

Entropy and order based definition of Life in Jain philosophy

Narendra Bhandari
(nnbhandari@yahoo.com)
Jain Academy of scholars

and

Science and Spirituality Research Institute. Ahmedabad

Abstract

Water, air, soil and fire, in certain forms, and even flow of electrons producing electricity, are considered to be 'alive' in Jain philosophy, in contradiction to modern biology where they are considered to be dead matter, devoid of life. This discrepancy can be resolved if we assume that anything with negentropy develops a degree of order and can be termed as *sachitta* or having a degree of consciousness. This definition necessitates that we distinguish between various reversible phases of matter ranging between *achitta* to *sachitta*, with an increasing degree of consciousness (*chitta*) and *nirjiva* and *sajiva*, without or with an embodied soul. Thus Jain philosophy considers *sachitta* as alive and modern biology considers *sajiva* as alive. A case in point is seeds which are not yet sprouted, but have the potential to sprout, given proper environment. This potential makes them *sachitta* but not *sajiva*, till they sprout. Seeds while they continue to have the potential of sprouting are called *yonibhut* as pointed out by Dr Anil Kumar Jain. Here there is clear distinction between *sachitta* and *sajiva*. They become *Sajiv* when they sprout and a soul (*anantajivi*) enters them. Scientifically they have information to sprout. Information is order and they are *sachitta*. When a soul from the loka will descend in them, they will become *sajiva*.

We further propose that water, air, soil and fire must be generalised to fluid, gases, solids and energy forms (thermal, nuclear, chemical, electrical, etc.) respectively, because they all are capable of acquiring orderly forms, under certain conditions, and become *sachitta*.

Key words: order, entropy, negentropy, *sachitta*, *achitta*, *sajiva*,

Introduction

There are many fundamental differences between modern biological concepts and concepts enunciated in Jain Scriptures. The Jain philosophy propounds that life exists in many forms, some of which are subtle (*sukshma*) and others are gross (*bādar*). We, humans, can only see and observe the *bādar jivas*. The subtle forms, which exist everywhere in the Loka (universe) are not only so small that they cannot be observed or experienced by our sensory organs, they cannot be observed even by the most powerful microscopes. The reason for this invisibility and their non-interactive nature may be that the bodies of these *jivas* are made of non-interactive *pudgals* (e.g. 2 or 4 Touch matter, see Bhandari, 2022). These forms of life are yet to come under active investigation of modern biology.

The second difference is the definition of life. Jain darshan classifies life based on functional organs like sensory organs and classifies all living beings based on 1,2,3,4,5 and 5+brain (called *sangyani jiva*) criteria. ones sensed organs have touch sense, two sensed have touch and taste, three sensed have touch, taste and smell, four sensed have touch,

tatse, smell and vision and five sensed additionally have hearing organs. In medical and biological sciences living beings are classified based on structure of their nucleus, (negative) entropy compared to surroundings, and other criteria, like mobility, response to external stimulation, communication, Darwinian evolution, reproduction, etc. The modern biological system classifies organisms with 2 or more sensory organs of Jains as living and ignores the one sensed living beings, and call them non-living. so this is a matter of definition.

The third and more fundamental difference is the consequence of the second criteria, discussed above, that, not only subtle, microscopic forms of life thrive in water, air, soil etc. but, according to Jain biology, water, air, soil and fire themselves are living entities having the sense of touch. Then there are two more kinds of living entities: Nigod and Siddha, The criteria which Jain darshan follows are two: consciousness and ability to know (gyan). According to Jain darshan, these two suffice; i.e. they are necessary and sufficient criteria for a living being. This is in contrast to the modern biology which subscribes to other criteria and accordingly considers the Jains one sensed jiva: water, air, soil, and fire, as well as nigod to be lifeless; Nor has the modern biology taken any note of consciousness and hence are not aware of siddha state. The discrepancy can be resolved with a proper definition of 'what is living' and in this article we propose an entropy¹ or order based definition of life to resolve this issue. We also propose that water (*apkāya*), air (*Vayukāy*), soil (*pruthvikāy*) and fire (*Teukāy*) must be generalized and replaced by liquids, gases, solids, and energy (chemical, electrical, nuclear, bio energy etc.) forms, because all of them can have an organised structure.

¹ Entropy, in a thermodynamic system, means the capacity of converting thermal energy into mechanical energy, as the components of every physical system proceed towards attaining equilibrium with time.

As far as the gross (*Bādar*) life forms are concerned, they are classified into immobile (*sthāvar*) and mobile (*tras jiva*), as in modern biology. Both of these kinds exist only in the habitable region (*Trasnādi*) of the Loka, a narrow channel connecting the upper, middle and lower Loka of the Triloka, the tri-universe of the Jainas (see, Bhandari, 2021). Yet the basis of classification of all living forms is different in modern biology and Jain biology. The Jain taxonomy classifies all *bādar* forms of life into six functional, sensory organ based groups viz. 1-sensed, 2-sensed, 3-sensed, 4-sensed, 5-sensed and 5-sensed with psyche. One sensed jivas (water, air, soil, fire and nigodia) are immobile (*sthāvar*) whereas all others are mobile (*tras*). There are two types of these most primitive, Nigodia jiva: *nitya nigod*, and *itar nigod*. *Itar nigod* are