and integrate as shown below.

According to quantum physics the electrons settle in orbits around the nucleus of atom in such a way that there is an optimal balance between the attraction of nucleus and the reluctant force of the electrons to be confined. Whenever an atom absorbs energy, its electrons jump to one of the outer orbits and later returns to the inner orbits by emitting the energy absorbed earlier. Since the electrons are never found any where between the orbits, they are assumed to keep jumping from one orbit to another, without passing through the intervening space. This is difficult to understand physically. It is explained by the quantum mechanics with reference to position momentum of the subatomic particles but Jain philosophy offers a simple explanation for this phenomenon.

Bonding between GMV forms an electron and this process can also reverse when suitable condition exists. So it can be assumed that when energy is supplied to atom the electron in the lower orbit disintegrates and simultaneously a new electron is formed in the higher orbit so that the optimal balance and stability is maintained. When the energy is emitted by atom the higher orbit electron disintegrates and a new one is formed in the lower orbit.

We now study the scientific character of other *varganas*. Our interpretation shall be based on the fact that *varganas* are electro magnetic energy.

5.5 *Ahara Vargana*

We know that *ahara vargana* constitutes the gross, fluid and migratory bodies of organisms. Scientifically, the functioning of gross body, which is made up of cells, depends on electrical energy. The electricity found in living bodies, zoological or botanical is known as bioelectricity. Biological cells use bioelectricity to store metabolic energy, to do work or trigger internal changes, and to signal one another. Bio electromagnetism is the electric current produced by action potentials along with the magnetic fields they generate through the phenomenon of electromagnetic induction. Bio electromagnetism is an aspect of all living things, including all plants and animals. Bio electromagnetism is sometimes difficult to understand because of the differing types of bioelectricity, such as brainwaves, myoelectricity (e.g., heart muscle phenomenon), and other related subdivisions of the same general bio electro magnetic phenomena. Bioelectricity is made of ions, and is different from bioelectrical energy made of photons (bio-photon).

The origin of electricity as found in living organisms is still a detail of uncertainty for which there are several theories. Four such theories include, but are not limited to, the Diffusion theory, the Membrane theory, the Oxidation theory, and the Phase - Boundary theory. The Diffusion theory states that chloride from sodium chloride (NaCl) in water found in the body may move at a faster rate than its sodium counterpart, which provides for a negative charge. The Membrane theory claims that a membrane, which may possess selective pores permeable to only one type of ion, separates ions of different charge. The Oxidation theory challenges the other two theories by focusing on the loss of electrons as ferrous changes into ferric ions, which produces a positive charge. However, the last theory, the Phase - Boundary theory, is centered upon the oil membranes on every cell in a living organisms and proposes thus: potential charge may be found when electrically active materials are distributed unequally at the interface of water and oil, therefore a negative charge potential in a nerve may arise from the dissolving of acetylchlorine chloride ($C_7H_{16}ClNo_2$, a powdered organic compound soluble in alcohol, decomposed by hot water) on one side of the nerve fiber's oil layer (surface). On the opposing side of the oil membrane, sodium chloride dissolves slightly in the oil. The potential across the oil layer is dependent upon the unbalanced distribution of the chloride.

The normal electricity cannot be converted into bioelectricity nor bioelectricity can be produced outside the body but the two kinds of electricity can mix with each other. Bioelectricity is much superior to normal electricity in the same way as a living organism is superior to non-living matter. Bioelectricity is many times more powerful and effective than normal electricity. Science has not succeeded so far, in finding the right source of bioelectricity. Jain philosophy clearly pronounces that *ahara vargana* is responsible for functioning, development and growth of physical body of organism. Knowing that the *vargana* is electromagnetic we can infer that *ahara vargana* is the source of bioelectricity. These *varganas* are probably directly absorbed by the cells, which are known to be sensitive to a broad range of frequencies. *Ahara vargana* (bio-electricity) is responsible for synthesis of enzymes and proteins in cells, functioning and control of various organs and development and growth of the body of organism, from constituents taken through

nutrition, respiration and environment. It is easy to see that electromagnetic *ahara vargana* also constitute the fluid body and migratory body, both of which are electrical and travel freely in space. All the three types of bodies can not be made without *ahara vargana*.

How *ahara vargana* performs its function is not clear. It may act independently or indirectly by improving the working of ions. It may assist and enhance the function of ions in some way so that ions become more energetic and powerful and perform in a superior and lively manner. It is possible karma or luminous bodies in their functioning also direct that ahara vargana. In any case, *ahara vargana* produce a form of electricity in the body of organism that performs various kinds of functions in the body.

According to Bhagwati canon the *audarik*, *vakriya* and *aharaka vargana* are eight- touch *vargana* and so the physical, fluid and migratory bodies must contain gross matter. This is also true. We know that physical body is made of GMV and *ahara vargana* provides the necessary energy for its construction. Similarly, the fluid body and migratory body may also contain a small amount of GMV and *ahara vargana* as a source of energy to construct these bodies. The GMV present in the last two bodies must be in subtle form making the bodies invisible.

5.6 Fiery (*Tejas*) *Vargana*

The fiery body of an organism is made of fiery *vargana*. Normally, an organism has three bodies' gross or physical, karma and fiery body. On death of the organism the subtle karma and fiery bodies travel with the soul, which now takes birth in a new mode? Thus karma and fiery bodies have always been attached to the soul and they shall remain so till soul attains liberation, when they two bodies get detached and destroyed. The fiery body performs two important functions viz., management of the body system and providing support and controls for the same. The fiery body is supposed to be an electric body and a place for vital energy; it receives *prana* energy through breathing. Kirlian photography has photographed the invisible subtle body. Through this photography it has been seen that a luminous body leaves the physical body at the time of death.

According to science, there are three states of matter; solid, liquid and gas. Two more were added later-plasma and protoplasm or bio-plasma, which is known in Indian philosophy as "Prana Sakti". A Soviet physicist, Mr.V.C.Grischecov, has found that there are independent electrons and protons in the bio-plasma, having no connection with the nucleus. They have tremendous speed and have the power to intercept their message into other living beings. This is something like telepathy. This force is condensed in the spinal cord of the human beings.

After the intensive research on this subject, the Soviet scientists have reached some conclusions. They are as under:

1 The basic source or seed of plasma is in the mind where it is stored in high density.

2 Bio-plasma is mostly operational in the spinal cord and in the neurons.

3 It is concentrated more in the various neuron centers of the body.

This proves the real existence of bio-plasma, which is quite similar to the concept of the subtle body as mentioned in Indian philosophy. Protoplasm is immortal, but the body is mortal. After death, the protoplasm does not perish. When we breathe, the protoplasm enters the body and through its property of nucleus it gives energy to the body. When the nucleus and its carrier agent protoplasm are weakened, we loose cetna (our living force). After death this protoplasm leaves the

body and get merged into the environment. It then travels further through vegetation and finally enters new bodies through nutrition. It finally transforms itself into DNA and gets a new life through birth.

This nearly proves that 'Re-birth' is a possibility as is indicated by the results of the scientific analysis. Dr.W.J.Killer, a well-known physician in London, has carried out many experiments on the patients on their deathbed. He has documented in his book "The Human Atmosphere" that there is something like a cluster of light, which remains intact after the clinical death of body.

The Soviet scientists have now endorsed the philosophical doctrine of 'Re-birth' (or Re-incarnation) or the cycle of births. They assert with certainty, "There exists subtle energy or an invisible body in the form of cluster of light, which covers the physical body in all living beings. We have obtained a proof for that." Such a cluster of light was observed through the electron microscope. Through it, they saw something as a discharge from the dying living being, which was seen only by clairvoyants earlier. Even in the living body, they could see the reflection of the same type of light.

A concept parallel to luminous body was developed by Vedic Rishis, in the form of five *kosas* (shells), and latter by western thinkers as energy bodies. The five *kosas* are *annamaya kosa, pranamaya kosa, manomaya kosa, vigyanmaya kosa* and *anandmaya kosa*. These *kosas* are normally in undeveloped state but can be developed by yogic and spiritual practices. The developed *kosas* produce many super abilities, like super natural powers, telepathy and clairvoyance, in the person. The western thinkers have described the Human Energy Fields in the body of a person. The Human Energy Field is a complex combination of overlapping energy patterns, which define the unique spiritual, mental, emotional and physical, make up of an individual. According to one school of thought a five-layer energy body system describes the Human Energy Field. In this system the physical body is counted as an energy body since all matter is ultimately energy. The other four bodies are the etheric energy body, the astral energy body, the mental energy body and the causal energy body. The higher subtle energy bodies overlap and interpenetrate the physical body. The five energy bodies make up the Human Energy Field or aura of a person. Its outer shape appears roughly egg like and extends out to 1 1/2 to two feet beyond the physical body in a normal person: however, this shape can be extended even further or contracted closer to the physical body depending on the mental and emotional state of the individual.

The energy bodies are supposed to be made of plasma. Jain philosophy regards that the luminous body is made of luminous *vargana*, which is 4-, touch subtle energy. The Human Energy Field is described for humans only but according to Jain philosophy the luminous body exists in all organisms. The luminous body in different species may consist of luminous *varganas* of different frequencies.

Different individuals of the same species have luminous bodies working on the same frequency and may possibly communicate with each other and establish a connection through telepathy if they have powers to do so. This shall not be possible between organisms of different species.

According to Bhagwati canon *tejas vargana* has eight- touch. There is also *swasochhavas vargana*, which is a mix of four touches, and eight touch matter. This requires some clarification. According to Vedic concept when an organism inhales air he also draws in *prana*, the vital energy, which is in subtle form. The *prana* energy can be considered to have four touches and the inhaled air made of GMV is eight-touch. So the concept of *swasochhavas vargana* is similar to the Vedic concept. The *prana* energy seems to be the fiery (*tejas*) *vargana*. There is mention in Vedic literature that the *prana* energy drawn in with inhaling process is discharged back while exhaling. It is probably assumed that having used their energy the prana particles become part of the body. This is same as assuming that the fiery *vargana* constitute the fiery body of the organism. The fiery body perhaps consists of both the fiery *vargana* and some subtle GMV. The fiery *vargana* may combine with GMV to provide the luminous body structure. Then the fiery *vargana* can be said to have eight- touch as pronounced by Bhagwati canon. Thus the fiery *vargana* exist as four-touch energy in the *loka* and perhaps as eight- touch matter in the fiery body. The fiery body, therefore, must have some weight, howsoever, small.

5.7 Sound (*Bhasha*) *Vargana*

Jain philosophy distinguishes between word and speech. A word is a sound produced by the movement of tongue and is a physical phenomenon accomplished with the help of brain, mind and prana. Imparting the intended meaning to the word is a mental and psychic process. The mental resolve to speak makes the speech biopotential karma to rise emitting a karma wave. This wave attracts appropriate sound vargana from the cosmos. The incoming sound vargana waves interact with the conscious mind and are conditioned to carry the intended meaning. The resultant wave is superimposed on to the sound wave produced in the throat giving rise to the speech wave. The speech wave travels in the space medium, usually air, and reaches the ear of the recipient subject who grasps the meaning carried by the wave with the help of his brain, mind and the ear mechanism.

Thus sound vargana fulfills the need of producing speech and transmitting the information to the recipient subject.

5.8 *Mano* (Mind) *Vargana*

According to Jain philosophy there are two kinds of mind, *dravya manah* the physical mind and *bhava manah*, the psychical mind or power of the soul. The physical mind is made of *mano vargana*. Only vertebrates have mind, in invertebrates some kind of neuron structure performs the function of mind. The functions of mind are thinking, making choices, memory, pondering, meditating and imagining. All these activities of the soul require a medium in the form of physical mind (*dravya manah*). In science a distinction is often made in the philosophy of mind and the brain, and there is some controversy as to their exact relationship, leading to mind-body problem. The brain is defined as the physical and biological matter contained within the skull, responsible for all electrochemical and neuronal processes. The mind, however, is seen in terms of mental attributes, such as beliefs and desires. Some adhere to metaphysical dualistic approaches in which mind exists independently of the brain in some way, such as soul or epiphenomenon or emergent phenomenon. Other dualisms maintain that mind is a distinct physical phenomenon, such as electromagnetic field, or a quantum effect. Materialistic options include beliefs that mentality is

behaviour or function or, in the case of computationalists and strong AI theorists, computer software (with brain playing the role of hardware).

In spiritual sciences the *manomaya kosa* and the mental energy body are assigned functions similar to mind. They are supposed to store the thoughts, experiences, beliefs and memories. The mental body and astral body are supposed to be connected. The mental body usually appears as yellow light radiating around the entire body from head to toe, and extends from three to eight inches beyond the physical body. Within this area, individual thought form appear as small 'blobs' of light of varying form and intensity. The astral body also contains energy 'blobs' of all colours of the rainbow, depending on the specific feeling or emotion. The astral body is supposed to contain the emotional patterns, feelings and vibrations that determine our personality, and also how we feel about ourselves and interact with others.

The omniscient knows and perceives the things in their absolute state. He does not make choices and there are no options for him. His knowledge is perfect, he only perceives the truth and there can be no deviation in his knowledge and perception. His knowledge and perceptions are made by the soul and the sense organs play no role in these experiences. The omniscient in the 13th stage of spiritual development has destroyed the four psychical karmas and his *manah* has been dislodged from the luminous body. The brain, spinal cord and heart are still present in his body and therefore, to equate them with *manah* shall be fallacious. The *manah* or mind must be a part of luminous body.

The *manomaya kosa* or mental energy body, made of *mano vargana*, is a part of general fiery (*tejas*) body and can be regarded as mind (conscious). Of course, mind and brain are related. In a way the brain is hardware and mind is software loaded on *mano vargana*. *Mano vargana* have positive or negative charge. One of them may store positive thoughts and the other negative thoughts.

5.9 *Karman Vargana*

The *karman vargana* constitutes the karma body, containing various types of karma. Karma infects and defiles all worldly organisms and veils, vitiates or obstructs the natural qualities of a pure soul. There are eight primary types of karma.

1. Knowledge obscuring (*Jnanavarna*) karma obscures the pure and perfect knowledge.
2. Intuition obscuring (*Darshanavarna*) karma obscures the pure and perfect intuition.
3. Bliss obscuring (or Feeling producing) (*Vedniya*) karma holds up the self - generated bliss and produces the feelings of pleasures and pain, joy and grief (in worldly life).
4. Deluding (*Mohaniya*) karma produces delusion - metaphysical and ethical and: (a) prevents the innate ability of belief in truth, (b) destroys equanimity of conduct.
5. Energy obstructing (*Antaraya*) karma obstructs / suppresses the spiritual energy and vitality.
6. Life span determining (*Ayuasya*) karma determines the biological species as well as their life span.
7. Form producing (*Nama*) karma determines the features of body, diversities and individual morphological traits.
8. Status or Inheritance determining (*Gotra*) karma determines the status of parents or inheritance.

Each of these primary types is divided into several sub-types. The total number of sub-types is 148.

The eight types of *karma* are divided into two categories

(i) Psychical (*ghatin*) karma. These karmas obstruct the natural abilities of the soul. 1st, 2nd, 4th and 5th types of karma fall in this category.

(ii) Physiological (*aghatin*) karma. This karma does not obstruct the natural abilities of the soul but compels it to have an embodied existence. The 3rd, 6th, 7th and 8th types of karma belong to this category.

A living being is engaged in some kind of activity, may it be through body, speech or mind or some combination of these. These actions and accompanying passions induce vibrations in the soul. The nature of vibrations depends on the type of action and the magnitude of vibration depends on the intensity of passion. Two things happen due to vibrations in the soul. First, the karma body also vibrates because of resonance. Second, the vibrating soul attracts *karman vargana* from the surroundings. The *karman vargana* bonding with the soul become part of karma body and are called karma. This karma carries the impression of the source action.

There are four kinds of karma bonds.

1. Numerical strength of bond (*Pradesa bandh*). The *pradesa* bond means the number of *karman vargana* binding with each soul *pradesa*. The bonding is uniform over all *pradesas*. Numerable, innumerable or infinite number of *karman vargana* may bond with each *pradesa* depending on the strength of action.
2. Nature of karma bond (*Prakriti bandh*). This determines the type of karma (one or more) bonding with the soul.
3. Duration of bond (*Stithi bandh*). This determines the duration of time for which the karma remains attached to the soul. The total duration consists of two parts, the passive and active duration. In the passive period the karma remains dormant and shows no effect on the soul. In the active period the soul experiences the prescribed effect of karma. The duration of the passive period is fixed at the time of bonding, lesser is the strength of passion smaller is the duration. The actives period is much small as compared to the passive period. After the end of active period the karma separates from the karma body and migrates to the surroundings in the form of *karman vargana*.
4. Intensity of bond (*Anubhag bandh*). This determines the intensity of experience, good or bad, the soul enjoys when the karma becomes active. This is also decided at the time of bonding. A strong passion binds high intensity karma and vice versa.

The numerical strength of the bond and nature of karma are determined by yoga, the activities of mind, speech and body, and the duration and intensity of bond depend on the passions of the soul that cause bonding.

The soul under the influence of passions and yoga experiences vibrations. These vibrations induce vibrations in the karma body, which are typical of the karma active at that instant. These vibrations produced by active karma are known as *adhyavasaya*. The *adhayavasaya* waves interact with the luminous body and brain. On interaction with luminous body the *adhayavasaya* are converted into another kind of vibrations called *lesya*. The *lesyas* interact with endocrine glands and regulate the secretion of hormones. The hormones mix with blood and reach the nervous

system and the brain that manages and controls our emotions, thoughts, speech, conduct and behaviour. Thus, karma acting through *lesya* and hormones determine our personality and traits.

Lesya provide connection between the subtle body and the physical body. They act in both directions. They pick up the signals from the soul through *adhyavasaya* and produce our feelings and through it transmit the message to the mind and body. On the other hand what mind, speech and body perform is communicated by *lesya* to the karma body. *Adhyavasaya* are present in all organisms, vertebrates only possess the mind. The *adhyavasaya* perform the function of mind in invertebrates. Some of the *adhyavasaya* bypass the luminous body and directly enter the brain producing an imprint of all our past memories and impressions.

Scientists have established that all living systems emit a weak light current of some photons. The intensity of this ultra weak light is nearly equal to intensity of light received from a candle placed at a distance of 10 kilometer. This light, called "bio photons", is supposed to regulate the whole biochemistry and biology of life. Scientists believe that molecules have no intelligence, despite the manifold impressive functions that have been assigned to them. Even the enzymes or messenger molecules have to be triggered by external energy i.e. photons which activate the diversion transition state complexes. These activation energies cover the whole electromagnetic spectrum. The non-thermal bio photons provide the right quantum energies at the right place and right time for the millions of reactions taking place per second per cell.

The bio photon emission is indicative of an endogenous, innate, electromagnetic field pervading the entire organism, which may act as both sender and receiver of the bio photon that are "electromagnetic bio-information" used in regulating life processes. This observation, among others, suggests control within the living state and is non-local and possibly electromagnetic in nature. Many significant correlations between features of the weak biological light and a number of fundamental biological processes, such as cell division, death, and major shifts in metabolism, exist. These correlations may indicate that the light (electromagnetic field of the organism) is a sensitive global expression of biological regulating processes.

We have two important discoveries coming from two different sources. One, the Jain philosophy says that there is a karma body in every organism, the emissions from this body in the form of *adhyavasaya* and *lesya* control and regulate the mind, body, speech and behaviour of organisms. The second, science indicates that every organism has a coherent electro magnetic field; the emissions from which regulate life processes. We clearly see the equivalence between the karma body and the coherent electromagnetic field present in organisms. We are, therefore, compelled to believe that the karma body is the coherent electromagnetic field the scientist's have discovered. The scientists do not know why such a electromagnetic field exists in organisms but Jain philosophy provides the answer. It is now easy to understand the source of intelligence in bio photons. The intelligence comes from the soul, which is the ultimate source of *adhyavasaya*. Being coherent electromagnetic field the karma body is very powerful and can store immense amount of information for very long time, up to thousands of years.

It is interesting to compare the functions of body determining karma and genes. A close examination shows that the genes are performing almost the same functions, which are assigned to various bodies determining karma. For example, the decisions like type of body, skeleton structure, pigment in body skin, fully developed or deficient body, morphology of body, etc are features

common to both. The genes carry all the instructions for making proteins. Only a part of the total DNA code is used at any particular location, to produce a cell suitable to that location. Who regulates the set of instructions to be followed? According to Jaina doctrine the karma body makes such decisions. The body determining karma contains the information required for constructing the body and body parts of any species. The feeling producing karmas are probably instrumental in producing faulty genes that develop various diseases and produce pain in the body. Division of cells determines the growth and maintenance of body. Scientists do not know the definite reason for cell division. According to Jainas the life – span determining karma and some body making karma must be responsible for division of cells. The process of inheritance is based upon the process in which the offspring receives one of each gene pair from each parent. According to Jainas the status determining karma decides the status and traits of the parents an organism inherits, in other words the heredity. Thus we find that the physiological karma operate at the level of genes. Recently a gene affecting the faith of a person has also been found. It implies that some psychical karma may also influence the genes. The psychical karma appears to be related to lesya, which produce our feelings that cause the endocrine glands to secrete hormones and control the body functions.

We now explain the bondage of karma. Under the action of yoga and passions the soul and hence the karma body vibrates. The frequency of vibration depends on the actions and passion; different types of actions and passions induce different frequencies. When the karma body vibrates at a particular frequency, the *karman vargana* of the same frequency are attracted and attach themselves with the existing karma of the same type. The bonded karma forms plasma like structure that assumes the shape of the physical body: The passion is the binding force between the old and new karma. The number of *vargana* bonding at any instant depends on the action; stronger the action larger is the number of *vargana* bonding on each soul *pradesa*. The duration and intensity of bond are determined by strength and type of passion. Bonding of *vargana* of different frequencies (that is different types of karma) takes place with any soul *pradesa* at any instant.

The shedding of karma from the karma body is a reverse process. On the expiry of passive time period, or on account of some initiative taken by the individual, vibrations specific to karma to be shed originate. The vibrations of specific frequency activate the respective karma, which shed uniformly and simultaneously from all soul *pradesa* depending on the intensity of action and passion. Strong passion shed more *vargana* resulting in intense experience by the soul. As infinite number of *karman vargana* bond for any karma the process of shedding continues for some time called the active period of karma. The shed karma as *adhyavasaya* interact with the luminous body and produce *lesya* waves in case of obstructing karma or produce bio photons in case of non-obstructing karma. In either case the organism experiences the outcome of the shed karma.

According to Jain philosophy the merit, good deeds, of an individual are light, and the demerit, bad deeds, are heavy. This implies that merit karma and demerit karma are made from different kinds of *vargana*. It appears that merit karmas are made from negative *karman vargana* and demerit karma are made from positive *karman vargana*. It is believed that a soul earning merit goes to heaven and a soul earning demerit goes to hell. This means that a soul having karma made up of negative *karman vargana* travels to heaven and the soul having karma made up of positive *karman vargana* travels to hell. Therefore, the lands in heaven must be such that they allow entry

to souls having negative *karman vargana* and the lands in hell allow entry to souls having positive *karman vargana*. A soul having a mix of merit and demerit is reborn in middle *loka*. This leads us to believe that the lands in heaven (upper *loka*), hell (lower *loka*) and the middle *loka* (like Earth) should be of different character.

5.10 Individual Body (Pratyeka Sarira) *Vargana*.

The four types of immobile beings namely earth body, water body, fire body and air body beings, most trees and grass etc. (autotrophic), celestial beings, infernal beings, migratory body and human beings in the 13th and 14th stages of spiritual development, called *sayoga kevali* (active omniscient) and *ayoga kevali* (silent omniscient) respectively, are supposed to have individual body. This means that these beings are the sole owner of their bodies; no other organisms share their bodies. Each individual body organism has actually three bodies, the physical body, and fiery body and karma body.

According to Jain philosophy the physical body of a normal human being (and animals) contains infinite number of nano and microorganisms. Scientific study also shows that there are a large number of bacteria, archaea, and viruses in the body of human beings and other animals. With spiritual advancement to the 12th stage, according to scriptures, most of the nano and microorganisms are destroyed and none of them is left in the body in the 13th stage, the stage of omniscience. It is perhaps for this reason that the physical body in the 13th and 14th stages is supposed to be individual body. Similarly, the body of a celestial being or an infernal being, or a migrating body, which are fluid type, do not contain nano organisms and so are called individual body.

Some bacteria are autotrophic and, like plants, obtain their food by photosynthesis. We know that photosynthesis requires the supply of solar radiations. The bodies of autotrophic plants and such bacteria cannot grow without sunlight.

So we have two types of individual body beings. In the first type we have human beings in the 13th and 14th stage of spiritual development, celestial beings, infernal beings, and migratory bodies. It is believed in Jain philosophy that the human beings in the 13th and 14th spiritual stages do not generally consume any nutritional food by mouth. So is the case with celestial beings, infernal beings and migratory beings. Such beings are therefore neither autotrophic nor heterotrophic. The second type of individual body beings are autotrophic plants and bacteria, they make their food with the help of sunlight. Limiting to the second type, we infer that sunlight is the individual body *vargana*, which develops their gross bodies. The human beings in the 13th and 14 spiritual stages, the celestial beings and infernal beings are though not autotrophic may yet use sunlight in some way that we do not know. If that happens then there is all the more reason to believe that they make use of individual body *vargana*, the sunlight, for their sustenance.

The bioelectricity, in the form of *ahara vargana*, responsible for growth and development of organisms is also found in plants. This means that autotrophic plants need two types of *vargana* for their growth; they need individual body *vargana* in addition to *ahara vargana*. Emission of bio photons is also found in plants. This confirms that plants have karma body.

The inference that individual body *vargana* is sunlight is of great scientific significance. It establishes a scale of equivalence between *vargana* and electromagnetic radiations. Sunlight is supposed to be made of photon, which is regarded, as a quantum of electromagnetic radiation, has

zero rest mass, and energy equal to the product of the frequency of the radiation and Planck's constant. In some context the photon is regarded as an elementary particle. According to Jain philosophy the photon as individual body *vargana* contains infinite number of *paramanus*. So the *paramanu's* quantum energy in Jain philosophy is infinitely smaller than photon. The individual body *vargana* is the lowest order eight-touch *vargana* (leaving out the nil *vargana*). So, photon is (i) smallest eight-touch matter having a mass, howsoever small and (ii) subject of all the four fundamental forces including gravity. The four-touch lower order *vargana* are much smaller than photon and are not subject of any of the fundamental force.

5.11 Large *Nigod* and Small Nigod *Vargana* (LNV & SNV).

The study of microorganisms and viruses is relevant for the study of these *vargana*. A microorganism or microbe is an organism that is microscopic (too small to be seen by the human eye). Microorganisms include bacteria, fungi, archaea or protists, but not viruses and prions, which are generally classified as non-living. Most microorganisms are single-celled, or unicellular, but some are microscopic, and some unicellular protists are visible to the average human. Bacteria measure from 0.5-5.0 micrometers and viruses generally from 10-300 nanometers. Most viruses are unable to be seen with a light microscope but some are as large as or larger than the smallest bacteria and can be seen under high optical magnification. Electron Microscopy is the commonest method used to study the morphology of viruses. Microorganisms live almost everywhere on Earth where there is liquid water, including hot springs, on the ocean floor, and deep inside rocks within the Earth's crust. Microorganisms are critical to nutrient recycling in ecosystems as they act as decomposers. As some microorganisms can also fix nitrogen, they are also an important part of the nitrogen cycle. However, pathogenic microbes can invade and grow within other organisms and cause diseases that kill millions of people and other animals every year.

Prokaryotes are organisms that lack a cell nucleus and the other organelles found in eukaryotes. Prokaryotes are almost always unicellular, although some such as mycobacterium can aggregate into complex structures as part of their life cycle. These organisms are divided into two groups, the archaea and bacteria. Bacteria are the most diverse and abundant group of microorganisms on Earth. Bacteria inhabit practically all environments where some liquid water is available and the temperature is below $+140^0$C. They are found in seawater, soil, and animal gastrointestinal tracts, hot springs and even deep beneath the Earth's crust in rocks. There are typically 40 million bacterial cells in a gram of soil and a million bacterial cells in a milliliter of fresh water. There are approximately 10 times as many bacterial cells as human cells in the human body, with large number of bacteria on the skin and in the digestive tract. The number of bacteria in the world is estimated to be around five million trillion trillion, or $5x10^{30}$. Under optimal conditions bacteria can grow extremely rapidly and can double as quickly as every 10 minutes.

Archaea are also single - celled organisms that lack nuclei. Archaea differ from bacteria in their genetic and biochemistry. Archaea were originally described in extreme environment, such as hot springs, but have since been found in all types of habitats. Only now are scientists beginning to appreciate how common archaea are in the environment, with crenanrhacota being the most common form of life in the ocean, dominating ecosystems below 150 m in depth. These organisms are also common in soil and play a vital role in ammonia oxidation.

All living things, which are individually visible to the naked eye, are eukaryotes (with few exceptions), including humans. However, a large number of eukaryotes are also microorganisms. Unlike bacteria and archaea, eukaryotes contain organelles such as cell nucleus, the Golgi apparatus and mitochondria in their cells. Unicellular eukaryotes are those eukaryotic organisms that consist of a single cell throughout their life cycle. This qualification is significant since most multi cellular eukaryotes consist of a single cell called a zygote at the beginning of their life cycles. Microbial eukaryotes can be either haploid or diploid, and some organisms have multiple cell nuclei. However, not all microorganisms are unicellular as some microscopic eukaryotes are made from multiple cells of eukaryotic groups; the protists are most commonly unicellular and microscopic. This is a diverse group of microorganisms, which are not easy to classify. Several algae species are multi cellular protists, and slime molds have unique life cycles with unicellular, colonial, and multi cellular stages. The green algae are a large group of photosynthetic eukaryotes that include many microscopic organisms. Although some green algae are classified as protists, others such as charophyta are classified with embryophyte plants, which are the most familiar group of land plants. The fungi have several unicellular species, such as baker's yeast.

All animals are multi cellular, but some are too small to be seen by the naked eye. Microscopic arthropods include dust mites and spider mites. Microscopic crustaceans include copepods and the cladocera. Another common group of microscopic animals are the rotifers, which are filter feeders that are usually found in fresh water.

Certain microbes have adapted so that they can survive and even thrive in condition that are normally fatal to most life forms. Microorganisms have been found around under water black smokers and in geothermal hot springs, as well as in extremely salty bodies of water. Extremophiles have been isolated from rocks as much as 7 kilometers below the earth's surfaces, and it has been suggested that the amount of living organisms below the earth's surface may be comparable with the amount of life on or above the surface. Extremophiles have been known to survive for a prolonged time in a vacuum, and can be highly resistant to radiation, which may even allow than to survive in space.

In contrast to higher organisms, bacteria exhibit an extremely wide variety of metabolic types. Bacterial metabolism is classified on the basis of three major criteria: the kind of energy used for growth, the source of carbon, and the electron donors used for growth. An additional criterion of respiratory microorganisms is the electron acceptors used for aerobic or anaerobic respiration. Carbon metabolism in bacteria is either heterotrophic or autotrophic. Energy metabolism of bacteria is either based on phototrophy or chemiotrophy.

A virus is a sub-microscopic infectious agent that is unable to grow or reproduce outside a host cell. Each viral particle, or virion, consists of genetic material, DNA or RNA, within a protective protein coat called caprid. Their shape varies from simple helical and icosahedra (polyhedral or near- spherical) forms, to more complex structures with tails or an envelope. Viruses infect cellular forms of life and grouped into animal, plant and bacterial viruses. It has been argued whether viruses are living organisms. Some consider them non-living, as they do not meet the criteria of the definition of life. For example, unlike most organisms, viruses do not have cells. Viral populations do not grow through cell division; instead, they use the machinery and metabolism of host cell to produce multiple copies of themselves. However, viruses have genes

and evolve by natural selection. They have been described as organisms at the edge of life. Some viruses, like tardigrade and others, can be preserved for years in dried powder state. When mixed with water they come to life again and start their activities in a host cell.

An argument can be made that accepted forms of life use cell division to reproduce, whereas viruses spontaneously assemble within cells. The comparison is drawn between viral self-assembly and the autonomous growth of non-living crystals. If viruses are considered alive, then the criteria specifying life will have to exclude the cell. If viruses are said to be alive, the question could follow of whether even smaller infectious particles, such as viriods and prions, are alive.

We now consider the classification of microorganisms on the basis of Jain philosophy. Most microorganisms, including bacteria, algae, etc., have tail in the form of flagelium or flagella that imparts movement in the medium they live in. From this consideration the microorganisms are mobile beings and must have at least two senses, touch and taste. The taste sense indicates that these organisms possess a mechanism for taking in food and digesting it to produce energy. We know that most microorganisms are heterotophs and some are autotrophs and chemiotrophs.

Viruses are a different class of organisms, smaller than microorganisms and considered to be at the edge of life. This means that they are part living and part non-living. Their consciousness is mostly latent a very small - explicit fraction enables them to enjoy life. Virions and prions are still smaller particles having even a smaller fraction of consciousness in the explicit state. Viruses do not have self-mobility (only complex viruses have tail) and are transported from one place to another by some medium. Viruses, therefore, qualify to be immobile organisms. The next question is whether they are large or small type. The small type of immobile organisms (*suksma nigod jiva*) are extremely small and do not interact (*apratighati*) with any other living being. Hence viruses, which interact with other organisms, must be considered as large immobile organisms. Each virus consists of several smaller virion particles, a structure that is typical of large nigod organisms.

A complete virus particle, known as a virion, consists of nucleic acid surrounded by a protective coat of protein called a capsid. Viruses can have a lipid 'envelope' derived from the host cell membrane. A capsid is made from proteins coded by viral genome. An enormous variety of genomic structure can be seen among viral species; as a group they contain more structural genomic diversity than the entire kingdoms of plants, animals, or bacteria. Viruses may employ either DNA or RNA as the nucleic acid. Rarely do they contain both. According to Jain philosophy the karma and gross bodies of large *nigod* organisms is made from LNV. But we have seen that the gross body of virus is made of protein and nucleic acid, like other mobile organisms. The karma body of virus however, may be made of LNV instead of *karman vargana*. Whether LNV also has a role in the construction of gross body is not known scientifically. But this possibility cannot be denied.

We have stated earlier that bulbous roots and roots of various sorts are examples of large microorganism. The roots grow in soil, which is attached to their body. We know that the soil contains large amount of bacteria. Perhaps it is for this reason that roots have been described as large microorganism and common body plants. If the upper layer of roots containing bacteria is removed; the remaining root should be treated like any other solitary plant.

The existence of small *nigod* organisms is known only to omniscient or to humans having high clairvoyance power (*param avadhi jnana*). These organisms are not likely to be discovered by

science, as they do not interact with other organisms or instruments. The occurrence of large *nigod* organisms, viruses, is limited but small *nigod* organisms are found all over *loka*. The small *nigod* organisms are so small, perhaps of atomic size, that their karma, luminous and gross bodies are supposed to be made of same *vargana*, SNV. In other words they have only one body, which fulfills the functions of gross, luminous, and karma bodies. This is the kind of body the soul has been having from the very beginning. The SNV being smaller than GMV, the small *nigod* organisms are a class different from viruses and cannot be seen even by electron microscope. A virion may contain innumerable small *nigod* organisms as claimed by Jain philosophy.

Some interesting aspects emerge from above analysis. The karma body stores information. The amount of information to be stored would depend on the state of development of consciousness of the organism. Humans are highly developed organisms and have more information than animals and animals in turn have more information than insects. Going down the line viruses have the least amount of information. The soul uses an appropriate medium to store the information. All mobile organisms use *karman vargana* for storing information. *Karman vargana* appear to be information intensive and can store very large amount of information for very long time. Viruses use LNV to store the little information they have. The small *nigod* organisms have the least amount of information and this is stored on the same *vargana*, which constitutes their gross body. Thus the soul makes an appropriate choice of material for constructing the various bodies.

Do small *nigod* organisms have genes? Normally genes are made of GMV. The question is whether such structures can also be made from SNV, and going further, whether they are essential for an organism. Since the small *nigod* organism has a sense of touch, some kind of organization, structure and regulation would be required for operation of its body. So it is imagined that small *nigod* organisms may have some primitive kind of gene like structure made of SNV that contains the necessary information code for construction and operation of the body. According to Jain philosophy their life span is very short, may be a few seconds (they complete 17 life cycles in one breathe). Oxygen made of GMV cannot be inhaled by organisms made of SNV and so the small *nigod* organism live without oxygen and survive all over *loka*, perhaps including places like sun. How small *nigod* organisms can be killed? They do not interact with GMV so perhaps cannot be killed by conventional methods. They are, of course, larger than photon and so may be killed by radiations.

Let us now consider what earth body, water body, air body and fire body organisms are? They are also assumed to be as small as small *nigod* organisms. It they really exist independently then their existence is not explained by *vargana* analysis. If they are same as small *nigod* organisms then their different nomenclature appears to be based on different habitats, earth, water, air and fire. In the later case the four types of organisms are fundamentally same. Another possibility is that the bacteria and viruses present in earth, water, air and fire are respectively called organisms of that class. In this case these organisms can be killed and justify the carefulness the Jains so faithfully observe.

5.12 Permanent Nil *Vargana* (PNV)

These *vargana* are supposed to constitute aggregates, which are not detectable directly. What is the significance of this kind of reality? We recall from $3.4 that about 70 percent of the

mass- energy of the universe is in the form of so-called dark energy which is not directly associated with particles. The precise nature of dark energy is not known. The remaining 30 percent of the universe's mass-energy comes from matter, particles and mass. Around 25 percent part of this matter is supposed to be dark matter, which is not supposed to be composed of normal Standard Model particles. Experiments indicate that the dark matter forms galaxy - sized dumps under the effects of gravitational force.

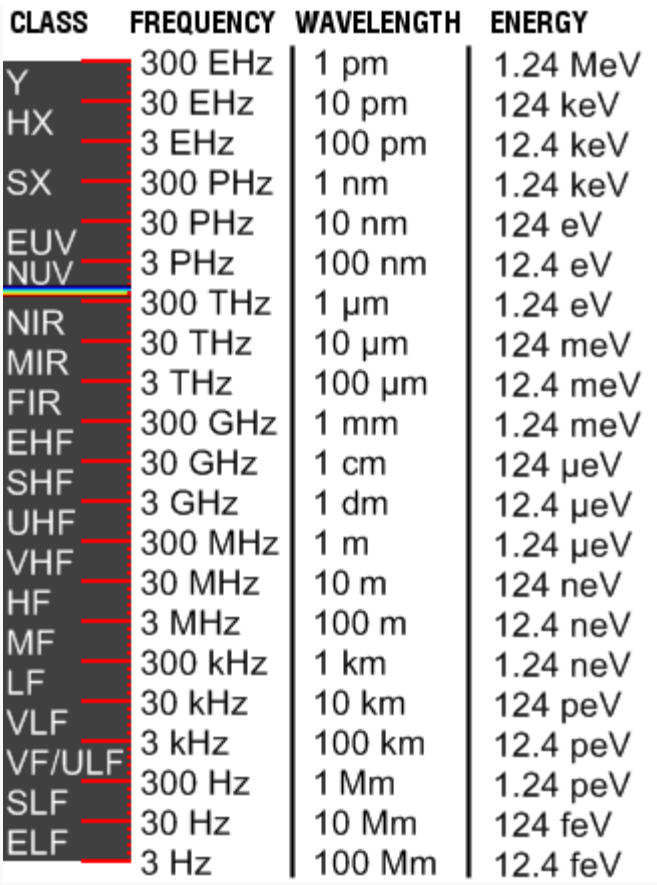
We know from Jain philosophy that the total mass energy in the *loka* exists as *vargana* (energy) and their aggregates. Only a part of the last gross matter *vargana* exists as particles, which, according to science is 4-5 percent of the total mass- energy in the universe. All other *varganas* of lower and higher order constitute the remaining 95 percent mass energy (these percentage are true for universe which, according to Jain philosophy, is the middle *loka* as shown in chapter 6. Considering the whole *loka* the percentage values will change). The permanent nil *varganas*, which have gravitational property and escape direct detection may account for the so-called dark matter. The share of permanent nil *vargana* as dark matter in the universe may be 25 percent. Out of remaining 75 percent 5 percent exists as particles and 70 percent as *varganas* of different order and kind i.e. dark energy.

5.13 The *Vargana* Spectrum

As the *varganas* are electromagnetic, they, like electromagnetic radiations, can be arranged on a spectrum. The *vargana* spectrum is comprised of all the *varganas* from the Anu Vargana to Gross Matter Vargana arranged in increasing energy order as was shown in figure 5.1. The first 14 lower *varganas* exist in unbound form and are mass less; they do not interact with solids, liquids and gases. The higher *varganas* from 16th PNV-1 to 23rd GMV are 8-touch type and interact with matter. The 15th Intermittent Regular *Vargana* may exist both in unbound or bonded state that is it may be mass less some time and may have a mass at other time.

The electromagnetic spectrum is the range of all possible frequencies of electromagnetic radiation as shown in figure5.2. The “electromagnetic spectrum” of an object is the characteristic distribution of electromagnetic radiation emitted or absorbed by that particular object. The electromagnetic spectrum extends from low frequencies used in modern radio to gamma radiation at the short-wavelength end, covering wavelengths from thousands of kilometers down to a fraction of the size of an atom. The long wavelength limit is the size of the universe itself, while it is thought that the short wavelength limit is in the vicinity of the Plank length, although in principle the spectrum is infinite and continuous.

Generally, EM radiation is classified by wavelength into radio wave, microwave, infrared, the visible region we perceive as light, ultraviolet, x-rays, gamma rays and cosmic rays. The behaviour of EM radiation depends on its wavelength. Electromagnetic radiation interacts with matter in different ways in different parts of the spectrum. The types of interaction can be so different that it seems to be justifiable to refer to different types of radiation. At the same time, there is a continuum containing all these “different kinds” of electromagnetic radiation. There are no precisely defined boundaries between the bands of electromagnetic spectrum. Radiation of some types has a mixture of the properties of those in two regions of the spectrum. For example, red light resembles infrared radiation in that it can resonate some chemical bonds.



Legend

γ= Gamma rays
HX= Hard X-rays
SX= Soft X-rays
EUV= Extremeultraviolet
NUV= Near ultraviolet
Visible light
NIR= Near Infrared
MIR= Mid infrared
FIR= Far infrared
Radio waves
EHF= Extremely high freq.
SHF= Super high freq.
UHF= Ultra high freq.
VHF= Very high freq.
HF= High freq.
MF= Medium freq.
LF= Low freq.
VLF= Very low freq.
VF/ULF= Voice freq.
SLF= Super low freq.
ELF= Extremely low freq.
Freq=Frequency

Fig 5.2 Electromagnetic spectrum

It is interesting to compare the two spectrums. They are seen to have some common features like (1) they have arrangement of electromagnetic entities in a given order, (2) the properties of each electromagnetic entity is different , (3) the boundary between two adjoining entities is not well defined and (4) despite differences in entities there is a continuum justifying the spectrum.

The entities in the two spectrums appear to be of different kinds but we find that Individual Body Vargana of the *vargana* spectrum compares with the visible light region of the electromagnetic spectrum. This provides a basis for comparison between the two spectrums. The lower order 4-touch *vargana* must be some part of the lower EM spectrum and the higher order 8-

touch *vargana* must form some part of the upper EM spectrum. Knowing that 4-touch *vargana* do not interact with matter like EM radiation the position of the two types of entities cannot be same on the EM spectrum. It is justifiable to assume that the 4-touch *vargana* must be placed lower than the lowest EM radiation on the EM spectrum. The *paramanu* must be at the lowest end of the spectrum. Now considering the lower *vargana* spectrum we are left with the 15th Intermittent Regular Vargana and the 16th first Permanent Nil Vargana to be compared with the radio waves, microwaves and the infrared regions. Assuming that the upper part of infrared region can combine with the visible region and the lower part with the microwave we are tempted to suppose that the IRV compares with radio waves and the 16th PNV with the microwaves. From this analogy the microwaves are seen to be permanent nil types radiation having mass. The significance of this new possible property of microwaves must be explored.

The comparison of the upper part of *vargana* spectrum with the EM spectrum is more difficult. The upper *vargana* spectrum contains two life *vargana*, the Large Nigod Vargana and the Small Nigod Vargana, which have no equivalents in the EM spectrum. The 22nd PNV is also called Nabho or space *vargana* and compares with the cosmic rays. The 23rd and the biggest Gross Matter Vargana may have energy greater than the energy of known cosmic rays so that a large number of these *vargana* may combine to materialize the subatomic particles. The GMV may constitute the highest end of the EM spectrum. Further study of comparison between the two spectrums may prove to be useful.

One important indication of the above comparison is that the 4-touch *varganas* which constitute the subtle bodies of organisms have very low frequencies and very large wavelengths. Their interaction with the subtle bodies is expected to be similar to the interaction of radio waves with matter. The wavelength of *paramanu* may be of the size of the *loka* so that it could cross the *loka* in one *samaya*.

5.14 Concluding Remarks

The scientific interpretation of *paramanu* and *vargana* has opened a new chapter in understanding the Jain philosophy. The atom in science is conceived, as the smallest fraction of matter but the *paramanu* of Jain philosophy is the smallest fraction of energy. The Jain *paramanu*, the real quantum of energy, is far too smaller than the quantum of energy, photon, assumed by science. It is the electromagnetic character of *vargana* that enables them to pervade the entire *loka*. Many new interpretations of *vargana* have become possible on account of its electromagnetic character. This new character brings Jain philosophy close to modern science. Science has discovered particles like quark but it still remains a mystery what makes the quark. The journey of science has been from gross to fine and it has gone to the level of quark. Jain philosophy starts from the ultimate particle *paramanu* and proceeds to describe the gross form of matter. Jain philosophy says that the fundamental constituent of nature is energy and *paramanu* is its ultimate unit. *Paramanu* makes up *vargana* and *vargana* make up the gross particles like quark, electron, etc. Jain philosophy presents the subtler form of matter which science has not discovered so far. The story of matter from quark and electron onward is known to science. Thus Jain philosophy and science together reveal the complete picture of the physical existence.

Jain philosophy also offers some explanation to puzzling questions like what is mass, why there are four fundamental forces, etc. Jain philosophy yet goes further and indicates the basic

source of there forces. For this, think of formation of *vargana*. In the lower order *vargana* why should the *paramanus* cluster and why *paramanu* density should increase as we go up to higher order *vargana*? What holds the *paramanus* together and what packs them in space as number of *paramanus* in the *vargana* increases. Is there some kind of force, how so ever small, which produces an affinity between these quantum energy particles and becomes a cause for their concentration with increase in population? It may well be so. If this is so then this force, call it *vargana* force, is a prerequisite to emergence of other four fundamental forces, generated by process of bonding between *paramanus*. This *vargana* force can be assumed as the mother fundamental force from which originates the other four forces. If this is accepted, it would be a big scientific advancement.

Jain philosophy establishes that solar radiations possess mass. It also offers explanation to existence of so called vacuum energy. Perfect vacuum does not exis in space; the *vargana* are present everywhere. Hence the space is full of energy; call it vacuum energy or ether. Scientists have been going back and forth on the question of ether. Earlier a luminiferous either was proposed to find a medium of propagation of light and to satisfy the requirements of Maxwell's equations and Einstein's general relativity. Now some scientists believe that the ether is gravitational field or electromagnetic field, which can describe the quantum structure of the universe. Jain philosophy proudly says that the whole space is full of quantum energy, which, through formation of *vargana*, produces the elementary particles of the known matter.

One may ask the question how the karma body of an organism is formed. Why should karmas stay together in the form of a body? The karma body has been assumed to have as plasma like structure. The *karman vargana* lack this kind of structure and occur in *loka* in a free state. Do *karman vargana* of the karma body have some kind of bonding? Perhaps this might be so. The bonding of karma may mean that the *karman vargana* experience bonding to form karma. Bonding should produce the fundamental forces including gravity. However, the gravitational effect is likely to be negligible as *karman vargana* are infinitely smaller than GMV. The karma shall have strong and weak bonds depending on the bonding of positive and negative *karman vargana*. This may impart karma varying life; strongly bond karma lasting for more duration than weakly bond karma. The karmas, now, have eight- touch and violate the assumption made earlier that lower order *vargana* have four- touch. So we must relax our assumption to that extent and say that the lower order *vargana* are four- touch energy in the free state, they may become eight- touch in the body of a living organism. The higher order *varganas* are always eight- touch type.

It appears that the karma body cannot live without the gross body for more than 3-4 '*samaya*', the maximum time taken by the soul to transit from one body to another on death. It means that the gross body has some role in holding the karma body in place and giving it a shape. This may be due to electromagnetic attraction between the gross body and karma body on account electromagnetic nature of both the bodies. This may also be a reason for karma body to conform to the size of gross body, as it grows right from the time of conception. Once outside the gross body the karma body on its own cannot retain the shape for long and so the soul immediately enters the next body, which at that time is in the form of a single cell.

The power of Jain philosophy is evident from *vargana* analysis. It is the beauty of versatile Jain philosophy that it can deal with the phenomena of physical world as well as the living world with equal authority.

5.14.1 Motion of Soul and Matter

The motion of a *paramanu* was described in 3.1.4.1. A free *paramanu* moves due to its own intrinsic characteristic without any external influence. When part of a group, say a four touch *vargana*, the motion of a *paramanu* is also influenced by other *paramanus*. In case of eight-touch *vargana* the fundamental forces are present and they play an active role in the motion of *vargana*. As the strong nuclear force and weak force are confined to atomic region, the important forces that influence the motion of aggregates are electromagnetic force and gravitational force. At micro level of existence the effect of gravitational force is negligible as compared to the effect of electromagnetic force.

Jain canonical literature describes two types of motion;

1. ***Sparshad gati***. The *sparsh* (touch) qualities and the forces derived from them influence the motion. Here speed is the ratio of the distance traveled in space and time taken in travel.
2. ***Asparshad gati***. The touch qualities or the forces derived from them have no role in motion. The concept of time and velocity is irrelevant in this case.

Based on above we consider the following cases of motion.

(a) Motion of a *paramanu.*

A *paramanu* is *apratigati*, it does not interact with any other object. Hence there is no external influence of any kind on the motion of a *paramanu*. Its motion is *asparshad gati* type. A *paramanu* moves due to its own intrinsic characteristic of dynamic action. Its motion is hindered only when it collides with another *paramanu*, a very rare possibility. It may be noted that the laws of motion of science and the limit imposed by special theory of relativity do not apply to *paramanu* as the forces on which these laws and theories are based are absent in this case. The dynamic activity of a *paramanu* is uncertain as described before and it may move with low, medium or high velocity as determined by the property of *sadgun-hani-vridh*i. In the extreme case of high velocity the *paramanu* can travel from one end to another end of loka in one *samaya* if not hindered by another *paramanu.*

(b) Motion of four - touch *Vargana*

A four – touch *vargana* may contain two to infinite number of *paramanus.* The fundamental forces are still absent in this type of *vargana* and its motion is not governed by known laws of science and the special theory of relativity. However, there is affinity between *paramanus* in a *vargana* and so the maximum velocity of a *vargana* would be less than the maximum velocity of a *paramanu*. Due to large number of *paramanus* the chances of its colliding with other *vargana* are significant. On collision the two *varganas* may merge and form a bigger *vargana* of the same kind or a *vargana* of another kind.

(c) Motion of eight – touch *Vargana*

Eight – touch *vargana* contains *paramanus* in the bound state and has all the fundamental forces. All electromagnetic radiations fall in this category. The eight – touch *varganas*, therefore,

are expected to obey the known laws of science and the limit on speed imposed by the special theory of relativity may apply. On account of small mass the gravitational force must be negligible and the motion is largely be governed by electromagnetic force outside nucleus.

(d) Motion of particles (made of *Mahaskandh Vargana*)

At the level of subatomic particles and atoms the gravitational force is still very small and other three forces determine the motion. As the aggregates grow in size the gravitational force increases and the effect of electromagnetic force diminishes because the number of *parmanus* having positive and negative charge in the aggregate is likely to be of the same order canceling the effect of each other. Thus the motion of large particles and objects is governed mainly by gravitational force.

(e) Motion of Soul

A mundane soul in transition from one body to another body contains subtle bodies, karma and fiery, made of four – touch *varganas*. The soul, therefore, moves with high velocity and completes its journey in one *samaya* when moving in a straight line. The travel time can increase to a maximum of four *samaya* depending on the number of turns the soul has to take in its journey.

A liberated soul is free of subtle bodies and is purely non – material. No laws of physical science apply to it. No material, even a *parmanu*, can obstruct its path. The liberated soul moves instantaneously, as there is nothing to hold it, and travels to the end of *loka* in one *samaya*. The concept of conventional time, and hence of velocity, becomes irrelevant in this case. The soul cannot cross the boundary of *loka,* as *dharmastikaya* and *adharmastikaya* are absent in trans-cosmic space (*aloka)*.

Chapter 6
Jain Cosmology and Universe

6.1 *Loka* in Jain philosophy

Loka is finite space in the centre of infinite *akasa*. *Loka* has a shape and volume. The Swetambara and Digambara literature differ in respect of the shape of *loka*. The shape of *loka* according to Digambara tradition is shown in fig 6.1. It is a prismatic shape having three divisions – upper *loka*, middle *loka* and lower *loka*. The shape of upper *loka* comprises of two trapezoidal prisms, one with a base of 5 raju, top of 1 raju, height of 3.5 raju and width of 7 raju, and the other with a base of 1 raju, top 5 raju, height 3.5 raju and width 7 raju. The lower *loka* prism has a base of 7 raju, top of 1 raju, height of 7 raju and width of 7 raju. The total height of *loka* is 14 raju and the width is uniform at every height, equal to 7 raju. As per this shape the volumes of upper *loka* and lower *loka* are 147 cubic raju and 196 cubic raju respectively and the volume of whole *loka* is 343 cubic raju. Raju is a very large distance whose exact value is difficult to determine. One estimate puts its value equal to 1.45×10^{21} miles but this is not generally accepted, the actual value may be much higher.

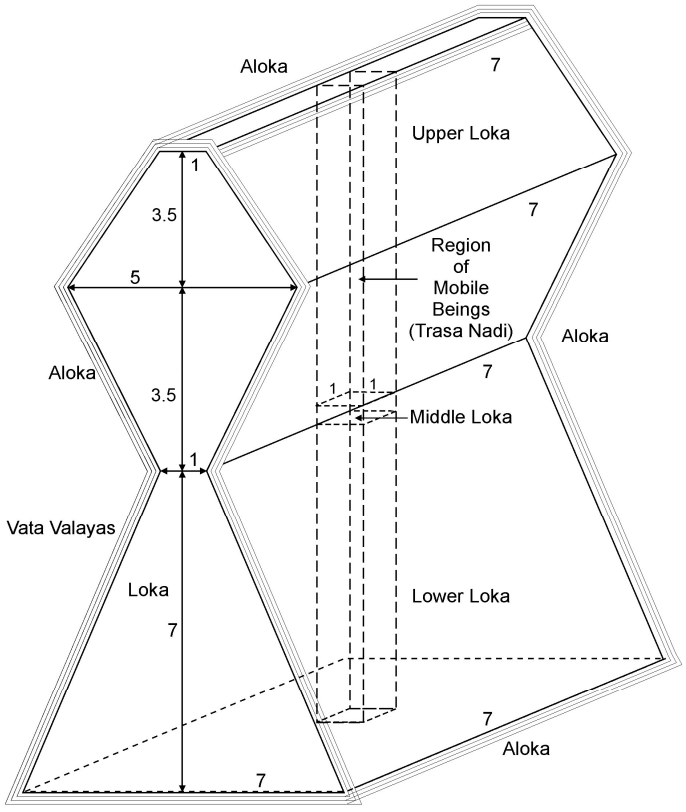


Fig 6.1: Loka in Digambara Tradition

According to Swetambara tradition the shape of *loka* is pyramid cal as shown in fig 6.2. The upper *loka* consists of two pyramids and the lower *loka* of one pyramid having dimensions as shown in the figure. At any height the dimensions of length and width are equal. The height of upper and lower *loka* is 7 raju each and the total height is 14 raju. The lower *loka* is 7x7 raju at the bottom and 1x1 raju at the top. The upper *loka* has dimensions of 5x5 raju at the height of *brahm loka*. Swetambara agree that the volume of upper and lower *loka* are 147 cubic raju and 196 cubic raju respectively and the total volume is 343 cubic raju but the shape and dimensions accepted by them do not provide these values. Muni Mehandra Kumar proposed that by assuming curved side surfaces of pyramids the volumes could be corrected. Assuming the surface curves to be cubic polynomial he derived equations for the three pyramid surface curves so that the volume of the lower *loka* is 196 cubic raju and that of upper *loka* is 147 cubic raju.

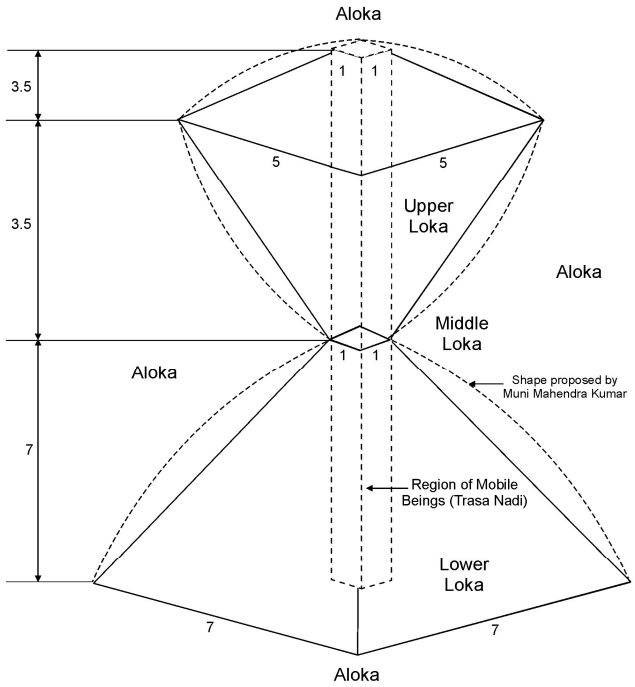


Fig 6.2: Loka in Swetambara Tradition

A third kind of *loka* is also obtained in Jaina scriptures. According to this the *loka* is *trisharavsamputakar* which means that the shape of *loka* is obtained by assembling three bowls of nearly truncated conical shape as shown in fig 6.3. The lower *loka* is an inverted bowl and two bowls placed one above another constitute the upper loka, the lower one in upright position and the upper one placed inverted over it. The two bowls of the upper *loka* provide the shape of *mridnga*, a musical instrument of drum family. The total height of *loka* is 14 raju and the height of lower *loka* and upper *loka* is 7 raju each. The width at the bottom of lower *loka* is slightly less than 7 raju. The width is 1 raju at middle *loka*, 5 raju at *brahma loka* and 1 raju at the top. The cross section of *loka* at any height is circular as against square in fig 6.2 and rectangular in fig. 6.1

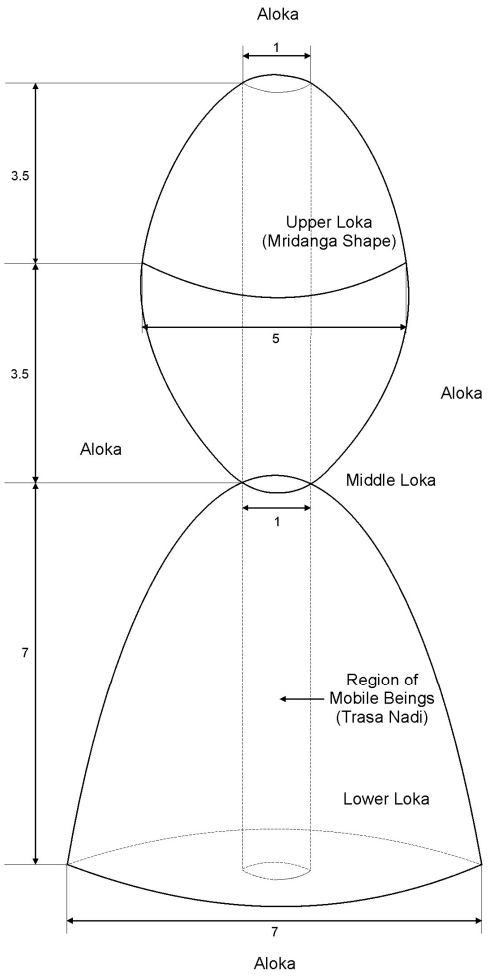


Fig 6.3: Three Bowl Shape Loka

In all three cases the central region of *loka* is called *transnadi*, or mobile zone, the abode of mobile organisms. The mobile zone has a spread of 1x1 raju in fig. 6.1 and fig 6.2 and is circular with a diameter of 1 raju in fig. 6.3. The height of mobile zone is 13 raju (leaving 1 raju at bottom) All-mobile beings, including celestial beings and infernal beings, are confined to this zone. Small nano organisms are found all over *loka*, including the mobile zone. This means that the mobile beings are found in a volume of about 13 cubic raju out of the total volume of 343 cubic raju of *loka*.

6.1.1 Lower *Loka*.

There are seven infernal lands in lower *loka* as shown in fig 6.4. Starting from top these are Ratnaprabha (gem hued), Sharkararaprabha (pebble hued), Balukaprabha (sand hued), Pankprabha (mudhued), Dhumprabha (smoke hued), Tamahprabha (dark) and Mahatamahprabha (pitch dark). The upper part of first infernal land Ratnaprabha is situated in the middle *loka*. The second infernal land is at a distance of one raju below this. Likewise all infernal lands are situated at a distance of one raju from each other. The Ratnaprabha has three divisions Khara division, Pank division and Abbahul division. These three divisions are 1600 yojana, 84000 yojana and 80,000 yojana thick

(high) respectively. Khar division is inhabited by mansion dwelling infernal beings (*Bhavanvasi deva*), Pank division is by demons and fiendish youths (*Raksasas)* and Asur Kaumar (*Vyantar deva*) and the Abbahul division by infernal beings (*Narki*). Sharkaraprabha is 32000 yojana, Balukaprabha is 98000 yojana, Pankprabha is 24000 yojana, Dhumprabha is 20000 yojana, Tamaprabha is 16000 yojana and Mahatamaprabha is 8000 yojana thick. Different kinds of infernal beings live in these six lands.

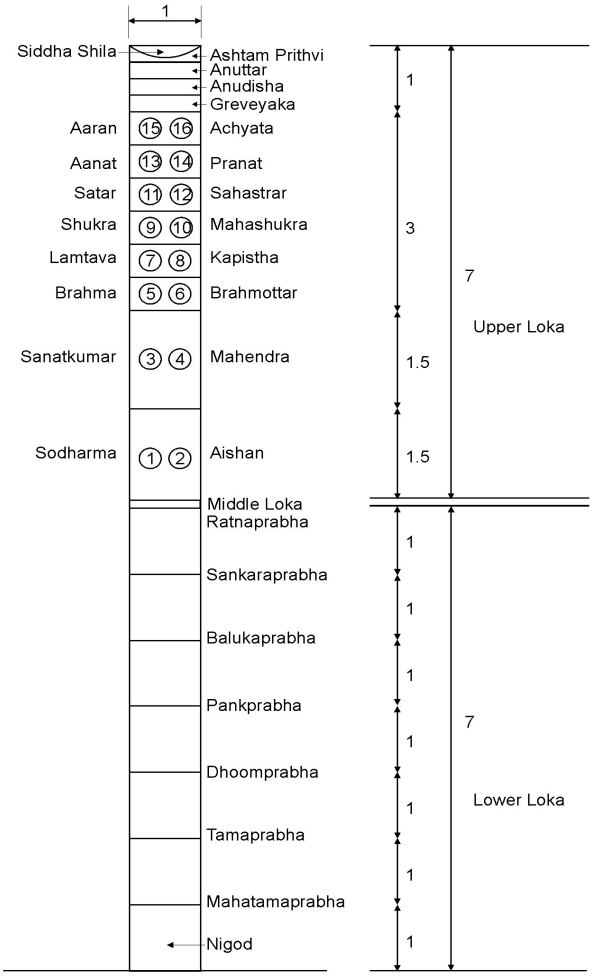


Fig 6.4: Trasnadi-Region of Mobile Beings

6.1.2 Middle *Loka*

The middle *loka* contains circular islands (*dweeps*) and oceans (*samudras*) alternatively placed as shown in fig 6.5. The central disk shaped island is called Jambudweep. Jambudweep is surrounded by ring shaped Lavana Ocean, which is surrounded by Dhatikikhand Island. The next ocean is Kalodaka *samudra* and surrounding this ocean is Pushkarvara Island. The next ocean is Pushkarvar *samudra*. In this way there are countless islands and oceans one after another. The last island is Swayambhuramana Island and the last ocean is Swayambhuramana Ocean. The width of each island or ocean is double the width of preceding ocean or island

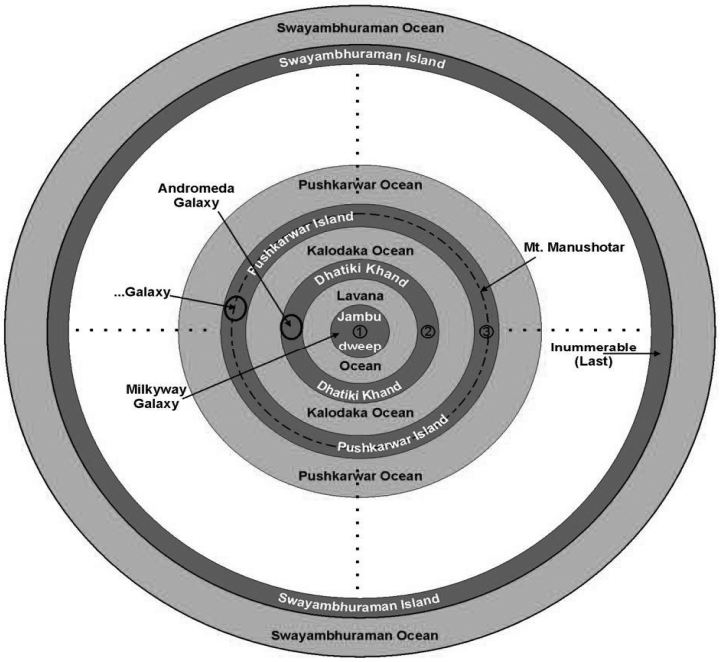


Fig 6.5: Middle Loka

The structure of entire middle *loka* follows an order. The Dhatikikhand has double number of mountains, rivers etc than Jambudweep. Pushkarvara island has these in double the number than Dhatikikhand and so on. A ring shaped mountain called Manushottara Mountain divides Pushkarvara Island in two circular halves of equal width. The inner half is similar to Dhatikikhand in respect of number of mountains, rivers etc. The Jambudweep, Dhatikikhand and the inner half of Pushkarvara Island together constitute what is called Two-and-Half Island (*Adhai dweep*). Human beings are found in this Two and Half Island part of middle *loka* only. No one, even monks having super natural powers, can cross the Manushottara Mountain. Dhatikikhand and inner half of Pushkarvara Island have two Bharat regions, two Airavat regions and two Videh regions each. So there are in all five Bharat regions, five Airavat regions and five Videh regions in the Two and Half Island. These regions are the lands of action. There are total of 170 lands of action in Two and Half Island. The people in a land of action (*karma bhoomi*) make use of weapons, writing skills, farming, trading, servicing and crafting for their living. There also exist lands of enjoyment (*bhog bhoomi*) where people do not use any of these skills and depend on trees and plants for their living and food. There are 126 lands of enjoyment in the Two and Half Island.

6.1.3 Upper *Loka* & Celestial Beings

Celestial beings are of four main types:

1. Mansion dwelling celestial beings (*Bhavanvasi deva*)
2. Wandering celestial beings (*Vyantar deva*)
3. Stellar celestial beings (*Jyotishka deva*)
4. Empyrean celestial beings (*Vaimanic deva*).

The part of *loka* above the base of mount Sumeru is called upper *loka*. Only empyrean celestial beings (*Vaimanic deva*) habitat the upper *loka*, the other three types of celestial beings lives in the middle *loka*. There are sixteen heavens (Digambara belief, 12 in Swetambara) in the 6 raju region of upper *loka* as shown in fig. 6.4. After these heavens, nine Graiveyaka, nine Anudisha and five Annuttar celestial lands are there in a region of one raju. The region between the last Annuttar land and the first outer layer (*vata valaya*) is called the Eighth Land (Ashtam Prithvi) having a height of 8 yojana. The *Sidhha loka*, abode of liberated souls, is situated in the middle of this Eighth Land.

There are 10, 8, 5 and 16 subtypes of the four main types of celestial beings respectively. The mansion dwelling and wandering celestial beings have two kings (Indras) in each subtype so that there are 20 and 16 kings for the two types of celestial beings. There are also opposition kings (Pratindra) of the same number.

The ten subtypes of mansion dwellings celestial beings are:

1. Fiendish youths – Asur Kumar
2. Serpentine youths – Nag Kumar
3. Lightening youths – Vidyut Kumar
4. Vulture youths – Suparna Kumar
5. Fiery youths – Agni Kumar
6. Stormy youths – Vata Kumar
7. Thundering youths – Stanit Kumar
8. Oceanic youths – Udadhi Kumar
9. Island youths – Dweep Kumar
10. Guardians of cardinal points youths – Dik Kumar

The eight subtypes of wandering celestial beings are: -

1. Deformed humans – *Kinnara*
2. Deformed persons – *Kimpurusa*
3. Great serpent – *Mahorag*
4. Musician - *Gandharva*
5. Treasure keeper – *Yaksha*
6. Demon – *Raksasa*
7. Devil – *Bhoot*
8. Goblin – *Pisach*

The subtypes of stellar celestial beings are

1. Sun – *Surya*
2. Moons– *Chandra*
3. Planet – *Graha*
4. Constellation – *Nakshatra*
5. Scattered stars – *Tara*

The stellar celestial beings orbit the mount Sumeru in the respective island. The time (*conventional kala*) – hour, day, night etc. exist due to motion of these celestial beings. The stellar celestial beings outside the Two and Half Islands are supposed to have no orbital motion.

There are two main divisions of empyrean celestial beings – ranked (Kalpopanna) and non-ranked (Kalpateet). In the first category the celestial beings have various ranks such as chiefs or assistant chiefs etc. In the second category there are no ranks among the celestial beings.

There are sixteen ranks in the ranked category of empyrean celestial beings living in sixteen heavens respectively.

1. Righteous - Saudharma
2. Great lord – Isana
3. Perpetual youth – Sanata Kumar
4. Supreme lord – Mahendra
5. Big Lord – Brahma
6. Super Lord – Brahmottara
7. Mysterious – Lantava
8. Banyan – Kapistha
9. Radiant – Sukra
10. Supremely radiant – Mahasukra
11. Hundred faceted – Satar
12. Thousand faceted – Sahastrar
13. Bent – Anata
14. Prostrated – Pranat
15. Beat – Arana
16. Unswerving – Achyuta

There are twenty-three types of non-ranked empyrean celestial beings living in lands beyond the sixteen heavens as follows.

(a) Nine are neck dwelling (Nav Graiveyaka)

- Three lower neck dwelling (Adho Graiveyaka) – Sudarshana, Amogha and Suprabuddha.
- Three middle neck dwelling (Madhya Graiveyaka) – Yasodhara, Subhadra and Suvishal.
- Three upper neck dwelling (Urdhva Graiveyaka) – Suman, Saumanashya and Pritinkara.
- Nine sub directional heavens (Anudisa) – Aditya, Archi, Archimalini, Vajra, Vairochana, Soumya, Saumyarupaka, Ank and Sphatika.
- Five excellent (Anuttar) – Victory (Vijaya), Victorious (Vaizayan) Conquering (Jayant), Unvanquished (Aparajita) and fully accomplished (Sarvarthsiddhi).

The age, power, happiness, radiance, purity of emotions (*lesya*), purity of senses and power of clairvoyance of the empyrean celestial beings is minimum in the first heaven and increases as we go up to higher heavens. The empyrean celestial beings of non-ranked category do not leave their lands (*Vimana*). The first four excellent empyrean celestial beings (Ahamindra) are liberated after two births as human beings as a rule. The last fully accomplished beings are

emancipated in the next birth as human being. A soul has to have a human body for liberation; liberation is not possible from celestial body.

6.1.4 Outer Layers

Three outer layers surround the *loka*. The three layers are *ghanodadhi* layer (dense like water), *ghana* layer (dense like air) and *tanu* layer (like rarefied air) as shown in fig 6.1 The first *ghanodadhi* layer is supposed to support the *loka*. The second *ghana* layer supports the first layer and the third *tanu* layer supports the second layer. The third layer is supported by *akasa*. The thickness of the three layers is not uniform. At the bottom of lower *loka* all three are 20,000 yojana thick. At the level of pitch-dark infernal land *ghanodadhi*, *ghana* and *tanu* layers are 7 yojana, 5 yojana and 4 yojana thick respectively. The thicknesses reduce towards the middle *loka*, where they are respectively 5 yojana, 4 yojana and 3 yojana. The layer thicknesses increases as we go up and become again 7 yojana, 5 yojana and 4 yojana at the level of Brahma *loka*. As we go up further the thickness decrease and become 5 yojana, 4 yojana and 3 yojana near the top of upper *loka*. The layers are thinnest on the topside of upper *loka*.

6.2 Jambudweep

We now study Jambudweep is some detail. Jambudweep is round like sun with diameter of 100000 yojana and circumference of 300000 yojana. Mount Sumeru is located at the center of Jambudweep. Two circular arc shape mountain ranges are situated on east and west side of Sumeru as shown in fig 6.6. These mountain ranges provide two separate zones called north Kuru and south (*deva*) Kuru.

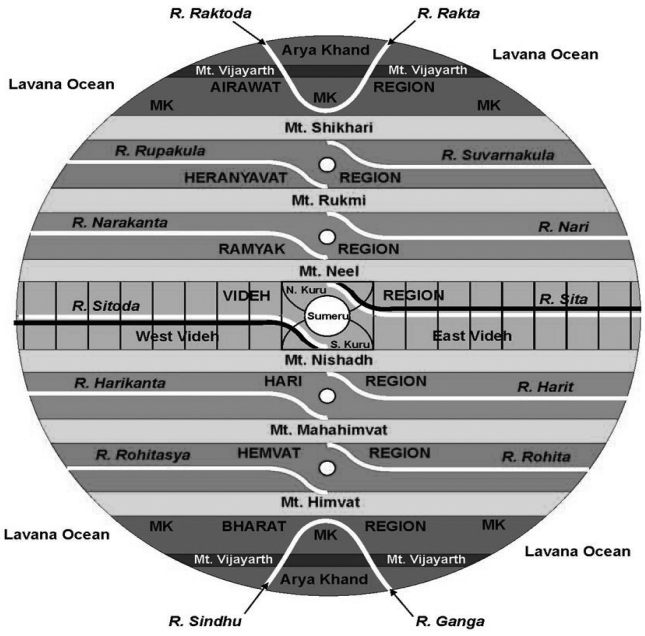


Fig 6.6: Jambudweep

Jambudweep is divided into seven regions called Bharat, Haimvata, Harivarsha, Videh, Ramayaka, Hairanyavata and Airavata. Six Kaluchala Mountains respectively called Himavata, Mahahimavata, Nishadha, Neel, Raukmina, and Sikharin as shown in fig. 6.6 separate these regions. These mountains in order have colours like gold, silver, hot gold, blue gem, silver and

gold. They have lakes (*Rhud – sasovar*) called Padama, Mahapadama, Tigicha, Kesarin, Mahapundarika and Pundarika respectively on them. Rivers called Ganga and Sindhu, Rohita and Rohitasya, Harita and Harikanta, Sita and Sitoda, Nari and Narikanta, Swarnkula and Rupyakula, and Rakta and Raktoda flow in the seven regions. The Bharat region is 526 6 /19 yojana wide. The width of the next mountain is double this value. The width is doubled in the next region and so on till we reach the central Videha region. The widths are now halved for each mountain and region in order. Thus the width of Airavat region is same as width of Bharat region.

6.2.1 Bharat Region

The Bharat region is surrounded by Lavana Ocean on three side and Himvan Mountain on the fourth side. The Vijayardh Mountain and the rivers Ganga and Sindhu divide Bharat region in six parts. The Vizayardh Mountain is 50 yojana wide, 25 yojana high, 6-¼ yojana deep and extends to Lavana Ocean at its east and west ends. The natives of this mountain are considered to be great scholars (*Vidhyadhara*), they use the six kinds of skills for living, like other human beings. Divine wandering celestial beings live on the elevated heights of this mountain. There are nine peaks on the top of this mountain on which angel like enlightened scholars and their beautiful fairy like wives live in peace and happiness.

The region south of Vijayardh Mountain, north of Lavana Oceans and between the Ganga and Sindhu rivers is known as Arya Khand. The natives of this region follow the path of salvation by observing austerity and penance. They adore virtuous life and are known as Aryas (Noble people). Aryakhand is considered to be the place of peace, prosperity, happiness and emancipation. On the east and west side of Aryakhand and on the north of Vijayardh Mountain there are five Mlechhkhand. Mlechh people, who are non-religious and have debarred conduct, habitat these areas. The famous Ayodhya city is situated in Aryakhand.

6.2.2 Other Six Regions

The Hemavat region is permanent land of enjoyment of low level. Ten main types of *Kalpa* trees (and also other trees) fulfill ten needs of the habitants of this region. These people do not use any of the six skills used by people in the land of action. The Hairanyavat region is similar to Hemavat region. The Harivarsh and Ramyaka regions are also permanent lands of enjoyment of medium level.

Videha region is known for its religious activities. People living in this region are very religious and follow the path of emancipation. The Videha region is divided in four parts, east Videha, west Videha, north Kuru and south (*deva*) Kuru. Mount Sumeru is situated in the centre of the region. River Sita flows through the east Videha and river Sitoda flows through the west Videha region. Eight countries are situated on either side of both rivers Sita and Sitoda. Thus there are total of 32 countries. Videha region always has balanced rainfall for 133 days during rainy season each year, no droughts or floods ever take place. All inhabitants, including animals and birds never suffer from any disease. Noble people, scholars, monks having super natural powers and omniscient always inhabit the region. The souls born in Videha region go up to 16^{th} heaven by their virtue of religious conduct. Some of the people here are reborn on lands of enjoyment by their merit of charity. Some are reborn as kings of heaven as a reward of their religious and spiritual pursuits. Many of the celestial beings are reborn in this region in their next life and accomplish

their ultimate aim of salvation. The Videha regions of Dhatikikhand and Pushkarvara Dweep are similar to Videha region of Jambudweep.

Mount Sumeru is situated in the center of Videha region. Its base is located 1000 yojana below the Chitra land. The base diameter is 10090 10/11 yojana and circumference is 31910 2/11 yojana. At Earth level its diameter is 10,000 yojana and circumference is approximately 31623 yojana. The height of Mr. Sumeru is 99000 yojana and the top is 1000 yojana wide. The mount face has multiple colours up to a height of 61,000 yojana and a single colour beyond this height. Three forests called Nandan, Sauman and Panduka are situated at three levels of Sumeru. Wandering celestial beings of Balbhadra class live in the Nandan forest.

On the east and west side of river Sita are located Chitra and Vichitra mountains at a distance of 500 yojanas. On the east and west side of river Sitoda are located Yamaka and Megh mountains also at a distance of 500 yojana. All the four mountains are 1000 yojana high, 1000 yojana wide at the base and 500 yojana wide at the top. Celestial beings of corresponding nomenclature live on these mountains.

North Kuru and south Kuru are lands of enjoyment of high level. The forests and trees fulfill all needs of the habitants. Male and female are born in pairs and they die together. After death they are reborn in heavens. These people never suffer from disease, fear, depression, untimely death, poverty, pain, and meeting with undesired, separation from desired, insult, etc. The weather remains pleasant all the time. The mountains of these lands are also described in scriptures.

6.3 Stellar world

The stellar celestial beings are of five types as described above. These stellar beings are found all over middle *loka*, from Jambudweep to the last island Swayambhuramana Island. The Moon is supposed to be the king and Sun the opposition king (copy) among the celestial beings. Their lights are of different kinds. There are 88 planets, 28 constellations and 66775×10^{14} stars in the family of one Moon. There are two Moons and two Suns in Jambudweep, 4 Moons and 4 Suns in Lavana Ocean, 12 Moons and 12 Suns in Dhatikikhand, 42 Moons and 42 Suns in Kalodaka Ocean and 72 Moons and 72 Suns in the first half of Pushkarvara Dweep. Jambudweep, Lavana Ocean, Dhatikikhand, Kalodaka Ocean and first half of Pushkrvar dweep have 36, 139, 1010, 41120 and 35230 Polar (*Dhruva*) stars respectively.

There are 133950×10^{14} stars in Jambudweep and 705×10^{14} stars in Bharat region. The stars in Two and Half Islands have orbital motion. The stars are found in circular formations (*Valaya*) in the rest of middle *loka*. The first circular formation is 50,000 yojana from the Manusottara Mountain. There are 144 Moon and 144 Suns in this formation. Other circular formations are situated at intervals of 100000 yojana, the number of Moons and Suns increase by 4 in each succeeding formation. The total number of Moons and Suns double in every subsequent island or ocean till the last ocean. The radiations from two adjoining formations cover the entire intervening region and so the entire middle *loka* is full of radiations.

The division of day and night is caused by orbital motion of Sun and Moon around the mount Sumeru. The orbits of celestial beings are placed at a distance of 1121 yojana from Sumeru. The Moon, Sun and planets follow different paths, the rest of stellar beings follow a common path. The orbital path zone of Moon and Sun is called Four Zone. The width of this zone is 510 yojana.

Out of this, 180 yojana is situated in Janbudweep and 310 yojana in the Lavana Ocean. The Moons and Suns in the Two and Half Islands orbit in their respective zones.

6.4 Two-and - Half Islands

Surrounding the Jambudweep is Lavana Ocean whose outer diameter is 5, 00,000 yojana. Aquatic beings are found in Lavana Ocean, Kalodaka Ocean and the last Swayambhuramana Ocean only. Other oceans of middle *loka* do not have lands of action and no aquatic beings as well. The entire region of middle *loka* between the Manushottara Mountain and the middle half of last Swayambhuramana Island contains lands of enjoyment of low level and only animals inhabitat these regions. The outer half of Swayambhuramana Island contains lands of action where largest size of animals, (excluding human) are found.

There are many small islands in Lavana Ocean. There are 8 solar islands in main directions and 16 lunar islands in the intermediate directions. All these islands are circular and serpentine youths of Belandhar class inhabitat them. Islands are also found opposite the delta of Ganga and Sindhu rivers and at entry to the Jambudweep. There are a total of 24 islands on the inner side and 24 islands on the outer side of Lavana Ocean. Thus there are 48 islands in Lavana Ocean. Similarly, there are 48 islands on both sides of Kalodaka Ocean. Human beings having animal face (*kumanush*) inhabitat these islands. They live under the trees and eat fruits and vegetables. They are born in pairs and enjoy the facilities available on islands. They are reborn as mansion dwelling celestial beings after death.

Dhatkikhand is 400000 yojana wide. There are two mountain ranges in the north and south side, which divide Dhatikikhand in two parts, the east and west. Each part has a mount Meru, 84000 yojana high, and one Bharat region and one Airavat region. So there are two mount Meru, two Bharat and two Airavat regions in Dhatikikhand. There are six lands of action, 12 lands of enjoyment and other mountain and rivers in Dhatikikhand.

The Kalodaka Ocean surrounding the Dhatikikhand is 800000 yojana wide. There are 24 lands of bad enjoyment (*Kubhoga*) on each side of this ocean. The Pushkarvara Dweep surrounding the Kalodaka Ocean is 1600000 yojana wide. The circular Manushottar Mountain divides it in two circular halves. This mountain is 1721 yojana high, 1022 yojana wide at the base and 424 yojana wide at the top. There are two mount Meru, one on east and the other one on west side of the inner half of the Dweep. Human beings are found only in the inner half.

6.5 Time (Environment) Cycle

The environment based experiences of living organisms in Arya Khand of Bharat and Airavat regions are time dependent. The variation in experiences takes place in a cyclic manner. The cycle consists of two divisions, Utsarpini and Avasarpini. The Utsarpini and the Avasarpini divisions have ascending and descending environmental conditions respectively. The Avasarpini division has six descending sub-divisions (*Aara*) – (i) Happy – happy (ii) Happy (iii) Happy – unhappy (iv) Unhappy – happy. (v) Unhappy, and (vi) Unhappy – unhappy, as shown in Fig. 6.7.

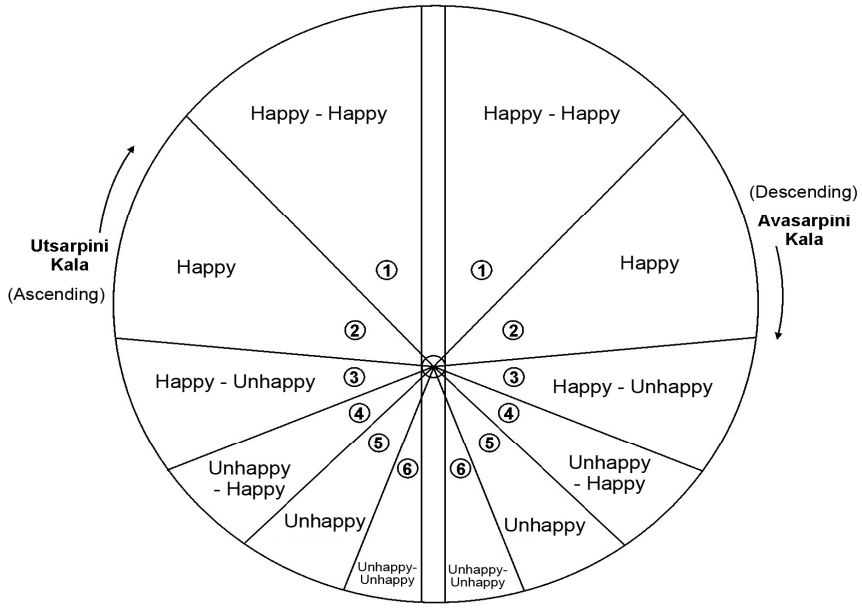


Fig 6.7: Time (Environmental) Cycle in Arya Khand

Similarly, there are six sub-divisions of the Utsarpini division in the reverse order. A Hundavasarpini cycle occurs after many time cycles. Such a cycle is presently running. The virtuous emotions progressively decline and debased emotions progressively increase in the Avasarpini division and reverse happens in the Utsarpini division. The attributes like touch, taste, odour and colour that is the quality of matter also progressively suffer in the Avasarpini division and reverse takes place in the Utsarpini division. Utsarpini follows Avasarpini and Avasarpini follows Utsarpini and the cycle keeps on repeating. Infinite such cycles have been completed so far and this shall continue forever. The time duration of each sub-division is different; it is a maximum for happy-happy subdivision and progressively decreases in other sub-divisions as shown in Table 6.1. The age, height and number of backbones of human beings – also progressively decrease in Avarsarpini division as shown in the table. The reverse order is followed in Utsarpini division.

Table 6.1 Avasarpini time divisions

Sub-division Number	Sub-division	Time span	Humans		
			Age	Height	Number of back bones
1	Happy – happy	4 KK sagar	3 palyopama	6000 bow	256
2	Happy	3 KK sagar	2 palyopama	4000 bow	128
3	Happy-unhappy	2 KK sagar	1 palyopama	2000 bow	64
4	Unhappy-happy	1 KK *sagar*-42000 years	1 KP	500(525)*bow	48
5	Unhappy	21000 years	130 years	7 Hands	24
6	Unhappy–unhappy	21000 years	20 years	1(3½)*Hands	12

KK = 10^7 x 10^7 = 10^{14}; Sagar = a large time unit; Palyopama = a medium time unit; KP = 10^7 *purva*; Bow = Length of bow, about 2 meters ; Hand = length of human arm, about ½ meter ; * - Digmbara belief

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We are living in the fifth sub-division of Avasarpini which started 3 years and 8 ½ months after the liberation of Lord Mahavira i.e. 524 years before Christ. Note that the environmental conditions change gradually and so in any one subdivision also there will be a gradual change in conditions within the limits shown in Table 6.1.

The above time cycle is said to be applicable only to Aryakhand of Bharat and Airavat regions. In other areas of Bharat and Airavat regions condition similar to the 4th sub-division of Avasarpini prevail.

The age of human beings and animals is one *palya* in Haimvat and Hairanyavat, two *palya*, in Harivarsha and Ramyaka and three *palya* in north and south Kuru, Other features of human beings also similarly apply. These regions are lands of enjoyment of low, medium and high level respectively. Thus there are six lands of enjoyment in Jambudweep and a total of 30 in the Two and Half Islands.

The conditions (environmental) prevailing in others regions of *loka* is shown in table 6.2.

Table 6.2 Conditions (Environmental) in different regions of *loka*

	Region	Conditions (Environmental)
1.	North and South Kuru	Similar to first sub-division of Avasarpini
2.	Harivarsh and Ramayaka	Similar to second sub-division of Avasarpini
3.	Haimvat and Hairanyavat	Similar to third sub-division of Avasarpini
4.	Between Manusottara Mountain in Pushkarvara and middle of last Swayambhuramana Island.	Similar to third sub-division of Avasarpini
5.	Outer half of Swayambhuramana Island and Swayambhuramana Ocean	Similar to fifth sub-division of Avasarpini
6.	Celestial Lands of upper *loka*	Similar to first sub-division of Avasarpini
7.	Seven infernal lands in lower *loka*.	Similar to sixth sub-division of Avasarpini

6.6 The Universe

We now briefly study the universe as known to science.

6.6.1 The Solar System

The Sun is the center of solar system. Our Earth orbits the Sun. The orbit is elliptical but nearly circular. The solar system consists of the Sun, nine planets, many satellites and asteroids. Moon is the satellite of Earth. About 99.86 percent mass of the solar system is concentrated in the Sun. Our Earth and Moon together make up less than one percent of the remaining mass. The nine planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto lie nearly in one plane and orbit the Sun in the same direction. The detailed information about these planets is given

in Table 6.3. There are about 32 comets in the solar system and about 100000 asteroids between Mars and Jupiter. They also orbit the Sun, their orbit is elliptical.

Table 6.3 Solar Systems

Planet	Mean Distance from Sun, Million Km	Mean Diameter Km	Mass Earth Masses	Sidereal Period, Earth Days	Mean Density	Time of Rotation Days	Satellites	Environment
Sun		1390000	333000	-	1.4	27	-	-
Mercury	57.91	4880	0.0543	87.97	4.8-5.43	59	0	CO_2
Venus	108.20	12104	0.8136	224.7	5.24	243	0	CO_2 Mainly
Earth	149.60	12756	1.0	365.26	5.52	1	1	O_2, N_2 etc.
Mars	227.94	6794	0.108	686.98	3.93	1.03	2	CO_2, H_2O
Jupiter	778.33	142984	318.35	4332.71	1.33	0.41	60	CH_4,NH_3,H_2
Saturn	1429.40	120536	95.3	10759.50	0.69	0.44	31	CH_4,H_2,He
Uranus	2870.99	51118	14.58	30685.00	1.32	0.72	27	CH_4,H_2,He
Neptune	4504.30	49532	17.26	60190.00	1.64	0.72	13	CH_4,H_2,He
Pluto	5913.52	2300	1.0	90550	2.06	6.38	3	Unknown
Moon	0.384 (from Earth)	3476	0.0123	27.32	3.34			

Mass of Earth = 5.976×10^{24} Kg.

Sun is the source of energy on Earth. The interior of the Sun has a temperature of about 14 million degree centigrade. At this temperature thermonuclear reactions occurs in which hydrogen is converted into helium, these reactions providing the Sun with its vast supply of energy. The Sun is composed of about 90% hydrogen, 8% helium, and only 2% of the heavier elements. The next region of Sun is full of gases. The gamma rays emitted by thermonuclear reactions bombard the gas molecules and produce ultraviolet radiations. The next region of the Sun is photosphere, which is 130,000 kilometer thick. Intense activity is caused here by the energy flowing from the interior. The outer end of photosphere, which is the visible surface of the Sun, is at a temperature of about 6000 C. Large patches, called sunspots, which appear black by contrast with their surroundings, are visible on the surface of the Sun. Owing to the rotation of the Sun, they appear to move across its surface. Their appearance is spasmodic, but their number reaches a maximum approximately every eleven years. Sun's atmosphere is divided in two parts – chromospheres and corona. Chromospheres are 10,000 to 15,000 kilometer thick. Its outer temperatures are about 100000^0C. Corona contains ionized oxygen, nitrogen, iron, nickel, calcium and some argon. Corona extends

millions of kilometers in space. Ions and electrons are continuously showered by Sun in space around.

Moon is the satellite of Earth. The axis of Moon orbit coincides with the axis of rotation of Earth and the orbital velocity of Moon and the rotational speed of Earth are such that the same side of Moon always faces the Earth. We cannot directly see the other side of Moon. Moon has no atmosphere and no life.

Earth is the third planet of Sun. It rotates on its axis and completes one rotation in 23 hours, 56 minutes and 4 seconds. One orbit around the Sun takes 365.26 days. Its diameter is 12683 kilometers on equator and 12640 kilometers on poles. Earth contains water on two-third of its surface and land on the remaining one-third part. The oxygen and nitrogen present in its atmosphere and the temperature are suitable for life. The interior of Earth is very hot all matter there exists in molten state. The outer crust of Earth supports water and all living organisms. It is believed that Earth is cooling down and that is the reason for formation of mountains and valleys. Compared to the universe the existence of Earth is negligible, yet it has intelligent life, which is found nowhere else in the solar system.

6.6.2 The Milky Way

Our Sun is just one star of Milky Way galaxy, which is visible from Earth as a hazy band of white light that is seen in the night sky. The disk of the Milky Way galaxy is approximately 100000 light years in diameter, about 250-300 light years in periphery, and about 1000 light years thick at the center (see fig 6.8). It is estimated to contain at least 200 billion and up to 400 billion stars (if small-mass stars predominate).

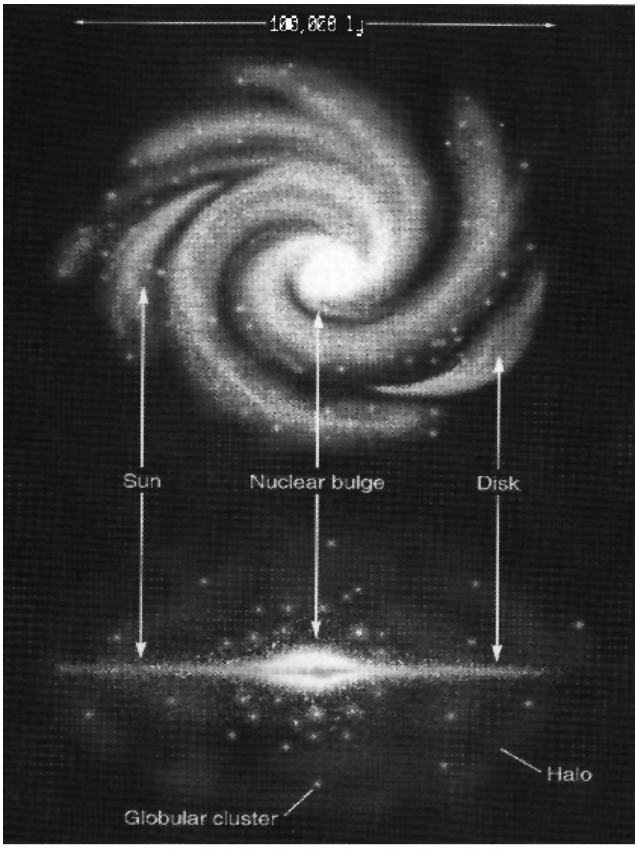

Fig 6.8 (a): Milky Way Galaxy

As a guide to the relative physical scale of the Milky Way, if it were reduced to 130 km in diameter, the solar system would be a mere 2 mm in width. Observations or Spitzer Space Telescope in 2005 suggested that the Milky Way is a barred spiral galaxy. As of 2006, The Milky Way's mass is thought to b about 5.8×10^{11} solar masses (some estimates put the mass at 1.91×10^{12} solar masses). Most of the mass of the Galaxy is thought to be dark matter, forming a dark matter halo of estimated 600-3000 billion solar masses, which is spread out relatively evenly. The galactic disk bulges outward at the galactic center as shown in fig 6.8(a). The distance from the Sun to the galactic center is now estimated at 26000 $\pm$ 1400 light years. The galactic center harbours a compact object of very large mass (named Sagitarius A*), strongly suspected to be a super massive black hole.

The evidence is mounting that Sag A* is indeed a black hole of 2-3 million times the mass of Sun, providing strong enough gravitational pull to keep the stars and gas in orbit. Most galaxies are believed to have a super massive black hole at their center. The fact that the Milky Way divides the night sky into two roughly equal hemispheres indicates that our solar system lies close to the galactic plane. The Galaxy's bar, figure 6.8(b), is thought to be about 27,000 light-years long, running through its center at a 44$\pm$10 degree angle to the line between the Sun and the center of the Galaxy. It is composed primarily of red stars, believed to be ancient.

Fig 6.8 (b) Milky Way Bars

Each spiral arm of Milky Way describes a logarithmic spiral (so do the arms of all spiral galaxies) with a pitch of approximately 12 degrees. There are believed to be four major arms which all start at the Galaxy's center. as shown in fig. 6.9. These arms are as follows: (1) 3-kpc and Perseus Arm (2) Norma and Cygnus Arm (3) Crux and Scutum Arm, and (4) Carina and Sagittarius Arm. There are at least two smaller arms or purrs, including Orion arm, which contains the solar system and the Sun. Outside of the major spiral arms is the Outer Ring, which consists of gas and stars torn from other galaxies billions of years ago.

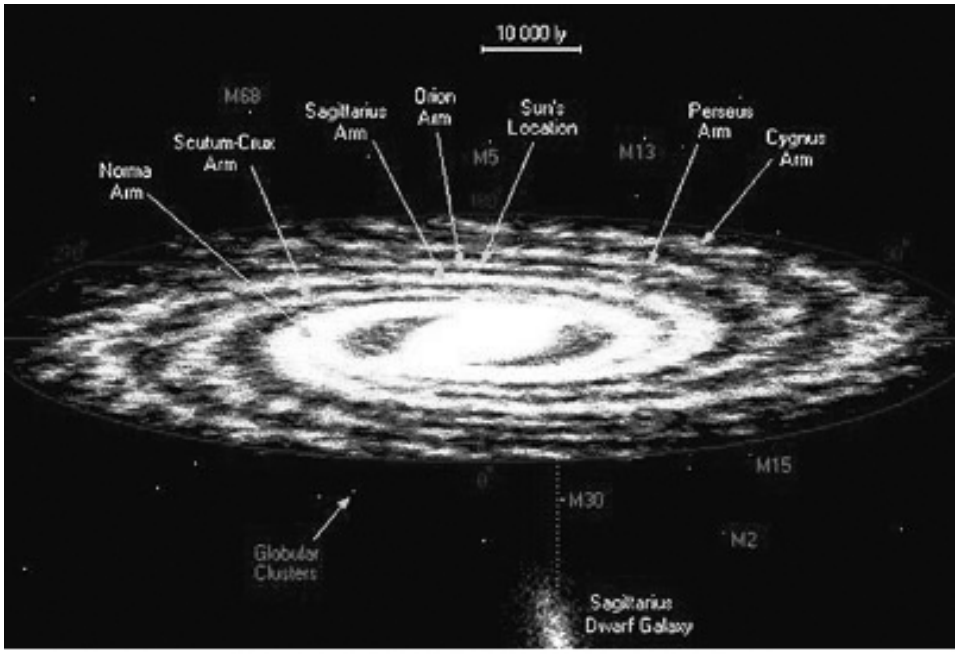

Fig 6.9 Spiral Arms of Milky Way

As is typical for many galaxies, the distribution of mass in the Milky Way Galaxy is such that the orbital speed of most stars in the Galaxy does not depend strongly on its distance from the center. Away from the central bulge or outer rim, the typical stellar velocity is between 210 and 240 km/s. This is unlike in the solar system where different orbits are also expected to have significantly different velocities associated with them, and is one of the major pieces of evidence for the existence of dark matter.

The galactic disk is surrounded by a spheroid halo of old stars and globular clusters, of which 90% lie within 100000 light-years, suggesting a stellar halo diameter of 200000 light years However, a few globular clusters have been found further at more than 200000 light – years away from the galactic center.

The Sun may be found close to the inner rim of the Orion Arm, at a hypothesized distance of 7.62 $\pm$ 0.32 kpc from the galactic center. The distance between the local arm and the next arm out, the Perseus Arm is about 6500 light-years. The Sun, and thus the solar system, is found in what scientists call the galactic habitable zone. The apex of the Sun's way, or the solar apex, is the direction that the Sun travels through space in the Milky Way. The general direction of the Sun's galactic motion is towards the star Vega near the constellation of Hercules, at angle of 60 sky degrees to the direction of the Galactic center. The Sun's orbit around the Galaxy is expected to be roughly elliptical with the addition of perturbations due to the galactic spiral arms and non-uniform mass distributions. In addition the Sun oscillates up and down relative to the galactic plane approximately 2.7 times per orbit. It takes the solar system about 225-250 million years to complete one orbit (a galactic year) and so it is thought to have completed about 20-25 orbits during its lifetime or 0.0008 orbits since the origin of humans. The orbit speed of the solar system is 220 km/s i.e. 1 light – year in calendar 1400 years. Many astronomers believe the Milky Way is moving at approximately 600 km/s relative to the observed locations of other nearby galaxies. If

the Galaxy is moving at 600 Km/s, Earth travels at 51.84 million km per day, or more than 18.9 billion km per year, about 4.5 times its closest distance from Pluto. The Galaxy is thought to be moving towards the constellation Hydra, and may some day become a close-knit member of the Virgo cluster of galaxies.

The Milky Way and the Andromeda Galaxy are a binary system of giant spiral galaxies. Together with their companion galaxies they form the local group, a group of some 50 closely bound galaxies. The Local Groups are part of the Virgo super cluster. The Milky Way is orbited by two smaller galaxies and a number of dwarf galaxies in the Local Group. The largest of these is the large Magellanic Cloud with a diameter of 20,000 light – years. It has a close companion, the small Magellanic Cloud. Some of the dwarf galaxies orbiting the Milky Way are Canis Major Dwarf (the closest), Sagittarius Dwarf Elliptical Galaxy, Ursa Minor Dwarf, Sculptor Dwarf, Sextans Dwarf, Formax Dwarf, and Leo Dwarf. The smallest Milky Way dwarf galaxies are only 500 light- years in diameter. These include Carina Dwarf, Draco Dwarf, and Leo II Dwarf. There may still be undetected dwarf galaxies, which are dynamically bound to the Milky Way.

6.6.3 Andromeda Galaxy (M31)

Andromeda Galaxy as shown in fig 6.10 is the nearest spiral galaxy to our own Milky Way. It is approximately 2.5 million light – years away in the constellation Andromeda.

Fig 6.10 Andromeda Galaxy

Andromeda is the largest galaxy of the Local Group, which consists of the Andromeda Galaxy, The Milky Way Galaxy, the Triangulum Galaxy, and about 30 other smaller galaxies. Although the largest, it may not be the most massive, as recent findings suggest that the Milky Way contains more dark matter and may be the most massive in the grouping. Andromeda Galaxy contains about one trillion (10^{12}) stars, greatly exceeding the number of stars in our own galaxy. It is easily visible to the naked eye; the full angular diameter of the galaxy is seven times that of the full moon. The diameter and mass of Andromeda Galaxy is estimated to be 220000 lights – years and 1.23×10^{12} solar masses. Spectroscopic studies have provided detailed measurements of the rotational velocity of this galaxy at various radii from the core. The velocity is high at a reaches of 1300 light years. As we move out it decreases then increases and decreases again. These velocity measurements imply a concentrated mass of about 6×10^{9} solar masses in the nucleus. M31 is known to harbour a dense and compact star cluster at its center. The nucleus is in fact double, consisting of two concentrations separated by 1.5 parsecs, a few light years. The brighter concentration, P1, is offset from the center of galaxy. The dimmer concentration, P2, falls at the true center of the galaxy and contains a 10^{8} solar mass black hole. Like the Milky Way, Andromeda galaxy has satellite galaxies, consisting of 14 known dwarf galaxies. The best known and most readily observed satellite galaxies are M32 and M110.

Current measurements suggest that Andromeda Galaxy is approaching us at 100 to 140 kilometer per second. The Milky Way may collide with it in 3 to 4 billion years, depending on the importance of unknown lateral components to the galaxies' relative motion. It they collide, it is thought that the Sun and the other stars in the Milky Way will probably not collide with the stars of the Andromeda Galaxy, but that the two galaxies will merge to form a single elliptical galaxy over the course of about a billion years.

6.6.4 Universe

The term universe has a variety of meanings based on the context in which it is described. In materialist philosophical terms, the universe is summation of all matter that exists and the space in which all events occurs, which an equivalent idea amongst some theoretical scientists, is known as total universe. In cosmological terms, the universe is thought to be finite or infinite space – time continuum in which all matter and energy and the physical laws and constants that govern them exist. In a well defined, mathematical sense, the universe can even be said to contain that which does not exist: according to the path – integral formulation of quantum mechanics, even unrealized possibilities contribute to the probability aptitudes of events in the universe. The terms known universe, observable universe, or visible universe are often used to describe the part of the universe that can be seen or otherwise observed by humanity. Due to the fact that cosmic inflation removes vast parts of the total universe from our observable horizon, most cosmologists currently accept that it is impossible to observe the whole continuum and may use our universe, referring only to that knowable by human beings in particular.

The Doppler shift measures the change in frequency (or sound of the pitch) as the source moves towards or away from the observer. A source of light that is approaching the viewer will be seen to the viewer to have a higher frequency than a source of light that is receding from the viewer. In 1929, observations from distant galaxies made by Edwin Hubble showed that light from those galaxies behaved (red shifted) as if they were going away from us. If all the distant galaxies are receding from us, on the average, that means that the universe as a whole could be expanding. Extrapolating this expansion back in time, one approaches a gravitational singularity, a rather abstract mathematical concept, which may or may not correspond to reality. This gives rise to the Big Bang theory, the dominant model in cosmology today. The age of the universe from this time of the Big Bang, was estimated to be about 13.7 billion years, with a margin of error of about one percent ($\pm$ 200 million years), according to NASA's WMAP (Wilkinson Microwave Anisotropy Probe). However, this is based on the assumption that the underlying model used for data analysis is correct. Other methods of estimating the age of the universe give different ages.

There is disagreement over whether the universe is indeed finite or infinite in spatial extent and volume. Many astronomers and cosmologists believe the universe is infinite due to recent findings in NASA's WMAP project supporting a flat (therefore infinite) universe. However, the observable universe, consisting of all locations that could have affected us since the Big Bang given the finite speed of light, is certainly finite. The edge of the cosmic light horizon is 13.7 billion light years distant. The present distance (commoving distance) to the edge of the observable universe is larger, due to the ever-increasing rate at which the universe has been expanding; it is estimated to be about 93 billion light years. This would make the commoving volume, of the known universe, equal to 1.9×10^{33} cubic light years (assuming this region is perfectly spherical).

The observable universe contains about $7x10^{22}$ stars, organized in about 100/140 billion galaxies, which themselves form clusters and super clusters. The number of galaxies may be even larger, based on the Hubble Deep Field observed with the Hubble Space Telescope. The Hubble Space Telescope discovered galaxies, which are over 13 billion light years from Earth.

There are four types of red shifts – Doppler red shift, Realistic Doppler, Cosmological red shift and Gravitational red shift. The consensus among astronomers is that the red shifts they observe are due to some combination of the three established forms of Doppler – like red shifts. The most distant objects exhibit larger red shifts. For galaxies more distant than the Local Group and the nearby Virgo Cluster, but within a thousand mega parsecs or so, the red shift is approximately proportional to the galaxy's distance. This is known as Hubble's law. In the widely accepted cosmological model based on general relatively, red shift is mainly a result of the expansion of space: This means that the farther away a galaxy is from us, the more the space has expanded in time since the light left that galaxy, so the more the light has been stretched (that is photons emitted have been stretched to longer wavelengths and lower frequency during their journey) the more red shifted the light is, and so the faster it appears to be moving away from us.

Recent observations have suggested the expansion of the Universe is not slowing down, as expected from the first point, but accelerating. It is widely, though not quite universally, believed that this is because there is form of dark energy dominating the evolution of the universe. The universe consists mainly of matter, rather than antimatter. Only 4% of the matter and energy in the universe is luminous, that is directly observable from its emitted electromagnetic radiation ("light" in its most general sense); the remainder consists of dark energy (73%) and dark matter (23%). The nature and composition of dark energy and dark matter are not known. The luminous matter within the universe is sparse and consists principally of galaxies, which are distributed uniformly when averaged over length-scales longer than 300 million light years; on smaller length scales galaxies tend to clump into clusters, super clusters and even larger structures. The universe is bathed in a microwave radiation that is highly isotropic (uniform across different directions) and corresponds to a black body spectrum of roughly 2.7 Kelvin. The relative percentages of the lighter chemical elements – especially hydrogen, deuterium and helium – are apparently the same throughout the universe. The universe has at least three spatial dimensions and one temporal (time) dimension, although extremely small additional dimensions cannot be ruled out experimentally; space-time appears to be smoothly and simply connected, with very small curvature so that Euclidean geometry is accurate on the average throughout the universe. The universe appears to be governed by the same physical laws and constants throughout its extent and history.

According to Big Bang theories, every thing in the universe, all forms of matter and energy, and even space-time itself – came into being at a single event, a gravitational singularity; as space expanded with time, the matter and energy cooled sufficiently to allow the stable condensation of elementary particles into primordial nuclei and atoms. Once atoms formed, matter became transparent to most wavelengths of electromagnetic radiation; the ambient microwave radiation observed today is the residual radiation that decoupled from the matter.

According to the prevailing scientific models, the Universe is governed by the Standard Model of physics (which governs various forms of matter and fields), as well as special and general relativity (which govern space-time and its interaction with matter and fields). The

universe appears to have no net electric charge, and therefore gravity appears to be the dominant interaction on cosmological scales. The universe appears to have no net momentum and angular momentum. Hence the theory of general relativity (the most accurate description of gravity presently available) offers the best predictions for the overall development of the universe, including its origin, expansion (which mainly accounts for the observed red shift), large – scale structures and ultimate fate, According to the theory of general relativity, some regions of space may never interact with ours even in lifetime of the universe, due to the finite speed of light and the expansion of space. For example, radio messages sent from Earth may never reach some regions of space, even if the universe lives forever; space may expand faster than light can cover it. It is worth emphasizing that those distant regions of space are taken to exist and be part of reality as much as we are; yet we can never interact with then. Strictly speaking, the observable universe depends on the observer. By traveling, an observer can come into contact with a greater region of space – time than an observer who remains still, so that the observable universe for the former is larger than for the latter; nevertheless, even the most rapid traveler may not be able to interact with all of space. Typically, the observable universe is taken to mean the universe observable from a stationary observer on Earth.

Despite its experimental verification, some scientists find the theory of general relativity implausible and have suggested alternatives. Such theories can only be considered scientific if they offer predictions that differ from those of general relativity. The main scientific alternative is Brans Dicke theory, which augments general relativity with a scalar field that determines the local value of the gravitational constant G. Other, more radical suggestions include the variable G cosmologies (in which the universe's physical constants vary with the age or size of the universe), the tired light hypothesis of Fritz Zwicky and the plasma cosmology theory. The validity of most such theories seems unlikely, given the available data.

There is some speculation that multiple universes in a higher-level multiverse (also known as a megaverse) exist, our universe being one of those universes. For example, matter that falls into a black hole in our universe could emerge as a Big Bang, starting another universe. However, all such ideas are currently not testable and cannot be regarded as anything more than speculation. The concept of parallel universes is understood only when related to string theory.

The obvious question that could be asked to challenge or define the boundaries between physics and metaphysics is: what came before the Big Bang? Physicists define the boundaries of physics by trying to describe them theoretically and then testing that description against observations. Our observed expanding universe is very well described by flat space, with critical density supplied mainly by dark matter and a cosmological constant that should expand forever.

It we follow this model backward in time to when the universe was very hot and dense, and dominated by radiation, and then we have to understand the particle physics that happens at such high densities of energy. The experimental understanding of particle physics starts to pop out after the energy scale of electroweak unification, the theoretical physicists have to reach for models of particle physics beyond the Standard Model, to Grand Unified Theories, supper symmetry, string theory and quantum cosmology.

Matter and radiation are gravitationally attractive, so in a maximally symmetric space-time filled with matter, the gravitational force will inevitably cause any lumpiness in the matter to grow

and condense. That's how hydrogen gas turned into galaxies and stars. But vacuum energy comes with a high vacuum pressure, and that high vacuum pressure resists gravitational collapse as a kind of repulsive gravitational force. The pressure of the vacuum energy flattens out the lumpiness, and makes space get flatter, not lumpier, as it expands. So one possible solution to the flatness problem would be if our universe went through a phase where the only energy density present was a uniform vacuum energy. If this phase occurred before the radiation – dominated era, then the universe could evolve to be extraordinarily flat when the radiation – dominated era began, so extra ordinary flat that the lumpy evolution of the radiation and matter – dominated periods would be consistent with the high degree of remaining flatness that is observed today. This type of solution to the flatness problem was proposed in the 1980s by cosmologist Alan Guth. This model is called the Inflationary universe. In the Inflation model, our universe starts out as a rapid expanding bubble of pure vacuum energy, with no matter or radiation. After a period of rapid expansion, or inflation, and rapid cooling, the potential energy in the vacuum is converted through particle physics processes into the kinetic energy of matter and radiation. The universe heats up again and we get the standard Big Bang. So an inflationary phase before the Big Bang could explain how the Big Bang started with such extraordinary spatial flatness that it is still so close to being flat today. The inflationary model also solves the horizon problem and magnetic monopole problem.

The Inflation model described above is far from an ideal theory. It's too hard to stop the inflationary phase, many of the assumptions that go into the model, such as an initial high temperature phase and a single inflating bubble have been questioned and alternative models have been developed. Today's inflation models have evolved beyond the original assumption of single inflation event giving birth to a single universe, and feature scenarios where universes nucleate and inflate out of other universe in the process called eternal inflation. There is also another attempt to solve the problems of Big Bang cosmology using a scalar field that never goes through an inflationary period at all, but evolves so slowly so that we observe it as being constant during our own era. This model is called Quintessence, after, the ancient spiritual belief in the Quinta Essentia, the spiritual matter from which the four forms of physical matter are made.

The inflation model assumes a quantum vacuum that has more energy in its nothingness than it should. Modern physical theory, specifically quantum electrodynamics, tells us that the vacuum can no longer be considered a void. This is due to the fact that, even in the absence of matter, the vacuum is neither truly particle nor field free, but is the seat of virtual particle – pair (e.g. electron-positron) creation and annihilation process, as well as zero- point – fluctuation (ZPF) of such fields as the vacuum electromagnetic field. The energy density associated with the vacuum electromagnetic ZPF background is considered to be infinite. Thus we see that, with its roots in relativity theory which banished the ether, QED has in some sense come full circle to provide us with a model of an energetic vacuum that once again constitutes a plenum rather than a void. The question is where the zero-point energy comes from, specifically the vacuum electromagnetic zero-point energy. The possibility that this is due to generation by the motion of charged particles that constitutes the matter has been investigated with positive results. The picture that emerges is that the electromagnetic ZPF spectrum is generated by the motion of charged particles throughout the universe which are themselves undergoing ZPF induced motion, in a kind of self-generating grand ground state of the universe. In contrast to other particle – field interactions, the ZPF interaction

constitutes an underlying, stable 'bottom – rung' vacuum state that decays no further but reproduces itself on a dynamic – generation basis. In such terms it is possible to explicate on a rational basis the observed presence of vacuum zero-point energy.

Attempts are being made to extract the vacuum energy. Some countries, including USA and Soviet Union, have undertaken programs to explore this on an experimental basis. Noble Laureate T.D. Lee has suggested a new branch of study known as 'vacuum engineering'.

Lastly, we briefly mention about Newtonian cosmology. The Newtonian cosmology had several paradoxes that were resolved only with the development of general relativity. The first of these was that it assumed that space and time were infinite, and that the stars in the universe had existed for an infinite time; however, since stars are constantly radiating energy, a finite star seems inconsistent with the radiation of infinite energy. Secondly, Jean – Philippe de Cheseaux noted that the assumption of an infinite space filled uniformly with stars lead to prediction that the nighttime sky would be as bright as the Sun itself; this became known as Olber's paradox in the 19^{th} century. Third, Newton himself showed that an infinite space uniformly filled with matter would cause infinite forces and instabilities causing the matter to crushed inwards under its on gravity. This instability was clarified by the Jeans instability criterion. One solution to these latter two paradoxes is the Charlier universe, in which the matter is arranged hierarchically (systems of orbiting bodies that are themselves orbiting in a larger system, *ad infinitum*) in a fractal way such that the universe has a negligible small overall density.

6.6.5 Steady State Theory

The steady state theory asserts that although the universe is expanding, it nevertheless does not change its outlook over time; it has no beginning and no end. The Theory requires that new matter must be continuously created (mostly as hydrogen) to keep the average density of matter equal over time. The amount required is low and not directly detectable; roughly one solar mass of baryons per cubit megaparsec per year or roughly one hydrogen atom per cubic meter per billion years, with roughly five times as much dark matter. Such a creation rate would, however, produce observable effects on cosmological scales.

Problems with steady-static theory began in the late 1960s, when observations apparently supported the idea that the universe was in fact changing: quasars and radio galaxies were found only at large distances, not in closer galaxies. For most cosmologists the refutation of the steady state theory came with the discovery of the cosmic background radiations in 1965, which was predicted by the Big Bang theory. Within the steady state theory this background radiation is the result of light from ancient stars, which has been scattered by galactic dust. However, this explanation has been unconvincing to most cosmologists as the cosmic microwave background (CMB) is very smooth, making it difficult to explain how it arose from point source and the CMB shows no evidence of features such as polarization, which are normally associated with scattering. Furthermore, its spectrum is so close to that of on ideal black body that it could hardly be formed by the superposition of contributions from dust clumps at different temperatures as well as at different red shifts.

Quasi- Steady State cosmology (QSS) was proposed in 1993 by Fred Hoyle, Geoffrey Burbidge, and Jayant V. Narlikar as a new incarnation of steady state ideas meant to explain additional features unaccounted for in the initial proposal. The theory suggests packets of creation

occurring over time within the universe, sometimes referred to as mini bangs, mini-creation events, or little bangs. After the observations of an accelerating universe, further modifications of the model were done.

6.6.6 Structure of Universe based on General Relativity (Space-time Geometry)

Think of a very large ball (like Earth). Even though you look at the ball in three space dimensions, the outer surface of the ball has the geometry of a sphere in two dimensions, because there are only two independent directions on motion along the surface. If you were very small and lived on the surface of the ball, you might think you weren't on a ball at all, but on a big flat two-dimensional plane. But if you were to carefully measure distances on the sphere, you would discover that you were not living on a flat surface but on the curved surface of a large sphere.

The idea of the curvature of the surface of the ball can apply to the whole universe at once. That was the great breakthrough in Einstein's theory of general relativity. Space and time are unified into a single geometric entity called space-time, and the space-time has geometry, space-time can be curved just like the surface of a large ball is curved.

The Einstein equation is the classical equation of motion for space-time, because quantum behaviour is never considered. For this reason, it is at best an approximation to exact theory. The Einstein Equation says that the curvature in space-time in a given direction is directly related to the energy and momentum of everything in the space-time that isn't space-time itself. In other words, the Einstein equation is what ties gravity to non-gravity, geometry to non-geometry. The curvature is the gravity, and all of the "other stuff" – the electrons and quarks that make up the atoms that make up matter, the electromagnetic radiation, and every particle that mediates every force that isn't gravity – lives in the curved space-time and at the same time determines its curvature through the Einstein equation.

The full description of a given space-time includes not only all space but also all of time; in other words, everything that happened and will ever happen in that space-time. To deal with the problem scientists make approximations and abstraction; they make abstract models that approximate the real universe fairly well at large distance, say at the scale of galactic clusters.

To solve the equations, simplifying assumptions also have to be made about the space-time curvature. The first assumption made is that space-time can be neatly separated into space and time. This assumption is well justified. The next important assumption, the one behind the Big Bang theory, is that at every time in universe, space looks the same in every direction at every point. So they are assuming that space is homogenous and isotopic. Cosmologists call this the assumption of maximal symmetry. At the large distance scales relevant to cosmology, it turns out that it is a reasonable approximation to make.

When cosmologists solve the Einstein equation for the space-time geometry of our universe, they consider three basic types of energy that could curve space-time: vacuum energy, radiation and matter. The radiation and matter in the universe are treated like uniform gases with equation of state that relate pressure to density. Once the assumptions of uniform energy sources and maximal symmetry of space have been made, the Einstein equation reduces to two ordinary differential equations that are easy to solve using basic calculus. The solutions tell us two things: the geometry of space, and how the size of space changes with time.

If at every time, space at every point looks the same in every direction; the space has to have constant curvature. If the curvature were different at any point, then space would look different in that direction from every other point. Therefore if space is maximally symmetric, the curvature has to be the same at every point. So that narrows us down to three options for the geometry of space: positive, negative or zero curvature when there is no vacuum energy present, just matter or radiation, the curvature of space also tells us the time evolution of the space-time in question.

1. Positive curvature: The unique N-dimensional space with constant positive curvature is an N-dimensional sphere, a closed universe as shown in fig. 6.11 In this space-time, space expands from zero volume in a Big Bang but then reaches a maximum volume and starts to contract back to zero volume in a Big Crunch.

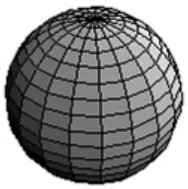

Fig 6.11 N- Dimensional Sphere Space with Constant Positive Curvature

2. Zero curvature: A space with zero curvature is called a flat surface. A flat space is non-compact, space extends infinitely far in any direction, so this option also represents an open universe. This space-time has space expanding forever in time.
3. Negative curvature: The unique N-dimensional space with constant negative curvature is an N-dimensional pseudo sphere, a hyperboloid as shown in fig 6.12. With negative curvature, space has infinite volume and an open universe. This space-time also has space expanding forever in time.

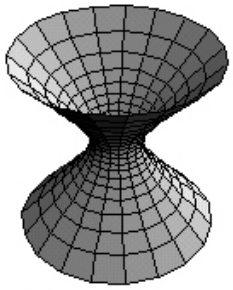

Fig 6.12 N-Dimensional Pseudosphere Space with Constant Negative Curvature

What determines whether a Universe is open or closed? For a closed universe, the total energy density in the Universe has to be greater than the value that gives a flat universe, called critical density. So a closed Universe has $\Omega>1$, a flat universe has $\Omega=1$ and an open Universe has $\Omega<1$.

The above analysis only takes into account energy and matter and neglects any vacuum energy that might be present. Vacuum energy leads to a constant energy density that is called the cosmological constant$\wedge$.

Einstein did not always like the conclusions of his own work, His equation of motion of space-time predicted that a universe filled with ordinary matter would expand. To fix the Einstein equation, he added a term now called the cosmological constant that balanced the energy density of matter and radiation to make a universe that neither expanded nor contracted, but stayed the same for eternity. A cosmological constant can act to speed up or slow down the expansion of the universe, depending on whether it is positive or negative. When a cosmology constant is added to a space-time with matter and radiation, the story gets more complicated than the simple open or closed scenarios described above. Although many scientists including Einstein, had speculated that $\wedge$ was zero, recent astronomical observations have detected a large amount of dark energy that is accelerating the universe's expansion preliminary studies suggest that this dark energy corresponds to a positive$\wedge$.

The ultimate fate of the universe is still unknown, since it depends critically on the curvature and the cosmological constant. If the universe is sufficiently dense, its average curvature throughout is positive and the universe will eventually re collapse in a Big Crunch, possibly starting a new universe in a Big Bounce. Conversely, if the universe is insufficiently dense, the universe will expand for ever, cooling off and eventually becoming inhospitable for all life, as the stars die and all matter coalesces into black holes. Recent data suggests that the expansion of the universe is not decreasing as originally expected, but accelerating; if this continues indefinitely, the universe will eventually rip itself to shreds (the Big Rip). Experimentally, the universe has an overall density that is very close to the critical value between re collapse and eternal expansion; more careful astronomical observations are needed to decide the question. A recent measurement shows that the universe is flat with only a 2% margin of error.

6.7 Comparison of *Loka* and Universe

Comparison of *loka* and universe is comparing the facts told by an omniscient and the observations made by human beings with the help of scientific instruments. The observations of scientists bear the constraints imposed by physical instruments and the intelligence of the observer. Large amount of piece meal information gathered by separate individuals is put together to figure out the reality just like the parts of a jig saw puzzle are assembled to obtain the whole. An omniscient on the other hand sees the full reality as it exists and describes it in parts. An omniscient has the power to see a *paramanu* as well as the entire *loka*.

The description of *loka* given by lord Mahavira was mainly in the form of answers to queries made by his disciples. To describe the structure of *loka* to people, who did not have scientific knowledge of modern era, should obviously entail use of examples and simplifications for presenting the subject in a comprehensible form. The description is largely qualitative because a quantitative description is neither possible nor required for broad understanding of the *loka*. Terms like countable, countless, infinite were good enough to offer description of many of the features of *loka*.

The information given by lord Mahavira was passed on orally and committed to writing after many centuries. In the intervening period to what extent the information was preserved in its original form is not known. During this period the other philosophies developed in India perhaps influenced the writings of Jain Acharyas. So the description of *loka* as available in Jaina canons

may be considered to be a mix of concepts and descriptions given by lord Mahavira, the contributions of the writer himself may be as exaggerations and imaginations, and the influence of other philosophies.

Our scientific knowledge of universe comes from observations as well as mathematical theories developed to explain the observations and the reality. Both these methods suffer from human limitations and so are expected to reveal some aspect and not the whole reality. It is possible to combine both the canonical and scientific information to arrive at a more realistic picture of *loka*. We make such an attempt here.

While interpreting distances given in Jaina canons the unit yojana must be carefully used. Term yojana has been used to measure distances on land as well as in space. A space yojana is 1000 times the land yojana in Swetambara canons and 500 tines the land yojana in Digambara canons. Thus the meaning of the same term yojana changes with context in which it is used.

6.7.1 Jambudweep and Middle *Loka*

The first question that can be asked is where is Jambudweep? Most people assume Earth to be the Jambudweep. We know that Jambudweep is disk shaped and the Earth is spherical. Where is mount Sumeru? Again people assume some mountain on Earth as Sumeru. If it were so then the Sun and Moon would orbit it. Similarly, attempts to locate Haimvat, Harivarsh, Videh regions on Earth have failed. Besides geography the other features of Jambudweep like presence of omniscient in Videh etc, are also not found on Earth. In no way the Earth can be Jambudweep. Let us broaden our vision and compare Jambudweep with the Milky Way.

Jambudweep and Milky Way both is disk shaped. Jambudweep has diameter of 100000 yojana and Milky Way has diameter of 100000 light years. The periphery of Jambudweep is 300000 yojana and the periphery of Milky Way is 250-300 thousand light years. 13^{th} Sthanak (Chapter) of Samavayang Sutra mentions that the expansion of the solar system is equal to 48/61 yojana. According to science the Oort cloud is considered to be the outer edge of the solar system where the Sun's orb of physical and gravitational influence ends. The Oort cloud is an immense spherical cloud surrounding the solar system and extending about 30 trillion kilometers from the Sun. Comparing yojana to a light year the expansion of the solar system according to Jain philosophy is (48/61 x 9.46 trillion =) 7.44 trillion kilometers. Though the agreement is not good, but knowing the approximations involved in defining and measuring the size of the solar system, comparison of yojana and light year for celestial measurements appears to be a reasonable choice.

Mount Sumeru is located in the center of Jambudweep and the center of Milky Way is dense and bulging out. Mount Sumeru is 10000 yojana wide at base and the dense center of Milky Way is 1-2 thousand light years wide. The Sun and Moon orbit Mount Sumeru in Jambudweep and the Sun and Moon in Milky Way orbit the center. The Jambudweep is surrounded by Lavana Ocean, which has 48 small islands, the Milky Way is surrounded by a halo containing 146 star clusters and many dwarf galaxies. The Bharat region is located on one side of Jambudweep and our Sun is situated away from the galactic center. Thus we see many features common to Jambudweep and Milky Way.

We extend our analogy further. Countless circular oceans and islands surround Jambudweep. No such island or ocean has ever been seen. This kind of description appears to be a symbolic representation of the reality. A circular island perhaps represents the orbital path of a

galaxy. That is, there is a galaxy at a distance from Jambudweep, which has an orbital motion. The countless islands signify that there are countless galaxies all having orbital motions. The oceans are intergalactic spaces, which contain many star clusters and small and dwarf galaxies. By this analogy the Andromeda Galaxy is the Dhatikikhand Island and perhaps the Triangulum Galaxy is the Pushkarvara Island. Dhatikikhand has two mount Meru and Andromeda has two separate concentrations P_1 and P_2 in its nucleus. Andromeda has more than 14 dwarf galaxies in its hello and the Kalodaka Ocean surrounding the Dhatikikhand has 48 small islands. The number of dwarf galaxies orbiting Milky Way and Dhatikikhand is not final and more are likely to be discovered in future.

According to Jain Philosophy the *loka* is beginning less but all matter follows the basic rule of origination-cessation-permanence. This means that any aggregate like star and planet can disintegrate into particles and *paramanus* and such particles and *paramanus* can assemble and aggregate to form new stars and planets. In the same way islands are also not permanent, they may disintegrate and loose their identity. Astronomical observations confirm that this is a regular process in space, old galaxies are destroyed and new galaxies are formed. This must be the reason that the number of islands in middle *loka* is said to be countless, as their number is not fixed and keeps on changing over time. But the overall structure of the middle *loka* is invariant; no event like Big Bang is permissible in Jain philosophy.

Space scientists have detected microwave radiations coming from distances as far as 11-15 billion light years. According to them these microwave radiations may have originated 300000 years after the Big Bang, which may mean that we have reached near the edge of the universe, about 93 billion light years (commoving distance) away. Based on this the universe may be assumed roughly to be 200 billion light years across, approximately equal to $2x10^{22}$ kilometers.

On the basis of above comparison we may infer that Milky Way may be the Jambudweep, at least from cosmic considerations. The middle *loka* and Jambudweep as depicted in fig 6.5 and 6.6 appear more like artist's conception then actual maps, the kind of symmetry shown in these figures can not be realistic. But even disregarding symmetry we admit that it is difficult to find exact correspondence between Milky Way and Jambudweep. We cannot easily identify the Haimvat, Harivarsh, Videha etc. regions of Jambudweep in the Milky Way in the manner described in Jaina scriptures. Nevertheless, we note that Milky Way contains seven major regions – four major arms, two smaller arms and a nucleus (see fig 6.9) like seven regions, Bharat, etc, in Jambudweep. Our Sun is situated in the smaller arm Orion, like Bharat region, which is only 526 6/19 yojana wide in the Jambudweep of 100000 yojana. The common features between Jambudweep and Milky Way do tempt us to believe that Milky Way galaxy is like Jambudweep. Mount Sumeru in the center of Jambudweep is signified by a dense nucleus in the Milky Way.

The middle *loka* is one raju wide and flat. The universe is also flat according to astronomical observations. The middle *loka* contains all the islands, which have been compared with galaxies. The universe is estimated to be nearly $2x10^{22}$ kilometers wide, which is roughly of the same order as one raju distance mentioned before. According to Jain philosophy the stellar celestial beings are found only in middle *loka.* Thus the universe known to science is comparable with middle *loka*. This is a very significant derivation as it means that the science does not know

about upper *loka* and lower *loka*. This indeed may be the case because the lands in there two *loka* are of different kind as shown below.

The description of Bharat region as obtained in Jaina scriptures also justifies its location on Earth. So we may say that Earth is Bharat region in a specific or local sense and the Orion arm is the Bharat region in a broader or galactic sense. This is just like Delhi, which is a city in the local sense and a state in the wider sense. The Vijayardh Mountain is the source of rivers Ganga and Sindhu and the abode of wandering celestial beings and great scholars. We know that rivers Ganga and Sindhu have their origin in Himalayas, where great Rishis live, as found in the writings of Pandit Shriram Sharma Acharya and Swami Rama. So, mountain Himalaya can be regarded as Vijayardh Mountain. The region surrounded by Lavana Ocean on three sides and the Vijayardh Mountain on the fourth side is the Arya Khand. The oceans on Earth are also known as Lavana Sea in *puranic* literature. This indicates that India is the Arya Khand where Ayodhya is also located*. The other areas of Bharat region have been called as Mlechha Khand where people were said to be non-religious. This statement perhaps has reference to the Shraman culture, which existed only in India. People outside India did not have concept of Ahimsa, which is one of the main principle of *Shraman* or Indian culture. Lord Mahavira did not travel to Mlechha Khand because of this difference in religion in India and outside.

Scientists have been trying to find intelligent life on other planets in space. According to Jain philosophy life exists all over Jambudweep. The Bharat, Airavat, and east and west Videha regions are lands of actions and the other regions are lands of enjoyment. The scientific advancements are expected only in lands of action. Thus intelligent life and scientifically advanced civilizations may be expected in Orion arm, the nucleic center of Milky Way, which must be the Videha region, and one more region corresponding to the Airavat region. The Videh region is also supposed to be spiritually advanced. Intelligent life must also exist on other spiral arms of the Milky Way but these being lands of enjoyment, scientific advancement may not be expected there.

According to Jaina scriptures human beings are found in the Two and Half Islands only. It means that life and civilizations similar to that in Milky Way are also expected in the

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* In other possible description of Bharat region, the Earth, the six continents viz., Eurasia, Africa, North America, South America, Australia and Antartica may be considered as six parts of Bharat region, the Eurasia being the Araya Khand.

Andromeda Galaxy and perhaps also in the Triangulum Galaxy. The other Galaxies must have animals but not human beings.

The above comparison of middle *loka* and universe opens up a new area of study both for Jain philosophy and science. It is hoped that with further research and study both these branches of knowledge would have much to exchange and gain.

6.7.2 Shape of the Universe

It is clear from above that the known universe matches only the middle *loka*, which is flat. It appears that scientific observations are limited to middle *loka* only that contains all stars and galaxies. The upper *loka* and lower *loka* do not contain stars and so do not produce the common

radiations, which can be detected by normal instruments. The solution of general relativity equation of Einstein, however, considers matter and radiations of all kinds and should be applicable to whole *loka*. As a first approximation the assumptions made above for the solution of general relativity equations are satisfied in the case of *loka*. *Loka* contains energy and momentum in the form of *vargana* (primarily eight- touch) and aggregates. It also contains vacuum energy in the form of *vargana* (primarily four- touch) and *paramanus*. The space is simply connected and so space and time in space-time can be assumed separate. The space can also be considered isotropic and homogeneous in the middle *loka* and also in upper and lower *loka* as first approximation. The symmetrical structure of islands and oceans in the middle *loka* is similar to the universe. In the upper and lower *loka* the centrally located mobile zone is denser than the surrounding region but this difference can be neglected in the first instance. The upper *loka* and lower *loka* being different from the middle *loka* the curvature of space in the three *loka* is expected to be different. With this difference in mind we compare different solutions obtained for different curvatures with Jain *loka* of fig 6.3. We find the upper *loka* is like an extended sphere, the lower *loka* is like a hyperboloid and the small region of middle *loka* can be regarded as flat. Thus we see that solutions of simplified general relativity equations for different curvature of space can be jointly compared to the three parts of *loka*. The agreement can be improved by considering the specific structures of upper and lower *loka* and the presence of vacuum energy by including the cosmological constant in the equations.

We must recognize the limitation of the mathematical equations of general relativity in describing the partial aspects of reality. For example they do not tell us whether the space-time described by them is a part of bigger reality. According to Jain philosophy *loka*, the space-time, containing all matter, energy, *jivas* etc. is a finite part of infinite *akasa*. The space-time relationship established in the presence of matter and energy is described by these equations but *akasa* being devoid of *pudgala* etc. does not enter the relationship.

It is pertinent to consider the significance of the assumed values of Ω for upper and lower *loka*. It was mentioned earlier that the upper *loka* contains lands of heavens where the souls having merit are reborn. The karma bodies of souls having merit is composed of lighter negative *karman varganas*. The lands of heaven provide attraction to these meritorious souls and so must have a positive character. This means that heavens must be made up of positive *varganas*, which are heavier. The celestial beings living in heavens have protean bodies, may be like plasma. The lands required for such bodies should also be of similar kind, called *vimana* (aircraft) meaning that these lands may be floating freely in their regions. Their constituent positive *varganas* make them heavier and attractive only to meritorious souls, souls having demerit cannot enter these lands. Similarly, the lands in lower *loka* should be made of negative *varganas* attracting souls with demerit and karma bodies made of heavier positive *karman varganas*. Such souls cannot enter the heavens made of positive *varganas*. So we have justification for mobile zone in upper *loka* being comparatively dense for which $\Omega > 1$ and the mobile zone in lower *loka* to be comparatively light giving $\Omega < 1$. These considerations apply only to the mobile zone. The region outside this zone contains only small nano organisms and therefore must contain energy in subtle rarefied form

giving $\Omega << 1$. The first outer layer is supposed to be dense like water, middle layer like air and the last layer like rarefied air. As an approximation the layers may be represented by $\Omega = 1$.

An interesting aspect of this model is that the positive upper *loka* and negative lower *loka* may provide an electromagnetic system on galactic scale pervading the whole *loka*. In fact, the mobile zone may work as a permanent magnet having positive pole in the upper *loka* and negative pole in the lower *loka*. If this is so, then electromagnetic force also becomes important in deciding the space-time geometry in addition to the gravitational force considered in general relativity equations. The structure of finite *loka* having gravitational and electromagnetic forces must be stable. The steady state theory of Jain philosophy is then proved beyond doubt.

The Bhagawati canon provides some basis for the shape of *loka*. First, the *dharma* and *adharma* are responsible for division between *loka* and *aloka* that is existence of a finite *loka* in infinite *akasa*. It was stated earlier in chapter 2 that but for the existence of *dharma* and *adharma* the matter in the *loka* would either spread out and vanish in infinite *akasa* or contract into a big Crunch; the *loka* loosing its identity and existence in both cases. Second, it is stated in Bhagawati canon that the particular shape obtained in upper, middle, and lower *loka* are also due to *dharma* and *adharma*. The *dharma* and *adharma* are in expanded state in some regions and in contracted state in other regions. They are in expanded state in the upper *loka* providing a drum (*mridanga*) like shape. They exist in contracted state in the middle *loka* giving a compact shape. *Dharma* and *adharma* are again in expanded state in the lower *loka* providing a flare out as observed.

Presuming that *dharma, adharma*, and *akasa* bear a one-to one relationship, that is one *predasa* of *dharma* and *adharma* coincide with one *pradesa* of *akasa*, the *akasa* (or space) also experiences expansion and contraction similar to *dharma* and *adharma*. We can see a direct correlation between space density of matter and expansion and contraction of *dharma* and *adharma* and hence that of the space. The space is seen to contract and expand according to distribution of matter. However, the primary reason for the shape of *loka* appears to be expansion and contraction of *dharma* and *adharma*, the agents of motion and rest of matter, energy, and soul, the space abound by *dharma* and *adharma* follows them and assumes an appropriate shape.

The above scenario may have implication for mathematical investigation of shape of *loka*. Can *dharma* and *adharma* be considered mathematical fields? If so, then their consideration in the evaluation of shape of *loka* along with matter and energy may prove important and significant in deciding the geometry. A steady state finite *loka* does not seem to be a mathematical impossibility.

6.8 The Environmental Time Cycle

It was stated earlier that the Environment time cycle operates in Aryakhand of Bharat and Airavat regions. So it is a local phenomenon that is taking place in a part of land of action. Cyclic time changes do not take place on lands of enjoyment. It means that these changes occur when human beings employ six kinds of skills for their living. The human beings on a land of enjoyment depend on bio products for their living and do not undertake any activity that may damage the environment. The human beings on a land of action resort to agriculture use crafting and industrial skills to manufacture goods and products, which may use fuel for energy and produce harmful emissions and effluents, engage in trading which may need transport, animate or mechanized and weapons which may harm the environment. The environmental pollution on Earth today is a clear

testimony to this phenomenon. All human beings on Earth are using the said six skills and influencing the environmental and so the time – cycle changes should concern the entire Bharata region and not Aryakhand only.

S.M. Jain has offered a plausible scientific explanation for operation of the time – cycle. In his book on Environmental Ethics he has proposed a forest-based life – style theory for environmental changes. “The '*kalpvriksas*' are the benevolent trees capable of giving all that are desired by human beings, animals and other life forms. Forests play a vital role in maintaining climatic and overall environmental balance. It offers an effective protective shield to earth and its inhabitants from harmful ultraviolet radiation, floods, droughts, storms, epidemics, earthquakes and other vagaries of nature and ensuing calamities.

In natural forest areas all life forms live in harmony and are symbiotic with mutually cooperative relationship among themselves and also in relation to inanimate constituents. The bigger tree with deeper root system helps provide moisture and nutrients to younger and smaller companions. Men, animals and birds eat flowers, fruits, get necessary food and simultaneously help the plants in dispersal of their seeds. Butterflies and other insects suck nectar from flowers of plants but are agents of pollination. It has been proved by experiments that production of fruits increase by more than 25 % in orchards where homey bee farming is also done. There are different species of pest and predator insects on different plants in perfect natural balance and there is no insect damage. Many insects living symbiotically on trees produce useful products like lac, silk, honey etc. The burrowers like rats etc., which cause extensive damage in agriculture, are useful in forests as they work as tillers of land by burrowing and turning up the soil. There are carnivore's animals, birds, insects and micro-organisms which work as scavengers in nature by consuming naturally dead bodies, disintegrating all sorts of dead and waste material and converting it into products like manure directly or through their excreta. There is hardly any waste or dirty things left in good forests. There is no predation of any sort. Even the carnivore like tigers were initially scavengers and consumed only naturally dead bodies which were plentiful when entire earth surface was covered with good forests before the onset of agriculture. It was only when forests and wild animals were destroyed and naturally dead bodies became scarce that these carnivore started killing animals for food. It is well known that when number of wild animals declines then such carnivore kill domestic animals and even become man eaters when extremely hungry or while protecting off-springs or when injured by hunters. It has been observed that wolves, hyena, jackals and others generally feed on left over of tigers etc., but when these are not available they too start killing smaller animals and birds and even domestic cattle, sometimes children also.”

“The most significant aspect of forest eco-systems is that populations of all life forms remain optimum according to availability of food. There is no population explosion or increase of any species. The meticulous interactions between the species, their inherent genetic characteristics and the environment are mutually reinforcing. All work and cooperate with each other within optimized capacities. There is no over- exploitation of any one of constituents by another. The renewable natural resources are utilized within their renewable and resilience capacities, reinforced by each other. Forest eco-system ensures symbiotic relationship between members of a species including humans, species to species and other physical constituents of environment. All life forms will be mutually beneficial including bacteria and viruses, which will not mutate to harmful

mutations. Human social environment will also be amiable and situations triggering mental disorders, psychic as well as neurotic and cognitive depression, hysteria, schizophrenia, will be non-existent. Likewise it will also steer clear of physical ailments. Such is efficient and organized symbiotic system of management in nature which mankind has not been able to achieve in spite of astonishing scientific and technological advances."

"Homo sapiens (mankind) are supposed to be on this planet Earth since about 300000 years and for 99% of this time human population has been very limited within carrying capacity of the ambient environment and its constituent natural resources. Before the advent of agriculture mankind lived on products of natural forests and the population was conditioned by naturally available food. The population started rising with the advent of agriculture about 10000 years ago. Man saw that it was easier and less laborious to grow seeds nearby than to go round and collect these from forests. It was this sense of lethargy that gave birth to agriculture and subsequent sense of greed to grow more that triggered rapid extension of agriculture. As food supplies increased population also increased requiring more land for growing edible seeds. Initially land was naturally available flat vacant or as grass lands. Subsequently it was extended to forest areas. Trees were cut, burnt and land cleared for cultivation. The virgin lands of forest thus cleaned gave bumper crops of edible seeds for 5-6 yeas and the yields declined subsequently, people cleared new areas of forests to meet growing needs of food for increasing population. There was a crusade against forest. Initially when population was small people went on practicing shifting cultivation from one end to last end of forests of their village boundaries and returned back to the same point after 30-40 years as by then the land left fallow was again covered back by the same natural forest and became fertile. But as population increased the cycle of 30-40 years gradually decreased to 10-20 years and eventually to 5-6 years which did not allow forest to grow and make lands fertile. This necessitated shifting of whole villages to remaining forests and eventually denuding the entire landscape."

"When agriculture was started some people opposed it as they stuck to their forest based life style and were determined to preserve the natural forests from which they were getting food, clothing and everything they needed. These people were known as *raksasas* (demons), *raksha* meaning protection of natural forests. The others who adopted agriculture were known as *suras* (god) word *sura* meaning activity of cultivation. The society was then divided in two groups of *suras* or *devas* and *asuras* or *raksasas*. The entire mythology from Rigveda to Puranas is full of fierce battles between these two groups."

"In that era of fierce battle between *devas* and *raksasas*, there were saner towering personalities who brought rapprochement between the two warring groups or cultures and civilizations. The first such towering personality was Rishabha who introduced and advised agro-forestry i.e. planting of rows of trees and cultivation of land intermittently. The trees were planted in a direction so that their shade did not affect the agricultural crops in between."

"The birth of agriculture gave impetus to increase in population which then needed more expansion of agriculture which further triggered more rapid population growth and the vicious cycle continued till now particularly in predominantly agriculture based societies in developing countries. As a result all available land up to 90% was brought under agriculture at many places. The health of the soil is getting more and more precarious being over exploited for feeding increasing number of mouths. Its natural productivity because of its multiple organic constituents

and numerous microorganisms has almost been decimated. The living soil has been turned into an inorganic machine requiring more and more doses of chemical fertilizers to produce same quantity and pesticides to protect monoculture crops from pests and these are poisoning the air, soil and water bodies more and more. The poisonous pesticides are getting into human system through food chain with biological magnification almost ten times more in quantity then in soil and it is increasing the incidence of various asthmatic, psychiatric, cardiac, and other serious diseases and even cancer."

"After agriculture came the industrial revolution which further ruined the environmental conditions. In addition to direct pollution of environment by industrial emissions of poisonous gases into atmosphere and toxic effluents into water system and soil the most harmful impact of industrialization is that it is triggering consumerism. To meet the increasing demands, more and more industries are coming up which further trigger consumerism and the vicious cycle is going on. Before industrialization it was only increasing number of people that was adversely affecting the environment. Now it is double-edged sword i.e. of population increase and consumerism that is cutting ruthlessly the very fabric of environmental safety. Most of the energy needs are met by burning fossil fuels the oil and coal. Combustion of coal or oil in thermal power plants is never complete, lot of harmful gases produced damage the environment. There are numerous other toxic solid, liquid and gaseous industrial effluents and emissions polluting soil, water and air, causing immense harm to human and other life forms and producing various diseases like asthma, cardiac and even cancer. The nuclear power plants considered less polluting than thermal plants are in fact more dangerous. More chemical and consumer goods industries are coming up. All the harmful chemicals are ultimately discharged in environment, in soil, water and air. The indiscriminate use of pesticides and chemical fertilizers has also resulted in extinction of several thousand species of useful microorganisms, insects, birds, animals and plants, disturbing the natural ecological balance."

"The mutually sustaining eco-systems were damaged and degraded mainly because of anthropocentric approach of mankind that human beings are centre of the universe and all resources are for them. If natural resources are utilized within their carrying capacities they are self-sustaining. Even the degraded eco-systems start rejuvenating as soon as the biotic pressure mainly of man and his domestic animals is taken off and balanced to the carrying capacity. But unfortunately the forests are being exploited many times more. Today the erratic climatic changes, green house effects, widening ozone hole, melting of arctic ice-caps (already more than 48%) and glaciers are all threatening our health and even survival."

The last to come and most dangerous of all is the invisible radiation pollution. The increasing use of radio, television, telephones, computers, mobiles, microwaves, etc are posing great threats to humans, animals and the environment. Radiations have been found to cause diseases like deafness, sleeplessness, headache, irritation, exhaustion and even cancer in humans, loss of hunting power resulting in starvation deaths in animals, loss of fertility and milk production in cows, mental disorder and deaths in mouse, reduction in crop yield, illusion in birds, etc. One study shows that by 2017 half of human population is likely to suffer from electro hypersensitivity.

"The process of succession or progression as a result of controlling biotic pressure and also of retrogression by increasing exploitation of forest eco-systems has been well studied and

documented. The process of biological evolution continues till a mix of species of plants and animals occupy the land and perpetuate in mutual collaboration. This is called climax stage. The intermediate stages are succession stages. If the balance in climate stage is disturbed by over exploitation and biotic pressure the process of retrogression sets in and species of higher climax stage are replaced by lower and lower ones of succession stages corresponding to the intensity of biotic pressure. It has been possible by human endeavour to maintain a particular succession stage of economically valuable species. Teak, the paragon of tree species is the tree of succession stage in tropical and subtropical forest eco-systems in India, Burma and other countries. If biological evolution is allowed by removing the required biotic pressure than teak will be replaced by biologically higher but economically less valuable species like syzigium cumunii etc. The system of manipulating biotic pressure of thinning, grazing, control burning is adopted to maintain succession stage suitable for teak. But this is also selfish concept of man. The best is climax stage which is self sustaining and mutually reinforcing."

According to S.M. Jain this phenomenon of succession and retrogression has been described in Jaina scriptures as the swinging time cycle. It has two swings one from best to worse known as Avasarpini i.e. down-wards retrogression like from the mouth to tail of a serpent and other Utsarpini i.e. upwards progression from tail to mouth of a serpent. Each half era of Avasarpini and Utsarpini has been divided in six successive stages as described earlier. The first stage of Avasarpini is the climax stage "Happy-happy" which is perfectly symbiotic, when even carnivore works as a scavenger of naturally dead and is not a killer. No species of plants or animals cause harm to others. The air, water and soil are in purest form without contamination of any sort. When greed and increased population disturb the balance the next slightly degraded stage "happy" follows. The greed and population continues to increase resulting in further deterioration of environment and the third stage of "Happy-unhappy" is entered. In this stage people are partially happy because forests providing requirements are there, though in reduced number, but unhappy because species start attacking each other, as there is a competition for decreasing available resources. The stronger like man, carnivore even annihilates many humbler ones, which too become aggressive like symbiotic bacteria, virus and insects becoming pests and harmful, causing ailments. The degradation continues and the fourth stage is "Unhappy-happy" i.e. people are more unhappy than happy as the forests suffer concerted onslaught because of expanding agriculture. The fifth stage is 'Unhappy" when people are by and large unhappy. This is the stage we are living in, when people are unhappy, in spite of phenomenal advances in science and technology, because the natural resource are being over-exploited many times more than carrying capacity and the environment has been polluted to a large extent. The fourth stage had pressure of agriculture but in the present fifth stage it is both from expanding agriculture and multiplying industries.

As a result of increasing consumerism, more and more exploitation and pollution of nature, the conditions will gradually deteriorate to worse when most of natural resources will be completely exhausted and environment will be so much polluted that life will become most miserable and a few numbers of a few species will be able to survive. This will be the sixth "Unhappy-unhappy" stage. The prediction seems to come true as the things stand and is unfolding. With fewer numbers and reduced biotic pressure the progression will start and events shall occur in

reverse order finally culminating in "Happy - happy" climax stage. This will complete the full cycle and again the retrograde swing shall take place and the process shall continue.

As described in Table 6.2 the swing can be arrested and maintained at a particular stage, say the first stage, if the people or the habitants of that region are wise enough not to allow degradation and balance their demands according to resources and carrying capacity of the environment. At other places realization might come after stage one, two or third and conditions there are stabilized and maintained at that particular stage by commensurate balance of consumption and carrying capacity of environment. These trends are visible in different regions of Jambudweep and the *loka* where the inhabitants by their awareness follow environmental practices that maintain a particular stage of balance. The inhabitants of Earth appear to be the worst lot who has least concern about their environment and a minimum will to protect it.

6.9 The Fate of the Universe

While dealing with the universe the scientific enquiry has focused primarily on matter, space and time and has neglected the living systems. Living systems have an important bearing on the state of the universe and their omission gives an incomplete picture of the universe. Without including soul the fate of organisms and hence the fate of the universe cannot be predicted successfully. We make an attempt to examine the fate of the universe in the light of Jain philosophy considering the existence of soul, matter and other substances.

6.9.1 Entropy and Cosmology

The second law of thermodynamics conventionally describes physical systems. An important law of physics, the second law of thermodynamics, states that the entropy of any system cannot decrease except insofar as it flows outward across the boundary of the system. As a corollary, in an isolated system, the entropy cannot decrease. By implication, the entropy of the whole universe, assumed to be an isolated system, cannot decrease; in fact the entropy of the universe is always increasing. It has been speculated that the universe is fated to a heat death in which all the energy ends up as a homogenous distribution of thermal energy, so that no more work can be extracted from any source.

However, the role of entropy in cosmology remains a controversial subject. Recent work has cast extensive doubt on the heat death hypothesis and the applicability of any simple thermodynamic model to the universe in general. Although entropy does increase in the model of an expanding universe, the maximum possible entropy rises much more rapidly-thus entropy density is decreasing with time. This results in an "entropy gap" pushing the system further away from equilibrium. Other complicating factors, such as the energy density of the vacuum and macroscopic quantum effects, are difficult to reconcile with thermodynamic models, making any predictions of large – scale thermodynamics extremely difficult.

Entropy has often been associated with the amount of order, disorder and / or chaos in a thermodynamic system. Entropy serves as a measure of how close a system is to equilibrium that is, to perfect internal disorder. The value of the entropy of a distribution of atoms and molecules in thermodynamic system is a universe of the disorder in the arrangements of its particles. Solids which are typically ordered on the molecular scale usually have smaller entropy than liquids, and liquids have smaller entropy than gases and colder gases have smaller entropy than hotter gases. At

absolute zero temperature, crystalline structures are approximated to have perfect "order" and zero entropy.

Mathematically, entropy S is defined as

$$S = -K \Sigma Pi \ln Pi \qquad (1)$$

The sum runs over all microstates consistent with the given macrostate and Pi is the probability of the ith microstate and, K is a constant. According to this definition highly-ordered states have low entropy and disordered states may or may not have high entropy. For microcanonical system where all accessible microstates have the same probability, equation (1) gives

$$S = K \ln W \qquad (2)$$

Where W is the number of possible states in which a system can be found.

Some scientists have questioned the relationship between entropy and disorder. If entropy is associated with disorder, and if the entropy of the universe is headed towards maximum entropy, then many are often puzzled as to the nature of the "ordering" process and operation of evolution. In the recent book SYNC – The Emerging Science of Spontaneous Order, Steven Strogatz writes "Scientists have often been baffled by the existence of spontaneous order in the universe. The laws of thermodynamics seem to dictate the opposite; the nature should inexorably degenerate towards a state of greater disorder, greater, entropy. Yet all around us we see magnificent structures galaxies, cells, ecosystems, human beings that have all somehow managed to assemble themselves."

The most general interpretation of entropy is as a measure of our uncertainly about a system. The equilibrium state of a system maximizes the entropy because we have lost all information about the initial conditions except for the conserved variables; maximizing the entropy maximizes our ignorance about the details of the system. This uncertainty is not of the everyday subjective kind, but rather the uncertainly inherent to the experimental method and interpretive model.

Locally, the entropy can be lowered by external action. This applies to machines such as a refrigerator, where the entropy in the cold chamber is being reduced, and to living organisms. This local decrease is, however, only possible at the expense of entropy increase in the surroundings.

6.9.2 Entropy and life

Some scientists draw a parallel between physical systems and biological systems. As a biological ecosystem evolves by the process of natural selection, it disperses energy, increases entropy, and moves towards a stationary state with respect to its surroundings. According to them whether an object is animate or inanimate, science does not make a distinction. In both cases, energy flows towards a stationary state, or a state of equilibrium, in the absence of a high-energy external source.

Erwin Schrödinger in his 1944 book What is Life? explains that most physical laws on a large scale are due to chaos on a small scale. He calls this principle "order- from disorder". He states that life greatly depends on order and that a naive physicist may assume that the master code of a living organism has to consist of a large number of atoms. He further states "... living matter, while not eluding the "laws of physics" as established up to date, is likely to include "other laws of physics" hitherto unknown, which however, once they have been revealed, will form just as integral a part of science as the former."

Schrödinger concludes the book with philosophical speculations on determinism, free will, and the mystery of human consciousness. He is sympathetic to the view that each individual's consciousness is only a manifestation of a unitary consciousness pervading in the universe. In the final paragraph, however, he emphasizes the uniqueness of each human being's store of memories, thoughts and perceptions.

The argument that life feeds on negative entropy or negentropy by Schrödinger served as a stimulus to further research. In the popular 1982 text book Principles of Biochemistry by American biochemist Albert Lehninger it is argued that the order produced within cells as they grow and divide is more than compensated for by the disorder they create in their surroundings in the course of growth and division. Thus, according to Lehninger, "living organisms preserve their internal order by taking from their surroundings free energy, in the form of nutrients or sunlight, and returning to their surroundings an equal amount of energy as heat and entropy.

In a study titled "Natural selection for least action" published in the proceedings of the Royal Society A, Ville Kaila and Arto Annila of the University of Helsinki describe how the second law of thermodynamics can be written as an equation of motions to describe evolution, showing how natural selection and the principle of least action can be connected by expressing natural selection in terms of chemical thermodynamics. In this view, evolution explores possible paths to level differences in energy densities and so increase entropy most rapidly. Thus, an organism serves as an energy transfer mechanism, and beneficial mutations allow successive organisms to transfer more energy within their environment.

Entropy has been associated with disorder and disorder, has been linked to disorganization by some workers; higher entropy means higher disorder and also higher disorganization. But this kind of relationship has been questioned by others, particularly in context with living systems. Living creatures are a very significant sub-class of open systems. An individual cell continuously takes up metabolites through its enclosing membranes and this material undergoes chemical reactions within the cell interior resulting in a variety of low- and high – molecular weight products, some of these pass out of the cell: others contribute to the cell's growth and to its eventual division. It is really difficult to make an accurate entropy balance on an organism with its environment. But the experimental evidence available does not reveal any violation of the second law.

K.G. Denbigh has cited an example of a fertile bird's egg inside an incubator. The latter contains a sufficiency of air and was initially raised to a temperature high enough for the hatching of the egg. The incubator was thereafter surrounded by perfect thermal insulation so that its total entropy can only increase or remain constant. However there remain two possibilities concerning a different aspect of the system's temporal development: (1) the egg dies; (2) the egg lives and eventually gives rise to a live chick. Now it is true that in case (1) there is an entropy increase accompanied by a process of disorganization, localized in the egg. But the opposite is the situation in case (2): for although the egg is certainly a highly organized system, the live chick must surely be deemed to be much more so. Entropy again increases but now there is an increase in the degree of organization as well. This example thus provides a clear instance of its being false to suppose that entropy increase is equivalent to a process of disorganization. This does not mean that organisms operate in a manner contrary to the second law. That is not the case at all. The

irreversible processes of metabolism, heat conduction etc., occurring within organisms are entropy producing like any others. It is only to say that changes in amount of organization and of entropy can occur quite independently of each other.

A similar conclusion was reached by Denbigh about changes or 'orderliness' and of entropy being mutually independent. He thinks that in addition to entropy there may well exist other 'one way functions' which add to the overall description of the worlds' temporal development.

6.9.3 Physical Systems

According to Jain philosophy the smallest constituent of all matter and energy is paramanu. The modes of energy of the paramanu change spontaneously [1] and so we have parmanus in which the electric energy is very small compared to thermal energy and also parmanus in which the thermal energy is very small compared to electric energy. So theoretically we can describe the cosmos in three ways.

1. Thermal cosmos – a thermal system having limited role of electric energy.
2. Electric cosmos – an electric (or magnetic) system having limited thermal activity.
3. General cosmos - a system in which both thermal and electric (or magnetic) energy are important for processes.

The state of a free paramanu is unpredictable, it can move with different velocities, from zero to very high velocity, and can occupy any position in the cosmos. The parmanu is thus associated with highest uncertainty. With the formation of clusters in a vargana the freedom of motion of the paramanu is subjected to restriction thereby reducing its uncertainty. This reduction in uncertainty gives rise to some order in the arrangement of paramanus in the vargana. The order is increased in those vargana, which have parmanus in the bonded state. The order is still high in matter which is comprised of largest mass type vargana. According to rules available in Jain philosophy bonding between two paramanus takes place when the difference in their electric charge exceeds a minimum level. This shows that a high electric charge (or magnetism) increases order in the system.

The processes taking place in varganas like clustering, declustering, bonding and separation are spontaneous. In the smaller mass less varganas the paramanus simply cluster without bonding and decluster easily. The process is going on randomly and is not expected to change the overall order in the cosmos. In the larger mass type varganas, which are in the form of energy, bonding and debonding is an electrical activity, which must be reversible in nature without disturbing the overall order in the system. Scientific theories indicate that 73 percent mass in the universe is in the form of dark energy. According to Jain philosophy the varganas must comprise this part of energy. We therefore expect that this 73 percent mass does not change order in the universe. Amongst the rest of the mass about 23 percent is said to be dark matter and the remaining 4 percent is visible (luminous) matter. Over 99 percent of the visible mass is contained in the stars and therefore their activities are important from the view of prevailing order in the universe.

The thermal processes taking place in matter are subjected to the second law of thermodynamics, according to which in an isolated system like universe the entropy is always increasing pushing the system towards an equilibrium state where no useful work is possible. We

[1] Spontaneous means "by itself, or without any outside influence", and has nothing to do with speed.

have stated above that the universe can be regarded both as a thermal system and an electrical system and that the system can change its mode from one type to another spontaneously. This has important implications regarding the overall order in the universe.

There is scientific evidence that verifies a spontaneous change in the mode of a system. In a process known as adiabatic demagnetization a reversible change in temperature of a suitable material is caused by exposing the material to a changing magnetic field. In this type of refrigeration process, a sample of solid such as chrome – alum salt, whose molecules are equivalent to tiny magnets, is inside in insulated enclosure cooled to a low temperature, typically 4 Kelvin or 2 Kelvin, with a strong magnetic field being applied to the container using a powerful external magnet, so that the tiny molecular magnets are aligned forming a well-ordered "initial" state at that low temperature. The magnetic alignment means that the magnetic energy of each molecule is minimal. The external magnetic field is then reduced, a removal that is considered to be closely reversible. Following this reduction, the atomic magnets then assume random less-ordered orientations, owning to thermal agitation, in the "final" state. The "disorder" and hence the entropy associated with the change in the atomic alignments has clearly increased. In terms of energy flow, the movement from a magnetically aligned state requires energy from the thermal motion of the molecules, converting thermal energy into magnetic energy. Yet, according to the second law of thermodynamics, because no heat can enter or leave the container, due to its adiabatic insulation, the system should exhibit no change in entropy. The increase in disorder, however, associated with the randomizing directions of the atomic magnets represents an entropy increase? To compensate for this, the disorder (entropy) associated with the temperature of the specimen must decrease by the same amount. The temperature thus falls as a result of this process of thermal energy being converted into magnetic energy. If the magnetic field is then increased, the temperature rises again.

One variant of adiabatic demagnetization is nuclear demagnetization refrigeration (NDR). In NDR the cooling power arises from the magnetic dipoles of the nuclei of the refrigerant atoms, rather than their electron configurations since these dipoles are of much smaller magnitude, they are less prone to self- alignment and have lower intrinsic minimum fields. This allows NDR to cool the nuclear spin system to very low temperatures, often 1μK or below.

The above example of adiabatic demagnetization shows that:

(1) The thermal energy and magnetic energy can mutually interchange spontaneously in an adiabatic system.
(2) The order in the system depends on both the thermal energy and magnetic energy.
(3) At low temperature the thermal energy and magnetic energy have opposing effect on ordering.

These observations though made under specific conditions do support the views that the universe can be regarded both as thermal system and electrical (or magnetic) system and that the overall order in the universe is jointly determined by these two modes.

6.9.4 Living systems

Living systems are characterized by soul. We know that in the development process the soul initially exists in impure state and takes birth as one sense being. At this stage the soul can take birth anywhere in the universe making its occurrence highly uncertain. From this point of

view the life as one sense being is a highly disordered system. As the soul develops and progresses on its journey the regions and scope of its birth are subjected to restrictions, the uncertainty is reduced and the order is increased. Finally when the soul is liberated the soul cannot take birth again and the uncertainty is reduced to zero giving a perfectly ordered system. Thus life in the universe proceeds temporally from a highly disordered system to a perfectly ordered system.

The above hypothesis is supported by history of evolution of species on Earth. Biodiversity found on Earth today is the result of 4 billion years of evolution. Until approximately 600 million years ago, all life consisted of bacteria and similar single celled organisms. The cell structure was prokaryotic. More complex creatures arose sequentially after this prokaryotic beginning, first eukaryotic cells, perhaps about two billion years ago, then multicellular animals about 600 million years ago. This was followed by the age of invertebrates. Then in sequence we had the age of fishes, age of reptiles, age of mammals and finally humans. The complexity of DNA increased through these sequences starting from simple DNA found in virus to highly developed DNA in humans. The structure of DNA can be considered as a representative of order in the living systems and we find that evolution of life on Earth has proceeded from disorder to order. Some scientists are of the view that this order in the world must be the result of intelligence (or an intellect being).

DNA is an organic superconductor that can work at normal temperatures. Artificial superconductors require extremely low temperatures of between 200^0K and 140^0K to function. All superconductors are able to store light and thus information. This is further explanation of how the DNA can store information. Bio photons responsible for the ability to communicate at all levels within cells, between cells, organization of metabolic activities within the cell, the operation of the immune network and host of other biological functions, also have high efficiency of energy transfer and transformation which often approaches 100 % in DNA, which undergoes physical resonance.

The above scientific information helps us to understand how life proceeds from disorder to order. First, some scientists also find it necessary to believe in the presence of intelligence in life, which we know is the property of the soul. In a soul the prana energy must produce the organization in a cell; in fact this may be the main function of prana energy. The entropy balance is difficult to make as we are not able to account for the subtle prana energy in the energy audit. Lehninger assumed that internal order in organisms is preserved by taking free energy in the form of sunlight and nutrients from their surroundings. This may be true of plants but the mobile beings are not expected to benefit much from sunlight. Instead in their case it should be the prana energy that preserves the order. The prana energy may constitute the “other laws of physics” Schrödinger has referred to. Second, amazing structure , like super conductor DNA holding large amount of information and a weak light in DNA accomplishing feats like 100% energy transfer and transmission efficiency and superb organization of metabolic activities in the cell etc are features which minimize entropy increase and maintain order in a living being. This kind of performance is not expected of innate matter; clearly it is the soul whose powers produce the order in DNA and organization in the cell. As the soul progresses in its journey from one sense microorganism it creates better order and organization in the biological systems which we see as evolution on Earth like planets. After the stage of human beings further increase in order has not been explored by science as yet as this falls in the realm of spiritual world. According to Jain philosophy the order

continues to increase in spiritual personalities, hopefully producing improved metabolic and other biological states which are endowed with many kinds of supernatural powers. The journey of progress ends in liberation, a state of perfect order of the soul. Such a state is not possible with physical body, which has inherent limitations, and therefore the soul drops the body at the last stage, becoming free forever. The total number of liberated souls is infinite and this number is increasing as more souls get liberated.

According to Jain philosophy one – sense microorganisms are found all over loka and mobile beings, 2-sense to 5-sense beings, are found in the central region of loka. All these organisms produce order from disorder as has been rightly recognized by Schrödinger. They take in matter and energy in various forms from the environment and assemble them to produce the body structure. The body is maintained with minimum increase in entropy. The processes taking place in body are primarily electrical and chemical both of which are energetically more efficient than thermal processes. Thus organisms are means of producing order from disorder.

6.9.5 Spatial and Temporal Variations in Order/Disorder

A relationship between order/disorder and quality of life can be established. Forests are order producing systems for they receive thermal energy from sunlight and convert it into chemical and electrical energy with the help of nutrients. As chemical and electrical systems are better ordered than thermal systems, plants produce order from disorder. Burning of fuel converts chemical energy into thermal energy and increases disorder. Atomic energy power plants convert electrical bonding energy into thermal energy and also increase disorder. A forest based life style where all requirements of living beings are met from forests conserves order in the environment. From this consideration animals do not contribute to disorder. Human beings burning fuel produce disorder the magnitude of which increases with increasing rate of burning fuel. Industrialization, using fossil fuels and atomic energy, increases disorder, a higher disorder must be associated with a low quality of life and vice versa.

Jain philosophy describes in detail the quality of life in the universe. There are two types of lands in the universe, the lands of enjoyment where the life is forest based, and lands of action where the living beings employ various kinds of skills for living, which may involve burning of fuel. The lands of action are found only in that part of universe which is inhabited by human beings, and human beings are found only in a small part of the universe, which is comprised of Jambudweepa and two more similar regions in the neighborhood. Jambudweepa and these two lands have not been identified in the modern context but in my opinion they are our Milky Way Galaxy, Andromeda Galaxy and a part of Triangulum Galaxy. In this part of universe there are 15 lands of action and our planet is one of them. This means that there are 15 planets or regions in the universe, 3 in Milky Way Galaxy and 6 each in Andromeda and Triangulum Galaxy, where human beings employ advanced skills for living. Most of the lands of action maintain a constant standard of quality of life, at different levels, but there are few others, like our Earth, which experience a temporal cyclic change in the quality of life. We are presently passing through the descending phase of the quality cycle that is the quality of life is going down. This means that disorder must be increasing on our planet, a fact that cannot be disputed. This downward trend is supposed to continue for about 40,000 years when the disorder shall reach the maximum level and the quality

of life shall be at a minimum level. Thereafter a reversal in the trend shall occur and disorder shall start decreasing, eventually producing conditions for better quality of life.

In those lands of action which maintain a given quality of life, the human beings must be wiser not indulging in activities that increase disorder. As stated above human beings are found only in a small part of the universe, in the remaining part only animals are supposed to exist, where life must be forest based producing no disorder. Thus the scenario which emerges is that in most part of the universe the living systems produce no disorder, only the physical systems may disturb the balance of order and disorder. As the physical systems involve electrical and chemical processes, besides thermal, there is a good possibility of order/disorder being maintained at a constant level on a galactic scale.

From above we see that Jain philosophy allows for local variation in disorder, as we find on Earth, but that should not be a matter of alarm as far as the universe is concerned. The universe being endless maintains a stable condition of order/disorder and life is respectfully maintained on a continuous basis.

6.9.6 Is Universe Expanding?

The Big Bang theory, which is widely accepted by scientists, is predicted by red shift given by Hubble's law based on astronomical measurements. The red shift is supposed to occur mainly due to expansion of space, which causes emitted photons to stretch to longer wavelengths and lower frequency during their journey of millions and billions of light years. The Jain philosophy offers an alternative explanation for stretching of photons in such long journeys.

A photon is made of vargana of mass category. A photon is supposed to be charge less and so it must be an aggregate of two or more varganas (a vargana has a charge). In fact photons of different frequency must contain differing number of varganas. These and other kinds of varganas of both mass less and mass category are found all over middle loka. These varganas travel in all directions at any given location. A photon traveling in space may encounter and collide with other photons or varganas traveling in different directions. The possibility of collision will certainly exist when the travel is on galactic scale involving millions of light years. As a result of such collisions it is expected that some of the varganas or paramanus will be knocked off reducing the number of paramanus and hence the energy of the photon. A photon with less number of varganas or paramanus also becomes less dense and shall occupy more space than before. Consequently, the frequency of photon shall decrease and the wavelength shall increase, when considering travel of photon on galactic scale. The frequency decrease can be expected to be more with greater distance of travel and more number of possible collisions of photon. Thus there is no need to make rather an unrealistic assumption of expansion of space to explain the Hubble's law. Jain philosophy supports a steady state universe; the concept of expanding universe is not acceptable.

Akasa in Jain philosophy is real, infinite, eternal and one indivisible unit and it cannot have any expansion. The expansion of space, assumed by scientists obviously raises the question; it is expanding in what? There can be no expansion without the presence of space and if the space is already present what is the meaning of expansion of space. Jain philosophy offers a way out for all such confusing assumptions. Is the Big Bang inferred by extrapolation of Hubble's observations not imaginary?

6.9.7 Comments

The active universe is comprised of two basic components, (1) matter and energy and (2) jiva, the living substance. The state of the universe is jointly determined by these two components. The inanimate component is bigger than the animate component. The 73 percent of the inanimate component is recognized as dark energy by scientists and not much is known about it. According to Jain philosophy this part of inanimate energy must comprise of varganas which are clusters of paramanus, some of them are in bonded state and others are unbounded. The bonding between paramanus is an electrical activity and therefore varganas are not supposed to contribute to disorder in the system.

The luminous matter, made up of one specific type of vargana, ultimately consists of paramanus, whose total energy comprises of electric energy and thermal energy (including kinetic energy of motion). The paramanu undergoes self-transformation and one mode of energy may change into another mode spontaneously. The second law of thermodynamics applies to thermal processes of gross matter that increases entropy in the universe. This is supposed to increase disorder. However the processes taking place in electrical mode are seen to increase order in the system (like ordering of molecular magnets). There remains a possibility of change of matter from thermal mode to electrical mode in some part of the universe producing order from disorder.

Organisms are systems that produce order from disorder. The order and organization seen in cells is not possible in non-living systems and it is surely a result of intelligence contained by the soul. The soul which proceeds from a highly disordered state to a perfectly ordered state also produces order in the body it occupies. It is because of the soul that the processes in the body are highly efficient minimizing entropy production in the environment. In most part of the universe organisms do not disturb the order; there are only a few regions where human beings resort to activities that increase disorder.

So, we have systems producing order from disorder and disorder from order in the universe. The galaxies, star systems, cells, organisms, etc. are examples of beautiful order in the universe. The two components, living and non-living, together give a steady and stable universe according to Jain philosophy and there is no fear of heat death or end of the universe.

Chapter 7
The Origin and Evolution of Life

We first review the scientific concepts of origin of life and evolution.

7.1 Origin of Life

How did life begin on Earth? This long-standing question continues to generate fascinating conjectures and ingenious experiments. There is no truly "standard" model of the origin of life; however most currently accepted models build in one way or another upon a number of discoveries concerning the origin of molecular and cellular components for life.

7.1.1 Abiogenesis

Some scientists believe that life arose spontaneously from available materials present on the early earth. The basic inorganic chemicals from which life was formed are methane (CH_4), ammonia (NH_3), water (H_2O) hydrogen sulphide (H_2S), carbon dioxide (CO_2), and phosphate (PO_4^{3+}). As of now, no one has yet synthesized a "proto-cell" using basic components, which has the necessary properties of life. Without such a proof-of-principle, explanations have tended to be short on specifics.

A number of clearly defined stages in explaining the origin of life has been recognized.

Stage 1: The origin of biological monomers

Stage 2: The origin of biological polymers

Stage 3: The evolution; from molecule to cell.

The 'Miller Experiments" (including the original Miller- Urey experiment of 1953) are performed under simulated conditions resembling those thought at the time to have existed shortly after Earth first accreted from the primordial solar nebula. The experiment used a highly reduced mixture of gases (methane, ammonia and hydrogen) in water vapour. The gases passed through a chamber containing two electrodes with a spark passing between them. The experiment showed that some of the basic organic monomers (such as amino acids) that form the polymeric building blocks of modern life could be formed spontaneously.

Simple organic molecules are a long way from a fully functional self-replicating life from; however, in an environment with no pre-existing life these molecules may have accumulated and provided a rich environment for chemical evolution ("soup theory"). On the other hand, the spontaneous formation of complex polymers from abiotically generated monomers under these conditions is not at all a straight forward process. Besides the necessary basic organic monomers, also compounds that would have prohibited the formation of polymers were also formed in high concentration during the experiments.

Other sources of complex molecules have been postulated, including sources of extra-terrestrial stellar or interstellar origin. For example, from spectral analysis, organic molecules are known to be present in comets and meteorites. The most crucial challenge unanswered by this

theory is how the relatively simple organic building blocks polymerize and form more complex structures, interacting in consistent ways to form a protocell.

So far no RNA molecules that direct the replication of other RNA molecules have been identified in nature. Some recent experiments provided that an RNA molecule produced by prebiotic chemistry could have carried out RNA replication on the early earth. However, much remains to be done, but scientists hope that some kind of RNA- catalyzed reproduction of RNA will be demonstrated in the not too distant future.

Gunter Wachtershauser provided another possible answer to polymerization conundrum in 1980s, in his iron-sulphur world theory. In this theory, he postulated the evolution of (bio) chemical pathways as fundamentals of the evolution of life. According to latest modification of this theory, the first cellular life forms may have evolved inside so-called black smokers at seafloor spreading zones in the deep sea.

The Bubble Theory

Waves breaking on the shore create delicate foam composed of bubbles. While bubbles comprised of mostly water burst quickly, oily bubbles happen to be much more stable. The phosphor lipid is a good example of an oily compound believed to have been prevalent in the pre biotic seas. They have the tendency to spontaneously form lipid membrane in water. A lipid bilayer bubble can contain water, and was a likely precursor to the modem cell membrane. Primitive reproduction can be envisioned when the bubbles burst, releasing the results of the experiment into the surrounding medium. Once enough of this stuff was released into the medium, the development of the first prokaryotes, eukaryotes, and multi cellular organisms could be achieved.

Clay theory

A hypothesis for the origin of life based on clay was forwarded in 1985. Clay theory postulates complex organic molecules arising gradually on a pre-existing, non-organic replication platform – silicate crystals in solution. Complexity in companion molecules developed as a function of selection pressures on types of clay crystal is then expected to serve the replication of organic molecules independently of their silicate "launch stage".

"Deep – hot biosphere" model

Thomas Gold in the 1990s put forward a theory that life first developed not on the surface of the earth, but several kilometers below the surface. It is now known that microbial life is plentiful up to five kilometers below the earth's surface in the form of archaea, which are generally considered to have originated around the same time or earlier than bacteria, most of which live on the surface including the oceans.

7.1.2 Exogenesis

An alternative to Earthly abiogenesis is the hypothesis that prime time life may have originally formed extra terrestrially. Organic compounds are relatively common in space, especially in the outer solar system where volatiles are not evaporated by solar heating. Comets are encrusted by outer layers of dark material, thought to be tar- like substance composed of complex organic material formed from simple carbon compounds after reactions initiated mostly by irradiation by ultraviolet light. It is supposed that a rain of cometary's material on early Earth could have brought significant quantities of complex organic molecules and that it is possible that

primitive life itself may have formed in space was brought to the surface along with it. A related hypothesis holds that life may have formed first on early Mars, and been transported to Earth when crust material was blasted off of Mars by asteroid and comet impacts to later fall to Earth's surface. Both of there hypothesis are even more difficult to find evidence for, and neither of them actually answers the question of how life first originated, merely shifting it to another planet/ comet.

7.1.3 Panspermia

Panspermia is the hypothesis that seeds of life are prevalent throughout the universe, and furthermore that life on Earth began by such seeds landing on Earth and propagating them. Panspermia can be said to be either interstellar or interplanetary. There is as yet no compelling evidence to support or contradict it, although the majority view holds that Panspermia – especially in its interstellar form – is unlikely given the challenges of survival and transport in space. Sir Fred Hoyle and Chandra Wickramsinghe were important proponents of the hypothesis who further contended that life forms continue to enter Earth's atmosphere, and may be responsible for epidemic out breaks, new diseases, and the genetic novelty necessary for macro evolution.

Until a large portion of the galaxy is surveyed for signs of life or contact is made with other civilizations, the Panspermia hypothesis in its fullest meaning will remain difficult to test. There is, however, circumstantial evidence for exogenesis. The Precambrian fossil record indicates that life appeared soon after the Earth was formed. Unless the Earth just happened to be the site of a large number of fortuitous coincidences, this would imply that life appears in several hundred million years when conditions are favourable. Evidence has accumulated that some bacteria are more resistant to extreme conditions than previously recognized, and may be able to survive for very long period of time even in deep space. Narlikar et al. took air samples at 41 km over Hyderabad – above the tropopause where mixing from lower atmosphere is unexpected – from which rod and coccoid bacteria were isolated. These extremophiles could possibly travel in a dormant state between environments suitable for ongoing life such as planetary surfaces. Another line of evidence comes from research that shows there are many more potential habitats for life than Earth – like planets. The Mars exploration Rover missions confirmed the presence of post liquid water on Mars, suggested by river- like formations on the red planet.

No undisputed evidence has ever been published in a mainstream scientific journal to suggest that intelligent alien species have visited the Earth. The majority view in the scientific community seems to be on acceptance that the existence of intelligent life elsewhere in the universe is at least highly probable, due to the sheer number of potential sites where life could take hold. However, the special theory of relativity holds that travel over the vast distances between stars would be limited to the speed of light, and so take such a long time that many scientists think it unlikely that such travel would be practical for life forms as we know them. Over the past century, thousands of people have reported UFO sightings in countries all over world. Some remain unexplained.

There are some objections to Pansphermia and exogenesis. Life requires heavy elements carbon, nitrogen and oxygen to exist at sufficient densities and temperatures for the chemical reactions between them to occur. These conditions are not wide spread in the universe, so this limits the distribution of life as an ongoing process. This, of course, presupposes that any life needs those elements, which the proponents of alternative biochemistries do not consider certain.

7.2 Evolution

Evolution was briefly dealt with earlier in 4.11. The process of evolution has left behind numerous records, which reveal the history of different species. While the best known of these are the fossils, fossils are only a small part of the overall physical record of evolution. The development of genetics has allowed biologists to study the genetic record of evolution as well. Other evidence used to demonstrate evolutionary lineages include the geographical distribution of species. Scientists correlate all of the above evidence – drawn from paleontology, anatomy, genetics and geography – with other information about the history of the Earth.

Not much is known about the earliest development in life. However, all existing organisms share certain common traits, including cellular structure, and genetic code. Most scientists interpret this to mean all existing organism share a common ancestor, who had already developed the most fundamental cellular process, but there is no scientific consensus on the relationship of the three domains of life (Archaea, Bacteria, and Eukaryota) or the origin of life.

The emergence of oxygenic photosynthesis (around 3 billion years ago) and the subsequent emergence of oxygen rich, non-reducing atmosphere can be traced through the formation of banded iron deposits, and later red beds of iron oxides. This was a necessary prerequisite for the development of aerobic cellular respiration, believed to have emerged around 2 billion years ago. In the last billion years, simple multi cellular plants and animals began to appear in the oceans. Soon after the emergence of the first animals, the Cambrian explosion (a period of unrivaled and remarkable, but brief, organism diversity) saw the creation of all the major body plans, or phyla, of modern animals. This event is now believed to have been triggered by the development of the Hox genes. About 500 million years ago, plants and fungi colonized the land, and were soon followed by arthropods and other animals, leading to the development of land ecosystems with which we are familiar.

Many critics of evolution claim that the theory robs life and the universe of any transcendental meaning. This fact is indeed one of the great strengths of the theory, many evolutionists say; it has no need for supernatural intelligence or any intelligent design. Many critics of the modern theory of evolution involve misunderstanding of the theory itself or of science in general. One of the most common misunderstandings of the theory is that one species can be "more highly evolved" than another, that evolution is necessarily progressive, or that its converse is "devolution". Evolution provides no assurance that later generations are more intelligent, complex, or morally worthy than earlier generations. Another misunderstanding is that only "microevolution" and not "macroevolution" has never been observed. "Microevolution" and "macroevolution" both refer fundamentally to the same thing, changes in gene frequencies. The difference between them is primarily one of scale, that is qualitative difference between species is the result of quantitative differences in gene frequencies. Macroevolution is microevolution over a longer period of time.

Stephan J. Gould holds that- “natural selection is not fully sufficient to explain evolutionary change for two major reasons. First, many other causes are powerful; particularly at levels of biological organization both above and below the traditional Darwinian focus on organisms and their struggles for reproductive success. Second, no matter how adequate our general theory of evolutionary change, we also yearn to document and understand the actual

pathway of life's history. Theory, of course, is relevant to explaining the pathway, but the actual pathway is strongly underdetermined by our general theory of life's evolution. Life's pathway certainly including many features predictable from laws of nature, but these aspects are too broad and general to provide the "rightness" that we seek for validating evolution's particular results – roses, mushrooms, people and so forth. Organisms adapt to, and are constrained by, physical principles. Laws of nature do not tell us why we have crabs and snails at all, why insects rule the multi cellular world and why vertebrates rather than persistent algal mats exist as the most complex forms of life on the earth.

The oldest rocks sufficiently unaltered to retain cellular fossils – African and Australian sediments dated to 3.5 billion years old – do preserve prokaryotic cells (bacteria and cyanophytes) and stromatolites. Thus, life on the earth evolved quickly and is as old as it could be. This fact alone seems to indicate inevitability, or at least predictability, for life's origin from the original chemical constituents. No one can doubt that more complex creatures arose sequentially after this prokaryotic beginning – first eukaryotic cells, perhaps about two billion years ago, then multi cellular animals about 600 million years ago, while a relay of highest complexity among animals passing from invertebrates, to marine vertebrates and, finally to reptiles, mammals and humans. The most salient feature of life has been the stability of its bacterial mode from the beginning of the fossils record until today and, with little doubt, into all future time so long as the earth endures.

Our impression that life evolves towards greater complexity is probably only a bias inspired by parochial focus on ourselves, and consequent over attention to complexifying creatures, while we ignore just as many lineages adapting equally well by becoming simpler in form. Life remained almost exclusively unicellular for the first five sixths of its history from the first recorded fossil at 3.5 billion years to the first well-documented multi cellular animals less than 600 million years ago. This long period of unicellular life does include, to be sure, the vitally important transition from simple prokaryotic cells without organelles to eukaryotic cells with nuclei, mitochondria and other complexities of intracellular architecture. If complexity is such a good thing, and multi cellularity represents its initial phase in our usual view, then life certainly took its time in making this crucial step. More curiously, all major stages in organizing animal life's multi cellular architecture than occurred in a short period, beginning now known from rocks on all continents. Great diversity quickly evolved at the dawn of multi cellular animal life during the Cambrian period 530 million years ago. Although interestingly and portentous events have occurred since, from the flowering of dinosaurs to the origin of human consciousness, we do not exaggerate greatly in stating that the subsequent history of animal life amounts to little more than variations on anatomical themes established during the Cambrian explosion within five million years. Three billion years of unicellularity, followed by five million years of intense creativity and then capped by more than 500 million years of variation on set anatomical themes can scarcely be red as a predictable, in exorable or continuous trend toward progress or increasing complexity”.

Sigmund Freud often remarked that great revolutions in the history of science have but one common, and ironic, feature: they knock human arrogance off one pedestal after another of our previous conviction about our own self-importance. In Freud's three examples, Copernicus moved our home from center to periphery, Darwin then relegated us to "descent from an animal world," and finally, Freud himself discovered the unconscious and exploded the myth of a fully rational

mind. In this wise and crucial sense, the Darwinian revolution remains woefully incomplete because, even though thinking humanity accepts the fact of evolution, most of us are still unwilling to abandon the comforting views that evolution means progress defined to render the appearance of something like human consciousness either virtually inevitable or at least predictable. We will not smash Freud's pedestal and complete Darwin's revolution until we find, grasp and accept another way of drawing life's history. J.B.S. Haldane proclaimed nature "queerer than we can suppose," but these limits may only be socially imposed conceptual locks rather than inherent restrictions of our neurology. New icons might break the locks.

7.3 DNA, Design and the origin of Life

Religious beliefs have always held that there is an intelligent cause for origin of life. The arguments put forward by proponents of religion have reason and logic, though they may not qualify to be scientific in the strict sense. We review a paper presented by Charles B. Thaxton on the subject of DNA, Design and the Origin of Life.

The design argument assumes that the order we see in the world around us bears an analogy to the kind of order exhibited by human artifacts. Since the two kinds of order are similar, the cause of one must be similar to the cause of the other. The order in human artifacts is the result of human intelligence. Therefore, the order in the world must be the result of an intelligent being (creator). DNA is considered the identifying mark of a living system. In recent years, scientists have applied information theory to biology, and in particular to the genetic code. The amount of information in the DNA of even the single – celled bacterium, E. coli, is vast indeed. It is greater than the information contained in the books in any of world's largest libraries. A DNA code is a very special kind of order. The sequence of nucleotides in DNA or amino acids in a protein is like the letters in a written language. There is no detectable difference between the sequence of nucleotides in E. Coli DNA and a random sequence of nucleotides. Yet within the E. Coli cells, the sequence of "letters" of its DNA is very specific. Only that particular sequence is capable of biological function.

The discovery that life in its essence is information inscribed on DNA has greatly narrowed the question of life's origin. With the insights from information theory we need no longer argue from order in a general sense. Order with low information content does arise by natural processes. However, there is no convincing experimental evidence that order with high information content can arise by natural process. Indeed, the only evidence we have is that it takes intelligence to produce the second kind of order. If we want to speculate on how the first informational molecules came into being, the most reasonable speculation is there was some form of intelligence around at that time. Even the simplest form of life, with their store of DNA, is characterized by specified complexity. Therefore life itself is prima facie evidence that some form of intelligence was in existence at the origin of DNA code. The claim that DNA arose by material forces is to say that information can arise by material forces. However, the material base of a message is completely independent of the information transmitted. The material base could not have anything to do with the messages' origin. The information within the genetic code is entirely independent of the chemical makeup of the DNA molecule. To accept a material cause for the origin of life actually runs counter to the principle of uniformity.

Scientists still hold the view that physical information exists regardless of the presence of intelligence, and evolution allows for new information whenever a novel mutation or gene duplication occurs and is kept. It does not need to be beneficial nor visually apparent to be "information". However, even if those were requirements they could be satisfied with the appearance of nylon-eating bacteria, which required new enzymes to digest a material that never existed until the modern age.

7.4 Russian DNA Discoveries

Russian discoveries have shown that DNA can be influenced and reprogrammed by words and frequencies. Only 10 percent of our DNA is being used for building proteins, the other 90 percent are considered junk DNA. The Russian linguists found that the genetic code, especially in the apparently useless 90 percent, follows the same rules as all our human languages. The Russian biophysicist and molecular biologist Pjotr Garjajov and his colleagues explored the vibration behaviour of the DNA. They found that living chromosomes function just like solitonic / holographic computers using the endogenous DNA laser radiation. They worked on devices that can influence the cellular metabolism through suitable modulated radio and light frequencies and thus repair genetic defects. They even captured information patterns of a particular DNA and transmitted it onto another, thus reprogramming cells to another genome. So they successfully transformed, for example, frog embryos to salamander embryos simply by transmitting the DNA information patterns.

The Russian scientists also found out that our DNA can cause disturbing patterns in the vacuum, thus producing magnetized wormholes. These are tunnel connections between entirely different areas in the universe through which information can be transmitted outside of space and time. The DNA attracts these bits of information and passes them on to our consciousness. This process of hyper communication is most effective in a state of relaxation. Stress, worries or a hyperactive intellect prevent successful hyper communication or the information will be totally distorted and useless. In nature, hyper communication has been successfully applied for millions of years. The organized flow of life in insect states proves this dramatically. Modern man knows it only on a much more subtle level as "intuition". But we too, can regain full use of it. An example of hyper communication is when a queen ant is spatially separated from her colony, building still continues fervently and according to plan. If the queen is killed, however, all work in the colony stops. No ant knows what to do. Apparently the queen sends the "building plans" also from far away via the group consciousness of her subjects. She can be as far away as she wants, as long as she is alive. Presumably in earlier times humanity had been, just like the animals, very strongly connected to the group consciousness and acted as a group. To develop and experience individuality we humans, however, had to forget hyper communication almost completely.

DNA is also an organic superconductor that can work at normal body temperature. Artificial super conductors require extremely low temperatures of between 200 and 140^0K to function. All super conductors are able to store light and thus information. This is a further explanation of how the DNA can store information. There is another phenomenon linked to DNA and wormholes. Normally these super small wormholes are highly unstable and are maintained only for a tiny fraction of a second. Under certain conditions stable wormholes can organize

themselves, which than form distinctive vacuum domains in which, for example, gravity can transform into electricity.

7.5 The Holographic Universe

Alain Aspect of University of Paris and his research team discovered in 1982 that under certain circumstances subatomic particles such as electrons are able to instantaneously communicate with each other regardless of the distance separating them. It does not matter whether they are 10 feet or 10 billion miles apart. Somehow each particle always seems to know what the other is doing. The problem with this feat is that it violates Einstein's long-held tenet that no communication can travel faster than the speed of light. University of London physicist David Bohm believes Aspect's findings imply that objective reality does not exist, that despite its apparent solidity the universe is at heart a phantasm, a gigantic and splendidly detailed hologram. A hologram produces a three–dimensional image of an object. If a hologram of a rose is cut in half and than illuminated by a laser, each half will still be found to contain the entire image of the rose. Indeed, even if the halves are divided again, each snippet of film will always be found to contain a smaller but intact version of the original image. Unlike normal photographs, every part of a hologram contains all the information possessed by the whole. Bohm believes the reason subatomic particles are able to remain in contact with one another regardless of the distance separating them is not because they are sending some sort of mysterious signal back and forth, but because their separateness is an illusion. He argues that at some deeper level of reality such particles are not individual entities, but are actually extensions of the same fundamental something that is ultimately as holographic and indivisible as the rose. And since everything in physical reality is comprised of these "eidolons", the universe is itself a projection, a hologram.

Karl Pribram, a Stanford neurophysiologist, was drawn to the holographic model by the puzzle of how and where memories are stored in the brain. For decades numerous studies have shown that rather than being confined to a specific location, memories are dispersed throughout the brain. In a series of landmark experiments in the 1920s, brain scientist Karl Lashley found that no matter what portion of a rat's brain he removed he was unable to eradicate its memory of how to perform complex tasks it had learned prior to surgery. In the 1960s Pribram encountered the concept of hologram and realized he had found the explanation for this memory puzzle. Pribram believes memories are encoded not in neurons, or small groupings of neurons, but in patterns of nerve impulses that criss-cross the entire brain in the same way that patterns of laser light interference criss-cross the entire area of a piece of film containing a holographic image. In other words, Pribram believes the brain is itself a hologram.

Pribram's theory also explains how the human brain can store so many memories in so little space. It has been estimated that the human brain has the capacity to memorize something of the order of 10 billion bits of information during the average human lifetime (or roughly the same amount of information contained in five sets of the Encyclopedia Britannica). Similarly, it has been discovered that in addition to their other capabilities, holograms possess an astounding capacity for information storage. It has been demonstrated that one cubic centimeter of film can hold as many as 10 billion bits of information. Indeed, one of the most amazing things about human thinking process is that every piece of information seems instantly cross-related with every other piece of information - another feature intrinsic to the hologram.

Another aspect is how the brain is able to translate the avalanche of frequencies it receives via the senses (light frequencies, sound frequencies, and so on) into the concrete world of our perceptions. Encoding and decoding frequencies is precisely what a hologram does best. Just as a hologram functions as a sort of lens, a translating device able to convert an apparently meaningless blur of frequencies into coherent image, Pribram believes the brain also comprises a lens and uses holographic principles to mathematically convert the frequencies it receives through the senses into the inner world of our perceptions. This belief has also received a good deal of experimental support. It has been found that each of our senses is sensitive to a much broader range of frequencies than was previously suspected. Researchers have discovered, for instance, that our visual systems are sensitive to sound frequencies, that our sense of smell is in part dependent on what are now called "osmic frequencies," and that even the cells in our bodies are sensitive to a broad range of frequencies.

In the 1950s, while conducting research into the beliefs of LSD as a psychotherapeutic tool, Grof had one female patient who suddenly became convinced she had assumed the identity of a female of a species of prehistoric reptiles. During the course of her hallucination, she gave a richly detailed description of what it felt like to be encapsulated in such a form. During the course of his research, Grof encountered examples of patients regressing and identifying with virtually every species on the evolutionary tree. Moreover, he found that such experience frequently turned out to be accurate. Grof also had patients who suddenly gave descriptions of Zoroastrian funerary practices and scenes from Hindu mythology. In other categories of experience, individuals gave persuasive accounts of out-of-body journeys, of precognitive glimpses of the future, of regressions into apparent past-life incarnations. As Grof recently noted, if the mind is actually part of a continuum, a labyrinth that is connected not only to every other mind that exists or has existed, but to every atom, organism, and region in the vastness of space and time itself, the fact that it is able to occasionally make forays into the labyrinth and have transpersonal experiences no longer seems so strange.

Keith Floyd, a psychologist at Virginia Intermont College, has pointed out that if the correctness of reality is but a holographic illusion, it would no longer be true to say the brain produces consciousness. Rather, it is the consciousness that creates the appearance of the brain as well as the body and everything else around us we interpret as physical. If the apparent physical structure of the body is but a holographic projection of consciousness, it becomes clear that each of us is much more responsible for our health than current medical wisdom allows. What we now view as miraculous remissions of disease may actually be due to changes in consciousness, which in turn effect changes in the hologram of the body.

7.6 Darwin's Theory of Evolution and Human Civilization

The advancement of science and technology of the modern era is generally considered synonym to advancement of civilization. But the historical and archeological evidences are contrary to this belief. With more and more research it is becoming clear that ancient civilization was highly advanced in respect of science, technology, industry, trade, air travel, civil structure, architecture and spirituality. Pandit Sriram Sharma has cited many examples in favour of this statement; we enumerate a few of them below.

Bhardwaj Samhita devotes a chapter on aircraft technology where techniques for building aircrafts, like the Pushpak Viman and other types of aircrafts, are described. The calendars made by Maya civilization could forecast solar and lunar eclipses for the next one billion years. These calendars show 365.2420 days in one Earth year. The duration of one year by modem techniques is 365.2422 days, which differs only by 0.0002 days, and it is not certain which value is actually correct. The Maya calendars accurately calculated the position of constellations and planets and their influence was considered while constructing structures like forts, palaces, cities, observatories etc.

The remains of Egyptian, Maya and Inca civilization show that cities of that time were very advanced and planned. These cities contained well-designed temples, statues, roads, water distribution and sewerage systems, stadiums etc. Research was conducted and books were written on subjects like languages, mathematics, history, science, philosophy, spirituality, music, etc. Stones weighing up to 100 tonnes were used in construction of buildings in the city of Tiahuanaco (Tiwanaku). The city had drainage channels made from stone slabs 6x 1 ½ feet in size that were better than concrete channels of today. There is a building, having a height of four stories that appears to have been made from one stone slab weighing about 20000 tonnes. A small section of 800 meters of this building appears to have been made from molten stone. We know that high temperature heat is required to melt stone, and this could not be done without advanced techniques.

There are other evidences of advanced ancient civilization on Earth.

- The remains of an ancient but advanced city "Nazaka" in the mountain region of Peru. Drawings of animals and birds on huge rocks 100 miles from this city. One drawing is 300 yards long.
- One 820 feet high stone spear structure on the mountain south of Lima.
- One 330 feet high human statue on a hill in the desert of Chili.
- The Terrace of Wall in Damascus was an international airport safer than modern airports.
- The terrace at a height of 13000 feet in Tiahuanaco was also an international airport.
- Sign of a very advanced observatory on the Human World Island 3600 kilometers from Chili. This place appears to be connected to Tiahuanaco at a distance of 5000 kilometers.
- The Brasia caves in Italy contain wall paintings of space travelers in special suits.
- An atlas of 1800 BC was found in a palace of Turkey. This atlas shows mountains, plains, rivers, seas, islands in various continents, plains of America, equatorial countries, south pole, etc.
- Huge pyramids are found between Cairo and Alexendria. The Chyops pyramid is built at the place of center of gravity. This shows that people had knowledge of gravitation and magnetic forces

The most notable about the people of ancient times was their virtuous conduct and power of extra sensory perception they used to acquire by little yogic practices or otherwise without much effort. All these features do not agree with Darwin's theory of evolution. This theory may be applicable to microorganisms, insects and other invertebrates but not to human beings. The mental power and emotional structure of human beings is so extraordinary that it may not be possible to evolve by heredity. Neither this power appears to be self acquired, because it is difficult to imbibe the virtuous character in the circumstances human beings live in, according to spiritual masters

humans belong to the deity family and are their successor. Many wise men hesitate to accept that human beings are consequences of natural material forces and have descended from aerial, aquatic or terrestrial animals. They believe that humans have come from other planets where civilizations older than ours must exist.

Sir Fred Hoyle once remarked that in the light of facts and evidences the Darwin's theory of evolution that starting from single cell organism the present biodiversity has evolved does not appear to be correct. The life is complex enough to be a consequence of chemicals and proteins. Different aspects of life are complete by themselves and they remain so with little variation generation after generation. For example, the fish is existing more or less in the same form for million of years without much change. If humans evolved from chimpanzee then why the chimpanzees found today are in the same primitive state?

The remains on Earth are testimony that a highly advanced civilization was in existence in ancient times. Einstein once told Charles Hapgood that in the absence of enough evidence it is not right to publicly admit but I personally believe that aliens used to visit Earth in ancient times.

The biggest drawback of Darwin's theory is that that the basic character of organisms does not change, it only considers morphological changes. Humans are a different class from their so-called ancestor chimpanzees. The chimpanzees have not learned any of the skills typical of human beings like thinking, speech, writing, house dwelling, storing basic necessities for future use etc. They cannot make any kind of appliance whereas humans have a strong faculty of innovation and exploration; for instance, they have made tremendous scientific progress in the last two-three hundred years. A child of two years becomes like his parents in most respect and this is his fundamental quality and not evolutionary trait. The qualities and body structure of human beings prove them to be successor of deities and not animals.

7.7 Origins and Evolution of Life in Jain Philosophy

Jain philosophy believes in dualism, the body is different from the soul. The soul is eternal; it can neither be created nor destroyed. The corollary of this rule is that the total number of souls in *loka* is fixed and it is infinitely infinite. The soul taking birth in *loka* is an active soul; birth only means acquisition of a new body by the soul. Science, while talking of origin of life, is referring to formation of a new body. The soul in essence is non corporeal and the body is made of matter. The characteristics of soul and matter are different but they unite to produce life. In order to appreciate life we must understand both the soul and the body forming matter.

The question to be answered is how life began on Earth? Before answering this question we clarify our view on origin of Earth. Jain philosophy supports the quasi steady state theory of finite universe where events like mini Big Bang, implying local and not overall, changes in the structure of the universe, are permissible. Such changes are in accordance with the rule of permanent existence through change of reality. So stars are destroyed and new stars and star systems are formed. Although life always exists in *loka*, the life on a new planet must begin in the sense that biodiversity must evolve. According to Jain philosophy small nano organisms found everywhere in *loka* are also present on the new planet. As remarked earlier the small nano organisms must contain a primitive gene like structure. Small nano organisms do not need oxygen so they survived in the oxygen deficient atmosphere of early Earth. Evolution starts from this organism when conditions on the planet are appropriate to sustain other forms of life.

As the life is a union of soul and matter, the role of both must be considered in evolution. Science, not recognizing the soul, focuses on the formation of material body through genes, DNA and other environmental factors. This is an incomplete view of evolution of life as has been aptly accepted by Stephen J. Gould. The soul is the source of intelligence; the high information content in life cannot arise by natural forces. Darwin's theory based on fossil records misses this subtler aspect of life that is so crucial to its growth and development. The soul is characterized by consciousness and without consideration of consciousness evolution can never be fully explained.

The study of consciousness is now drawing increasing attention of psychologist. According to Jain philosophy consciousness manifests as a power of intuition, perception, emotions, will, attitude and behaviour of organisms. Attributes like intensions, doubts curiosity, inquisitiveness, etc. are expressions of consciousness. More or less similar functions are being assigned to phenomenal consciousness and Access – consciousness by psychologists. Rene Descartes has identified soul as the experience and Chalmers accepts Cartesian Dualism. The Panpsychism of Leibniz accepts that consciousness pervades in all matter and each point in the universe is endowed with conscious content. Autonio Damasio agrees that consciousness allows planned and not instinctual, responses in human beings. Durkheim proposed a concept of group consciousness and collective intelligence. All these ideas are drawing close to the concept of soul. Scientists are also expected to come to terms with these developments sooner or later. The quantum mechanic theories of consciousness on the other hand tend to identify with the functioning of the subtle bodies. Though still away from the concept of soul, these theories do describe important aspects of deeper functioning of the human body. To say that consciousness emerges from brain processing is certainly not acceptable; consciousness is the property of the inner-self and not of material body. Psychologists and Jain philosophy both accept the existence of unconscious mind and it has a definite role in determining the behaviour of human beings. The psychologists now agree that consciousness also exists in animals. The Jain view is very clear; consciousness is a characteristic of the soul and is present in all organisms. Consciousness has an important bearing on birth, growth and development of an organism and on biodiversity.

The atman is non corporeal and therefore for its functions in the gross world acts through a corporeal body in subtle form. The subtle body exists as karma body and luminous body as mentioned earlier. The karma body was identified as a coherent electromagnetic field storing information of actions and thoughts of all past lives and as an agency exercising regulation and control on the body through *adhyasaya* and *lesya* waves.

Of particular interest here are the bodies determining karma, which are responsible for physiological structure bodies of various species and the construction of body and organs of a particular species. We briefly study these karmas now.

7.7.1 Form Producing Karma

The form producing karma decide the place of birth like heaven, hell or Earth like planet, the kind of species on Earth, shape and structure of the body, number of organs, etc. of the soul in the next birth. Other types of karmas determine the qualities and capabilities of the organism. There are 42 types, and 93 sub-types, of form producing karma. The fruition of these karma initiates processes, which determine the respective body characteristics.

1. The realms of existence (*Gati*) karma. The karma, which give the soul the shape of an infernal being, subhuman being, human being or celestial being, are called realms of existence karma.
2. The genus of being (*Jati*) karma. The fruition of genus of being karma is the reason that the soul becomes one sense, two-sense, three-sense, four-sense, or five-sense being.
3. Body (*Sarira*) karma. The body karma decides the kind of bodies from among the 5 types the soul will have. The 5 types of bodies are gross (*audarik*), protean (*vaikriya*) migrating (*aharaka*), fiery (*tejas*) and karma body.
4. Organ (*Angopang*) karma. The fruition of this karma determines formation of various organs at proper place and of appropriate size in the body. This is of three sub types, the organs for gross body, protean body and migration body.
5. Morphology (*Nirman*) body karma. The fruition of this karma determines that all organs and parts shall assemble and integrate in a proper way to impart a shape typical of the species.
6. Body bond (*Bandhan*) karma. The fruition of this karma is the basis for atoms and molecules of the five types of bodies to unite.
7. Integration of body (*Sanghat*) karma. The fruition of this karma effect integration of united molecules to form a monolithic structure.
8. Architecture of body (*Sansthan*) karma. The fruition of this karma gives the lump of mass a definite shape. There are six types of body shapes.
    a. Perfect symmetry all over (*Samchaturastra Sansthan*) karma.
    b. *Nyagrodh Parimandal Sansthan* karma. *Nyagrodh* means fig. Tree, and *parimandal* means circumference. The fruition of this karma is the cause for the body to be like a fig tree. The body is short and asymmetrical below the navel, and large and symmetrical above it.
    c. *Svati Sansthan* karma. Fruition of this karma gives the body a tapering shape, broad and symmetrical in the lower, but short and asymmetrical in the upper extremities.
    d. Hunchback figure (Kubjak) body karma. The fruition of this karma gives the body a hunch or spread in the middle.
    e. Dwarf (*Vaman*) body karma. The fruition of this karma results in a dwarf or short body.
    f. Asymmetrical (*Hundak*) body karma. The fruition of this karma gives an asymmetrical or irregular body
9. Skeleton (*Sanhanan*) karma. The fruition of this karma provides the skeleton structure of bones and joints to the body. There are six types of skeleton structures.
    a. Fully adamantine skeleton (*Vrij Rushabh Narach Sanhanan*) karma. The fruition of this karma gives the body the adamantine bones, joints and nerves. It is very strong structure (like steel).
    b. Partial adamantine skeleton (*Vrij Narach Sanhanan*) karma. The fruition of this karma gives the body the adamantine bones and joints but not nerves. This structure is also very strong.

c. Unbreakable skeleton (*Narach Sanhanan*) karma. The fruition of this karma gives skeleton structure of unbreakable bones and joints.
d. Semi unbreakable skeleton (*Ardha Narach Sanhanan*) karma. The fruition of this karma gives a skeleton structure of semi-unbreakable bones and joints.
e. Riveted skeleton (*Kilika Sanhanan*) karma. The fruition of this karma gives a skeleton structure having riveted bone joints.
f. Loose skeleton (*Asamprata Supatika Sanhanan*) karma. The fruition of this karma gives a skeleton structure of loosely jointed bones. This is the weakest type of skeleton structure. The normal human beings have this kind of skeleton structure.

10. The body colour (*Varna*) karma. The fruition of this karma determines the colour of the body.
11. The body smells (*Gandh*) karma. This karma determines the smell of the body. The smell can be fragrant or foul.
12. The body taste (*Rasa*) karma. This karma determines the taste of the body or its parts (like fruits, leaves)
13. The body touches (*Sparsha*) karma. This karma determines the quality of touch of the body.
14. Migration (*Anupurvi*) body karma. This determines the shape of the body the soul has during migration from one life to another life. The shape of migration body is similar to the shape of the body left by the soul.
15. Balanced weight (*Agurulaghu*) body karma. This karma determines the balance of weight in the body. The body is not too heavy, like an iron ball, nor too light like a cotton ball.
16. Self-destructive (*Upaghat*) body karma. The fruition of this karma provides a body that can harm the self. For example, a stag's horn.
17. Bellicosity (*Paraghat*) body karma. This provides a body, which becomes a cause in destroying others. For example, poison in the mouth of a snake, sting in the tail of a scorpion, paws of a lion, poison in a tree, etc.
18. Hot radiation (*Atap*) body karma. The fruition of this karma provides a body that gives hot radiations. The body itself is not hot but its radiations produce heat.
19. Cold radiation (*Udyot*) body karma. The fruition of this karma provides a body that gives cold radiations. For example a glowworm.
20. Movement of body (*Vihayogati*) karma. The fruition of this karma provides movements to body. The movements are of two types: graceful and awkward.
21. Respiration (*Uchchhavas*) body karma. The fruition of this karma enables the body to have respiration i.e. a respiration system is formed in the body.
22. Mobile (*Trasa*) body karma. Fruition of this karma provides mobility in the body. The body has two to five senses.
23. Stationary (*Sthavar*) body karma. Fruition of this karma provides a stationary body to soul. For example, earth body, water body, air body, fire body or plant body. These living beings are motion less.
24. Gross (*Badar*) body karma. This karma determines that the soul will have a gross (visible) body.

25. Nano (*Susksma*) body karma. This karma determines that the soul will have a nano body. For example virus, nano organisms.
26. Developed (*Paryapta*) body karma. This karma determines that the body is fully developed in respect of six bio potentials.
27. Underdeveloped (*Aparyapta*) body karma. This karma results in underdeveloped, body lacking in one or all bio potentials.
28. Individual (*Pratyeka*) body karma. The fruition of this karma gives an individual body to the soul.
29. Common (*Sadharana*) body karma. The fruition of this karma determines that a body is shared by many souls.
30. Stable (*Sthir*) body karma. The fruition of this karma ensures that the organs in the body are stable.
31. Unstable (*Asthir*) body karma. The fruition of this karma makes the organs in the body unstable. That is, the organ formed shall not retain shape and size.
32. Beautiful (*Shubh*) body karma. The fruition of this karma produces a good-looking charming body.
33. Ugly (*Ashubh*) body karma. The fruition of this karma produces an ugly looking body.
34. Amiable (*Subhag*) body karma. The fruition of this karma gives an amiable body, but this may or may not be beautiful or handsome.
35. Unpleasant (*Durbhag*) body karma. The fruition of this karma gives a non-amiable body, even when it is beautiful.
36. Sweet voice (*Sushvar*) body karma. The fruition of this karma produces a sweet voice in the body.
37. Harsh voice (*Dushwar*) body karma. The fruition of this karma produces a harsh voice in the body.
38. Impressive (*Adey*) body karma. The fruition of this karma produces an impressive and radiant body.
39. Non-impressive (*Anadey*) body karma. The fruition of this karma produces a non-impressive body.
40. Fame (*Yash Kirti*) body karma. The fruition of this karma brings fame to the individual.
41. Notoriety (*Ayash Kirti*) body karma. The fruition of this karma brings notoriety (bad name) to the individual.
42. *Tirthankara* (Omniscient) body karma. The fruition of this karma produces a body suitable for omniscient.

We find that Jain philosophy provides an elaborate description of karmas, which are responsible for producing a variety of shapes and sizes of bodies suitable for whole range of bio-diversity and beyond. We had seen earlier that these karmas form a coherent electro magnetic field in the body, the emission from which influence the genes and thus produce the expected results in the body. Form producing karma, must play a role in gene mutation which is considered to be the main cause of evolution. The fact, that various types of form producing karma perform different kinds of functions shows that a large number of genes are required to produce a body and its parts, and more so to produce the biodiversity. Mutations occur in random errors, and evolution operates

retrospectively on the result of the random errors, which are usually disastrous. A previously mutated gene may prove beneficial in a new environment and the organisms, carrying such a gene will then successfully reproduced. Only half of our genes are given to our offspring, diluting any germ line genetic modifications over time. Non-germ line alterations are not carried out to next generation.

7.7.2 Evolution of Soul in Jain Philosophy

Jain philosophy lays focus on evolution of soul and shows how a soul climbs the ladder from lowest level to highest level of existence. This journey of progress is mainly determined by karma. As mentioned earlier there is an inexhaustible stock of inactive nano organisms in the bottomland of lower *loka*. When a soul in middle *loka* is liberated and occupies a place in the abode of emancipated souls at the top of upper *loka* a vacancy is created in the mobile zone and so a nano organism migrates from its abode to the mobile zone. This is the beginning of evolution. At this stage only a minutest fraction of consciousness of the soul is explicit, the rest of consciousness is covered by karma and is in the latent state. A soul with latent consciousness feels deficient and incomplete. By natural instinct the soul wants to be pure and so tries to overcome the forces, which are shielding his consciousness. This provides a motivating force to soul to act and annihilate the karmas, which are hindering his progress. This struggle against karma is the journey to progress and is evolution.

The form and complexity of the gross body of an organism is compatible with his explicit consciousness. The complexity of the body increases with consciousness. With minimum consciousness the organisms has only one explicit sense and needs the simplest kind of body. Here we should be clear about the meaning of sense of an organism. The organism, in fact, has all the five senses; the gross body has the facility to use only the sense of touch, which is explicit. We know that the subtle body, mainly the luminous body, carries out the management and regulation of the gross body. At the minimum level of consciousness the ability of the luminous body is also at its lowest level and it cannot support a complex body. So the soul has the simplest kind of body in which only the touch sense exists, no parts are formed in the body that is sensitive to other stimuli.

In order that the soul achieves perfection, all the five senses must be operational. So the first priority of soul is to develop the remaining four senses. This needs higher consciousness, which can be achieved by reducing karma. The easiest and possible way of doing so, at that stage of development, is to enjoy (*bhog*) the karma. So soul spends time in one-sense bodies, which could be millions of years, till his consciousness is sufficient to assume a more complex body having two senses. In this phase of life over a long period of millions of years the karmas reduce by way of emissions and consciousness increases. We have classified the one-sense small nano organisms as earth body, water body, air body and fire body and also plant body souls. In the initial phase of evolution the soul occupies the four kinds of nano or micro bodies and then enters a plant body. This order of evolution is also accepted by science. The unicellular bodies prevailed on Earth in its earlier life and then came vegetation and plants. The question how the first cell was created is not important in Jain philosophy. The small nano organisms present on Earth in its early life provide the primitive cell having some kind of gene structure. The evolution starts from this basic stage and a cell suitable for higher organisms is developed in due course of time. The small

nano organism can be considered to be the common ancestor of all organisms including bacteria and archaea. Further refinement of cell takes place and prokaryotes cells are evolved which prepare ground for vegetation and plants.

It has been discovered that different class of bacteria existed on early Earth. Photosynthesizing bacteria evolved in volcanic eruptions where hydrogen was found. Such bacteria can still be found in volcano areas like Yellowstone in Wyoming (these could be fire beings). Other bacteria forms eventually arose, which were able to extract hydrogen from a much more widespread source, water (these may be water beings). When hydrogen is removed from water, free oxygen remains. The oxygen so accumulated through millions of years provided environment for oxygen-based life to evolve. These organisms, which are complex only as compared with bacteria, are found where there is constant moisture and are close relative of green algae. Some of these algae, which are blue green, have developed a strange lime oozing form. The blue-green pillars of Hamelin Pool are living stromolites. They are living organisms that secrete lime, producing skeletons of stone and live in an environment where deposits of ooze and sand are being laid down (these may be earth beings). The most primitive life forms that share plant characteristics are smallest viruses and algae (these could be plant beings). Thus various forms of immobile organisms evolved from nano organisms on early Earth.

In the next phase of development the soul acquires a plant body (having one sense of touch). This is also a long phase of millions of years. Vegetation and plants produce oxygen and make the atmosphere suitable for other forms of life. The soul with increased consciousness is now capable of having a two-sense body. Darwin has rightly called the transition from plant body to two-sense body as natural selection. But in a deeper sense natural selection means struggle by the soul to reduce his karma and improve the quality of genes so that a higher form of body can be assumed. The mutation of genes, which is supposed to be the main force behind evolution and natural selection, is the result of will power of the soul to improve his consciousness and not just chance as is generally assumed. It is known that genes can be changed by frequencies. Such frequencies must be generated internally by the soul with his consciousness so that gene mutation takes place. Psychologists also believe that consciousness can alter the hologram that is karma.

The progress of development of consciousness continues and the soul assumes successively three sense, four sense and five sense bodies. The group consciousness may also have a role in evolution. Jain philosophy believes that life exists all over the universe and there is a possibility of intercommunication between them at subtle (unconscious) level due to hyper communication and collective consciousness. Hyper communication is possible through 4-touch vargana, which do not suffer from speed limitation imposed by special theory of relativity. Frequencies generated through such communication may alter gene characteristics and internally motivate the organisms to evolve. Is natural selection instrumental in transition through all these stages shall be discussed later? We first attempt to validate the theory that evolution takes place from one sense to five-sense organism.

Evolution has been assumed to take place with increase in consciousness and reduction in karma, including the knowledge obscuring karma. The knowledge increases with the number of senses. In the five-sense category there are two distinct forms of life, animals and humans. Humans have highly developed mental faculty and possess far more knowledge and intelligence

than animals. The knowledge, as information, is stored in the brain. This means that if soul evolves from one sense to five sense animals and finally as human being the brain must also grow correspondingly to store larges amount of information. This is verified by medical science when we examine the nervous system and brain structure of animals and human beings

Plants do not have a nervous system and brain; the hormones regulate the body functions. The hormones control the chemical activity in cells, growth and flowering. All this is possible with minimum amount of consciousness and knowledge. In the higher stage of evolution the body has a nervous system. The simplest possible creature has incredible simple nervous system made up of nothing but reflex pathways. For example, flatworms, two sense organism, and invertebrates, having up to four senses, do not have a centralized brain. They have a loose association of neurons arranged in simple reflex pathways. Flatworms have neural nets; individual neurons linked together that form a net around the entire animal.

Most invertebrates (such as lobster) have simple brains that consist of localized collections of neuronal cell bodies called ganglia. Each ganglia controls sensory and motor functions in its segment through reflex pathways, and the ganglia are linked together to form a simple neuron system.

As neuron system evolved, chain of ganglia evolved into more centralized brain. Brains of invertebrates evolved from ganglia.

Regardless of the animal, brains have the following parts: -

1. Brainstem – The brainstem consists of the Medulla, Pons and Midbrain (lower animals have only a Medulla). The brain stem controls the reflexes and automatic functions (heart rate, BP), limb movement and visceral functions (digestion, urination).
2. Cerebellum – The cerebellum integrates information from the vestibule system that indicates position and movement and uses this information to coordinate limb movements.
3. Hypothalamus and Pituitary Gland – These control visceral functions, body temperature and behavioral responses such as feeding, drinking, sexual response, aggression and pleasure.
4. Cerebrum (Cortex) – The cerebrum consists of the cortex etc. If integrates information from all the sense organs, initiates motor functions, controls emotions, and holds memory and thought process (emotional expressions and thinking are more prevalent in higher animals).

As you proceed from fishes towards humans, the cortex gets bigger, takes up a larger portion of the total brain and becomes folded. The enlarged cortex takes an additional higher – order functions, such as information processing, speech, thought and memory. In addition, the part of the lower brain called the thalamus evolved to help relay information from the brainstem and spinal cord to the cerebral cortex.

Lower animals (fish, amphibians, reptiles, and birds) do not do much thinking, but instead concern themselves with everyday business of gathering food, eating, drinking, sleeping, reproducing and defending them. Therefore, their brains reflect the major centers that control these functions. We perform these functions as well, and so have a reptilian brain built into us. The basic lower brain consists of the spinal cord, brainstem, and diencephalons (i.e. Medulla, Pons, Midbrain, Thalamus, and Hypothalamus).

Three groups of animals have notably complex brains: the arthropods (insects, crustaceans, arachnids, and others), the cephalopods (octopuses, squids, and similar mollusks), and the craniates (vertebrates and hagfish). The brain of arthropods and cephalopods arises from thin parallel nerve cords that extend through the body of the animal. Arthropods have a central brain with three divisions and large optical lobes behind each eye for visual processing.

The brain of craniates develops from the anterior of a single dorsal nerve cord, which later becomes the spinal cord. In craniates, the bones of the skull protect the brain. Primitive vertebrates such as fish, reptiles, and amphibians have fewer than six layers of neurons in the outer layer of their brains. More complex vertebrates such as mammals have a six-layered neo cortex, in addition to having some parts of the brain that are allocortex. In mammals, increasing convolutions of the brain are characteristic of animals with more advanced brains. These convolutions provide a larger surface area for a greater number of neurons while keeping the volume of the brain compact enough to fit inside the skill.

In insects, the brain has four parts, the optical lobe, the protocerebrum, the deutocerebrum, and the tritocerebrum. The optical lobes are located behind each eye and process visual stimuli. The protocerebrum contains the mushroom bodies, which respond to smell, and the central body complex. In some species such as bees, the mushroom body receives input from the visual pathway as well. The deutocerebrum includes the antennal lobes, which are similar to the mammalian olfactory bulb, and the mechano-sensory neuropilus, which receive information from, touch receptors on the head and antennae. The antennal lobes of flies and moths are quit complex. In cephalopods, the brain has two regions: supraesophageal mass and subesophageal mass, separated by the esophagus.

In mammalian brain, the cerebrum is the largest region. In humans and several other animals, the fissures and convolutions give the brain a wrinkled appearance. In non-mammalian vertebrates with no cerebrum, the metencephalon is the highest center in the brain. Generally, comparing the locations of certain structures between humans and other vertebrates often reveal number of differences. Behind (or in humans, below) the cerebrum is the cerebellum. The cerebellum is known to be involved in the control of movement, and is connected by thick white matter fibers to the pons. The cerebrum and the cerebellum each have two hemispheres.

The structure of human brain differs from that of other animals in several important ways. These differences allow for many abilities over and above those of other animals, such as advanced cognitive skills. Human encephalization is especially pronounced in the neocortex, the most complex part of the cerebral cortex. The proportion of the prefrontal cortex is larger than in all other mammals (indeed larger than in all animals, although only in mammals has the neocortex evolved to fulfill this kind of function).

Humans have unique neural capacities, but much of their brain structure is similar to that of other mammals. Basic systems that alert the nervous system to stimulus, that sense events in the environment, and monitor the condition of the body are similar to those of even non-mammalian vertebrates. The neural circuitry underlying human consciousness includes both the advanced neocortex and prototypical structures of the brain stem. The human brain also has a massive number of synaptic connections allowing for a great deal of parallel processing. The human brain contains more than 100 billion neurons, each linked to as many as 10000 others.

The surface area of the brain is about 1500 to 2000 square centimeters, which is about the size of one to two pages of a newspaper. The human brain weights 1 to 1.5 kilograms. It has been estimated that the cerebral capacity of the gorilla brain is 10^{14} bits and that of human brain is 10^{15} bits. Assuming that 10^{14} bits is the minimum threshold of information required for self maintenance and reproduction of an organism as complex as gorilla or man, there is in a man a vast reservoir (10^{15}-10^{14}) = $9x10^{14}$ bits of cerebral power available for his practice of language, science, technology, spirituality and other cultural pursuits. If this happens that while only 10% of this cerebral capacity suffices to perform all the physiological functions of his animal existence, the remainder 90% enables him to become what he is, namely homosapien – man the wise.

Brain also produces a portion of the body's hormones that can influence organs and glands elsewhere in a body – conversely, the brain also reacts to hormones produced elsewhere in the body. In mammals, the hormones that regulate hormone production throughout the body are produced in the brain by the pituitary gland.

We see from above that development of brain is related to evolution of soul. One-sense plants have no brain, worms have neural net and invertebrates have ganglia. Brain is developed in five sense animals and its complexity increases from lower order to higher order animals. The human brain is the most complex. Thus as soul evolves with increasing consciousness he possesses a body with increasingly complex mind. A corollary of this is that a soul with low consciousness cannot occupy a body having a complex brain, which is suitable for soul with high consciousness. For instance, a soul having ant's body cannot jump the order and occupy a human body. A soul has to gradually evolve step by step as his consciousness increases. In other words the evolution is driven by consciousness or karma. The small nano organisms are at the bottom and humans are at the top of the ladder of evolution.

We have some knowledge about how karma operates. According to Jain Philosophy the decision of species in the next life is made in the present life. This decision is made by the soul based on the level of consciousness and the merit and demerits an individual has earned in this life. This decision and all other information are stored in the karma body. The karma body is attached to the soul, which after death starts a new life in the next body. The next life begins from a cell. As per scriptures the first food of life is called *ohja ahara* or luminous food. This implies that the soul owns the cell and receives its bioelectricity as the first food. Jain philosophy also provides that the six bio potentials are accomplished within one Indian hour of conception. It means that all the information regarding formation of six important systems in the body is recorded on the DNA in few minutes after conception. We know that only 10 percent of DNA contain protein-making instructions and the remaining 90 percent part has regulatory function. Russian research indicates that this major part of DNA acts like a language. The information from the karma body is perhaps transferred to this part of DNA, which appears like a language. So, the DNA now contains a blue print of the body to be constructed. If the complete information on all the six bio potentials is not correctly transferred, the body shall be underdeveloped having deficiency in parts or organs corresponding to the missing information.

The karma body has some features of a hologram. Like a hologram every pradesa of the soul, and hence every part of the karma body, contains all the karma. Also the karma body can store vast amount of information, it has memories of all the past lives. Akin to hologram, karma

body can easily encode and decode frequencies and bond and de-bond karma. The chromosomes are thought to behave as holographic computers. So then there are trillions of holographic computers in a human body each carrying the complete information of past and present life? This is same as saying that the soul has countless *pradesas*; each *pradesa* has all the karmas. The karmas direct, instruct and motivate genetic codes and the genes function and mutate accordingly. Thus karmas are the cause and the genes are their effect. Besides karmas the genes are also influenced by environment around it, cell nutrition wrapped around genes and the temperature of the light. It is believed that in developed complex beings during a certain time only up to 2-15% genes remain active.

Gene spacing is also important. Prokaryotic genomes are very small with little space between genes. The gene spacing increases with complexity of the organisms. Actually it is the spacing and not the genes that determine the complexity of the organism. In higher organisms (animals and plants, rather than bacteria and viruses) the non-code sequences out number the coding ones by a factor of ten or more. A large non-coding region enables storage of large amount of information for a complex body.

According to scientific view chromosome 1 contains record of past lives, chromosome 2 contains the history of journey leading to human life, and chromosome 3 contains evidences for the entire past history and chromosome 4 contains information about the future. According to Jain philosophy all this information is stored in the karma body. It is on this basis that a soul is classified as *bhavya*, capable of salvation and *abhavya* not capable of salvation. It means that the blue print of evolution and development of consciousness exists in the karma body of the nano organism from where the life starts. The evolution takes place according to this blue print under the influence of environmental factors. The consciousness may exercise control on genes through holographic computers. The genes are the hardware, holographic computers the software and consciousness is the source of intelligence. The ultimate control rests with the consciousness.

We now revert back to the question of natural selection; to what extent it is responsible for evolution at all stages. According to Jain philosophy one to four sense organisms are produced by the process of agglutination and are supposed to be hemophrodite. The consciousness of these organisms is also of low level. No womb is required for birth; the birth can take place in open. The soul collects material from the surroundings to construct the body. This means that natural forces have a dominant role in the construction of body at this stage. So, natural selection is expected to play primary role in evolution in early part of life. As consciousness increases natural selection becomes less effective, and at the stage of five- sense organism natural selection might play only a marginal role and it may have no role at all in evolution of humans. Pandit Sriram Sharma is right that human beings are successor of deities and not animals. It is quite probable that alien deities may have visited Earth and established some kind of relationship with the local habitants. According to Jain philosophy the mansion dwelling celestial beings live in middle loka. We know that five sense animals and humans, particularly the humans, have a developed mind, a feature that is radically distinct from normal physical structure, and such a feature is not likely to have a material origin.

Higher order organisms having five senses need womb for birth where a controlled environment exists for formation of highly sensitive information intensive nervous system in

which consciousness must play a major role. Thus it appears that in lower order organisms, up to four senses, the natural forces are predominant and in higher order organisms having developed mental faculty, the consciousness prevails over natural forces. All mechanisms of evolution, mutation, linkage, heterozygosis, recombination, gene flow, population structure, drift, natural selection and adoption are effective for lower organisms. Further research is needed to scientifically confirm evolution of higher order five sense organisms.

Based on these observations we postulate an evolution hypothesis.

7.8 Evolution Hypothesis

Evolution is of two types:

1. Horizontal evolution. Development of new species having same number of senses.
2. Vertical evolution. Development of new species with increasing number of senses.

There are two types of forces of evolution:

1. Natural forces. These forces originate in the environment. The mechanisms of evolutions like, linkage, heterozygosity, recombination, gene flow, population structure, drift, natural selection and adoption are of environmental origin.
2. Inner forces or forces of consciousness. These forces have their origin in the consciousness and operate through karma body. Mutation belongs to this category.

Natural forces cause horizontal evolution in lower order organisms. For example, under the influence of antibiotic drugs a new kind of bacteria resistant to the drug is evolved.

The ease of horizontal evolution of organism declines with increase in consciousness. It means that horizontal evolution of one sense organism is easy and it progressively becomes more restrained in two, three and four sense organisms.

Both the natural forces and inner forces cause vertical evolution in lower order organisms. Unless requisite level of consciousness is attained, vertical evolution cannot take place.

Inner forces primarily determine evolution in higher order organisms with five senses. Natural forces may have a marginal role in horizontal evolution but not in vertical evolution from animal to humans. Animals with five senses have mind, make choices and so bond karma. Strictly speaking organisms without brain or mind can also have bondage of karma. This happens in some plants and in organisms having one to four senses, but the bondage is relatively small in these organisms, karmas acting through gene mutation may become cause for horizontal as well as vertical evolution. Under the influence of karma a five-sense animal may go down the line and be born as an animal of lower order or become eligible to be a human being. Upward journey here does not mean that the human body is evolved from animal body it only means that the animal soul is reborn in a human body. A five-sense animal can also have infernal or celestial body in the next birth depending on his karma.

The human being has the highest mental power and bonding of karma becomes most important for him. Natural forces have a minimal role in his horizontal evolution and no role in vertical evolution. The vertical evolution (or de-evolution) is entirely determined by karma. A human being having a balance of demerit to his/ her credit may be born as animal of higher or lower order, or as infernal being in the next life depending on the balance. A human being having a merit balance may have a celestial body in the next birth. In case of mix of merit and demerit the soul may retain the human body in next life.

In general the pace of evolution is proportional to the level of consciousness. It means that vertical evolution of one sense soul is slowest and takes more time and that of five senses soul is fastest and takes less time. According to this rule the population of one-sense organisms e.g. plants and viruses, shall be a maximum and the population of human beings shall be a minimum at any time, even without voluntary and artificial means of birth control.

Evolution is only half the story of a soul. The ultimate destination of a soul is salvation. This important aspect of life has no place in science but is studied seriously in philosophy and psychology. Jain philosophy gives utmost importance to salvation and has deliberated on it in detail.

7.9 Development of consciousness

Consciousness is an attribute of the soul. In the general sense consciousness is one but in a specific sense it is of two types; pure consciousness and impure consciousness. Pure consciousness means the atman; impure consciousness is the atman with attached karma. Pure consciousness is pure intelligence. Impure consciousness is of two types – karmic consciousness and consciousness of karmic enjoyment. The former is due to total existing karma and the later is due to fruition of some karma. Thus we have three types of consciousness (i) cognitional consciousness (ii) karmic consciousness, and (iii) consciousness of karmic enjoyment. All kinds of knowledge and power of cognition is cognitional consciousness. Our freedom of actions of mind, speech and body constitute the karmic consciousness. The actions may be inauspicious, auspicious and pure. The inauspicious actions are known as demerit; the auspicious actions as merit and pure actions are neither merit nor demerit. Demerit favours de evolution of soul and merit favours evolution and heavenly life in future. Pure actions do not bond karma and help in salvation. The experience of pain and pleasure on account of fruition of karma is consciousness of karmic enjoyment. This consciousness mainly concerns with experiencing the fruits of karma, good or bad.

The consciousness of immobile beings is least developed. These beings lack power and knowledge, have only one sense of touch and therefore have no option but to experience the fruits of karma. Immobile beings are unable to protect themselves from external influences and adverse conditions. So they possess consciousness of karmic enjoyment. But immobile beings do react to situations. For example, the root of a tree grows in the direction of water and the branches grow in the direction of sun. The sensitive plant *mimosa pudica* contracts on touch. Plants flourish in favourable climate and fade away in adverse climate. Science has established that plants exhibit a sense of fear when they are cut and a sense of pleasure when watered. Music is found to have a favourable influence on flowering and pollution adversely effects the growth. Other immobile beings also show similar behaviour.

The mobile beings are at a higher level of consciousness and are relatively more powerful and knowledgeable. They also have karmic consciousness in addition to consciousness of karmic enjoyment. Mobile beings can move and defend themselves. These abilities increase with consciousness. As the karmas reduce, the power and knowledge increase. Though karma is powerful in determining the behaviour of a soul it is not the sole controller of our personality as shown below.

A person has two kinds of potentialities – ability potential or energy and action potential or power of action. A person must possess both to be able to act. To appreciate this important aspect

we should know the relationship between soul, body and mind. Soul and body and so also mind and body, mutually influence each other. The soul, body or mind individually cannot explain our personality. The soul can perform its tasks like, development of consciousness, bliss and vitality to the fullest extent. But when consciousness expresses through the body, it is partial and incomplete. Sense organs, mind and intellect are means of expression of our consciousness. Bliss is an experience; the vitality is expressed through body and sense organs. Expression of consciousness and bliss need body. Without a body the soul is helpless. Both mind and body influence the soul. Actually speaking, the karma bound by the actions of mind and body are the influencing factors.

Some scholars believe that soul is influenced by external factors only. According to the principle of non-absolutism (*anekanta*) the effect may not necessarily be due to external cause alone the cause may also be internal; the doctrine of karma accepts both the external and internal causes. If external cause were the only influencing factor then no one would ever break the cycle of karma. Similarly, the internal cause karma is not the sole operator. There are situations which are unaffected by karma. For instance, time is also powerful. When right time comes, the soul exercises its power (irrespective of karma) and comes out of shackles of bondage breaking all barriers of attachment and perversity.

Thus we note that both internal and external factors affect our fate and destiny. The knowledge increases as karmas reduce. When the person develops right perception, cognitive consciousness appears. This is the beginning of spiritual journey. As a person advances on this journey with his initiative, austerity and penance he gets closure to his ultimate aim of salvation.

7.9.1 The Spiritual Stages (*Gunasthana*)

Our knowledge, perception, vitality, thoughts, feelings and emotions represent the attitude of the soul (*bhava*) at any instant. The attitude of the soul (*bhava*) is determined by karma. There are three ways in which karma exercise their effect (i) fruition or rise of karma, the karma become active after completing their passive period (ii) suppression of karma, the karma are suppressed temporarily by will power and made ineffective, and (iii) the karma are destroyed completely by powerful actions. Based on this there are five kinds of attitudes of the soul.

1. Attitude of the soul by fruition of karma (*audayika bhava*)
2. Attitude of the soul by suppression of karma (*aupashamik bhava*)
3. Attitude of the soul by annihilation of karma (*kshayik bhava*)
4. Attitude of the soul by partial suppression and partial annihilation of karma (*kshayopshamik bhava*)
5. Attitude of the soul by natural disposition (*parinamika bhava*).

The last attitude of the soul is determined by the general make up of the karma body.

The first four attitudes are due to induced (artificial) irradiation of karma and the fifth one is due to natural (spontaneous) irradiation of karma.

The fruition of karma decides the realms of existence, the gender and the attitudes, like anger, ego, deceit, greed, wrong belief, wrong knowledge, non restraint, etc. The suppression of karma develops attitudes of true faith and true conduct. The annihilation of karma develops true faith, true conduct, right perception, right knowledge, vitality, etc. Partial suppression and partial annihilation of karma develops true faith, true conduct, perceptions of vision, non vision and clairvoyance type, empirical, scriptural and clairvoyance knowledge of right or wrong type,

telepathy, vitality, partial restraint, etc. The general body of karma determines the state of the individual soul and its ability or inability to obtain salvation.

We recall the four main powers of the soul, knowledge, perception, bliss and energy. There are five agents of bondage of karma – Perverted views, Non restraint, Carelessness, Passion and Activities. Perverted view means false notions regarding the soul or misunderstanding about "Who am I?" It means that the right knowledge and the right perception elements are obscured. The term non-restraint implies there is no self-control, which may lead to involuntary evil deeds. Thus, the bliss element is defiled. The term carelessness implies general inertia in working towards salvation. Thus the energy element is obstructed. Passion is the main agent of karmic fusion. It has four main sub-agents-anger, pride, deceit and greed-anger and pride are grouped as "attachment" and deceit and greed are grouped as "aversion" since these reflect such emotional states. The term activities refer to general activities of the body, mind and speech.

Jain philosophy dwells in detail on methods and practices to stop karmic fusion and removing the existing karma. These practices include austerities, meditation and penance. Austerities imply control of the senses with extreme alertness while keeping positive non-violence in the forefront. However, one should not practice austerities to the extent of harming oneself by trying to go beyond one's capabilities.

The journey of the soul from the stage of human being to the highest stage of pure and perfect soul is identified by fourteen spiritual purification stages as follows. Instead of traditional terminology we use the terms used by K.V. Mardia to describe these stages.

1. Deluding world – view.
2. Lingering Enlightened World- View (EWV)
3. Mixture of deluded and Enlightened World View
4. Non-restrained Enlightened World- View
5. EWV with partial self-restraint.
6. EWV with careless self-restraint
7. Careless-free self – restraint
8. Complete Self – Restraint (CSR) with unprecedented Volition
9. CSR with uniformly mild volition
10. CSR with subtle greed
11. CSR with suppressed greed
12. CSR with eliminated greed
13. Dynamic omniscient state.
14. Static omniscience state

The first stage is applicable to all beings and it is here that the karmic matter is at its densest for human beings. The karmic matter decreases up the stages and is zero at the 14^{th} stage. We could view the purification process as through the karmic density with fourteen important points on it. To understand the dynamic process of karmic fission, it should be clearly understood that as karma are shed, there is an increases in the energy of the soul, which allows further spiritual growth. It is assumed that future karmic influx will be checked, and there will be a further release of energy and knowledge elements, which allow the soul to search for its true nature. Another

important point to note is that the effect of the karmic matter is mostly first suppressed rather than altogether eliminated. Furthermore, each stage severely limits karmic fusion and diminishes the old karmic matter, and at most of the stages the degree of anger, pride, deceit and greed are reduced gradually, with anger being the first and greed being the last to be eliminated.

The first stage corresponds to all living beings with a deluded world-view. In the beginning every soul is in this stage of complete ignorance, i.e. it has the four passions at the maximum level. However, every soul strives to release its four elements from karmic matter. This process can be triggered off by either internal experience, such as remembering past lives, or external experiences such as hearing to sermons. This event is followed in a flash by passing through stages 2 and 3 to stage 4, which corresponds to "Non-restrained Enlightened World –view". This experience is the complete revelation of the true nature of life and the reality of the soul, i.e. true insight.

This first experience of true insight lasts only for a few moments and it comes from jamming the insight – deluding karmic component rather than from its elimination. The jammed component will be quickly unjammed and will assert its influence again. Hence soul will revert to its extreme perverted stage with all five karmic agents operating with full force. However during this fall, the soul goes through the third purification stage for a short time where the gross passions remain suppressed but there is no longer true insight; this stage is described as the stage of mixture of Enlightened World-View. Below this is stage 2, the Lingering Enlightened World – View, in which the fourth degree of passions reassert themselves and instantaneously drop the soul down to stage -1 again. In the first transition to the fourth stage, the insight-deluding component is suppressed only, but in subsequent (guaranteed) transitions, of longer durations, there is also partial elimination of this component. After a number of such transitions involving partial elimination – cum – suppression, the soul gets firmly established in the fourth stage to proceed to the fifth stage and beyond.

At the fourth stage perverted views are removed and equanimity is attained. It is this increase in purity, which allows the flash of true insight to take place. The partial removal of the four passions leads to increased energy and knowledge elements of the soul, which makes the soul search for true knowledge more vigorously than before. Also it places significant less emphasis on the manifestation of karmic matter including on one's own body, psychological states seen through the four passions and one's personal possession to which it had formerly identified itself. Thus, a pure and serene state is attained.

In order to reach the fourth stage, austerities are not mentioned explicitly, but implicitly it is assumed that they are required since, to be in the fourth purification stage, one has to have all the four passions reduced which cannot be achieved without restraint. The first awakening removes some of the karmas leading to a moderate degree of self – control / restraint, i.e. one does not get into a fit of anger, intriguing deceit, blinding pride, devouring greed etc. Further, on the perfection of the fourth purification stage, there will be evidence of more tolerance and less anger, more humility and less pride, more straightforwardness and less deceit, more contentment and less greed.

At the fifth stage one starts working to achieve even greater restraint; that is one follows various vows that lead to partial restraints. At the sixth stage, full restraint is accomplished. The firth stage is equivalent to the way of life of the ordinary laymen whereas the sixth stage

corresponds to following the path of a monk. At stage six full disciplines and higher vows are achieved.

At stage seven, one removes the carelessness to zero, implying also that anger goes to zero. However, some remnants of the four passions still persist. One rises through meditation to decrease the degree of pride, deceit and greed to the zero degree at stage eight, nine and ten respectively. When in these states, if the four passions are suppressed rather than eliminated, then one will only be able to reach the eleventh stage from which one will be forced to move downwards. However, if the four passions and their effects are fully eliminated during the trances, so that the degree of greed becomes permanently zero, then one will jump straight from the tenth stage to the twelfth stage.

On the instant of attaining the twelfth stage, three remaining primary karmic components, namely knowledge obscuring, intuition (perception) obscures and energy obstructing, are automatically eliminated, leading to the attainment of the thirteenth stage which is the stage of dynamic omniscience. At this stage only yoga governs the remaining activities which are necessary for the physical body to still function. These activities do not, however, lead to new karma. Also, secondary karmic components of the omniscient being gradually fall off until eventually none of them remain. In the final moments, the body is in a state of total immobility. This state is the fourteenth "Static Omniscience" stage. This stage lasts only for at the most 48 minutes prior to liberation. The moment death occurs, the soul, completely and forever freed from the cycle of rebirth, attains salvation.

We have indicated how transfer takes place from one stage to another. Fig 7.1 shows the various transitions. From stage 1, we go into stage 3 then 4 and then either progress to stage 5 or fall back to stage 2. Again from stage 5, either we proceed to stage 6 or we go down to stage 4 or 2. From stage 6 we proceed to 7 or again we fall down to 5 or 4. From stage 7 we precede to 8 or, as at 6, we go down. From stage 8 one can proceed to 9 or again we can go down. From stage 9, transition to 10 is possible. One can jump straight from stage 10 to 12. Stage 11 is very slippery and one can go downward anywhere, usually to 6 or 7. Once one has reached stage 12, and then there is no fall and one progress to stages 13 and 14.

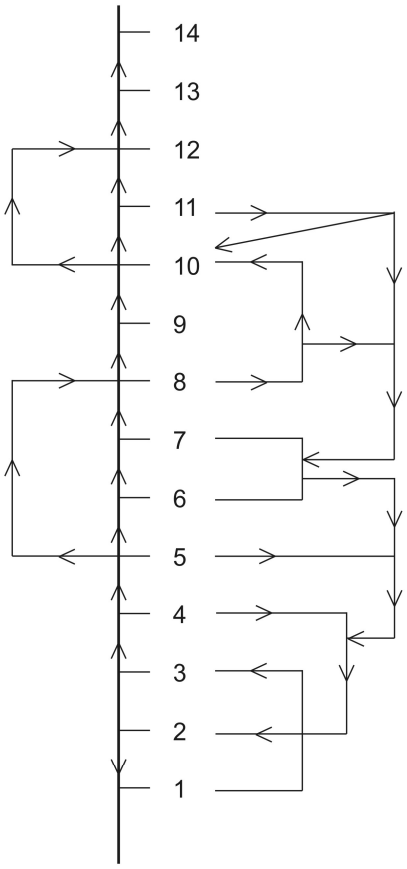

Fig 7.1 Transition of Spiritual Stages

The celestial beings, humans, animals and infernal beings can have the first four stages. Humans and auspicious animals can attain the fifth stage. Only monks attain the sixth and higher stages. The seventh to twelfth stages are possible only for monks practicing meditation and confined to inner self; duration of each of these stages can be less than 48 minutes.

All one-sense organisms and beings up to the second stage lack perceptual / cognitive knowledge, and scriptural knowledge. Beings in the third stage have a mix of this knowledge and ignorance. Beings from 4^{th} to 12^{th} stages possess perceptual, scriptural and clairvoyance knowledge. Telepathy knowledge is possible from 6^{th} to 12^{th} stage. The beings in the 13^{th} and 14^{th} stages are omniscient as mentioned above.

Perception is of four types – vision perception, non-vision perception, clairvoyance perception and omniscience perception. The non-vision perception is acquired by sense organs other than eyes and mind. The vision and non-vision perceptions are possible in 1^{st} to 12^{th} stages. The omniscient perception is capable of direct knowledge of a *paramanu* to the largest material aggregate. Clairvoyance perception is possible for beings in 4^{th} to 12^{th} stages. The omniscient in the 13^{th} and 14^{th} stages can perceive the whole *loka* and also *aloka*.

Generally human beings are born in the first stage, in exceptional cases, like that of Lord Mahavira; fourth stage can also prevail at the time of birth. A human being has to complete the journey from the 1^{st} (or 4^{th}) to 14^{th} stage in one lifetime.

Fig 7.2 shows the development history of consciousness graphically. The purity of the soul is drawn on Y-axis and the time on X-axis to some unknown scale. The time is counted from the moment an inactive soul exits its permanent abode and enters the active life as one – sense organism. At this stage only a negligible fraction, say 10^{-50}, of its consciousness is expressed.

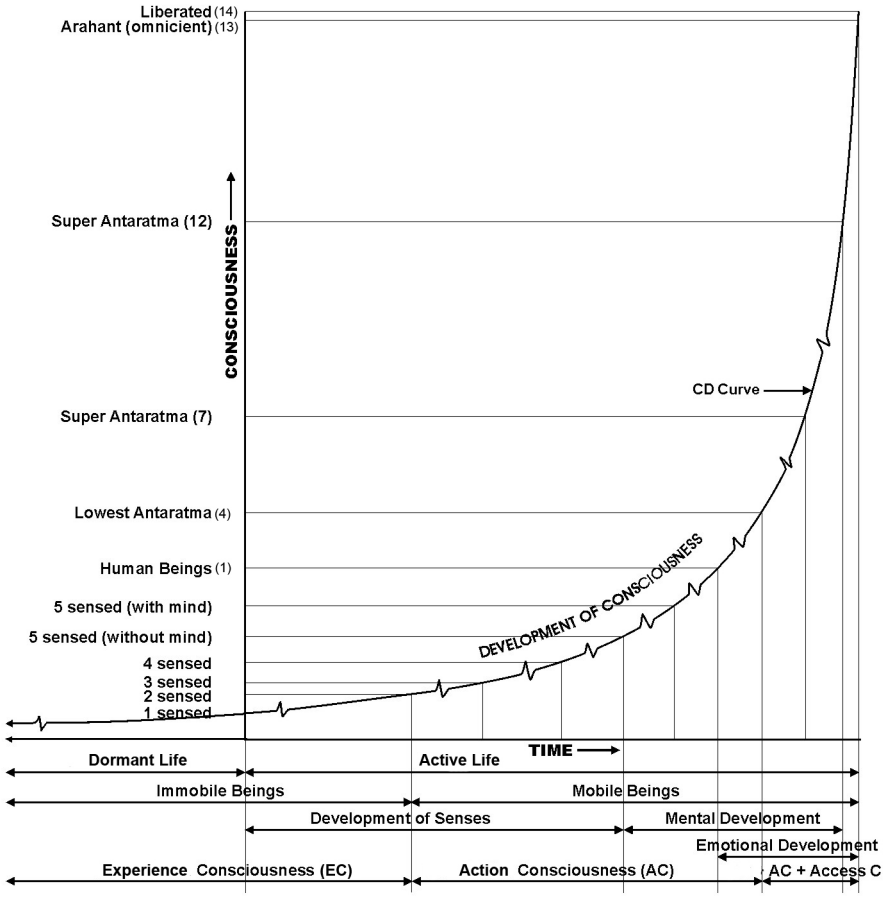

Fig 7.2 Development of Consciousness

The cuts in curve indicate that actual time intervals of stages of development are different from that shown on the figure

EC - Karmaphala Chetana, AC - Karma Chetana, AccC - Gyan Chetana

The pace of development of consciousness was earlier assumed to be proportional to the current level of consciousness. Hence,

$$DC/dt = KC$$

Where C is consciousness K is a constant. This gives an exponential trend of development of consciousness as shown in Fig. 7.2. The development is slowest at the level of one-sense being and progressively becomes faster as consciousness increases. The soul first develops the senses and reaches the level of five-sense animal. This marks the end of the period of development of senses. At this stage the mind gets developed and mental development of the soul begins. On further development of consciousness the soul gets human body and emotional development also

begins. As a human being the soul remains in the first spiritual stage till awakening of identity takes place. An awakened soul eventually enters the fourth stage of development.

As an immobile one sense organism the soul has consciousness of karmic enjoyment only. On further development as two sense organisms the soul also possesses the karmic consciousness. These two kinds of consciousness prevail till the fourth stage of spiritual development. At this stage the soul also develops cognitive consciousness and so now onwards in higher stages the soul possesses all three kinds of consciousness. The development process after the 4^{th} stage becomes fast and the soul proceeds towards the final stage in a measurable amount of time. The figure shows that the consciousness is one percent pure in the 7^{th} spiritual stage, 50 percent pure in 12^{th} spiritual stage and 99.9 percent pure in the 13^{th} omniscient stage. These values are arbitrary but they do indicate the ignorance of common human beings and the relative power of the omniscient and the pure and perfect liberated soul. The liberated soul is body less pure consciousness and is never embodied again.

There is scientific evidence that spiritual development is genetic and hence karmic. The spirituality, as measured by self-transcendence is innate. It comes from within, not from without. Of course spirituality has to be developed, just like any other talent. But evidence suggests the predisposition is there from beginning. Spirituality is based in consciousness, religion in cognition. Spirituality is universal, religion is not. Spirituality is genetic; religiousness is learned in the classical sense – from parents, teachers, religious leaders and seers. Gene scientist Dean Hammer who is working on "spirituality gene" says by exercising our free will, we could change the nature or quality of our genes. Through our effort dormant genes could get activated. For example, creativity gene can lie dormant till person is passed her middle age. At a later stage, one might have found time and suitable circumstances to activate her dormant creativity genes. The God gene acts by influencing the brain's capability for various types and forms of consciousness, which become the basis for spiritual experiences.

The development of genes is related to development of consciousness. Jain philosophy has suggested ways to develop the consciousness as mentioned before. By practicing austerities, restraint and penance through exercising his free will one can climb the ladder of spiritual stages and become an omniscient.

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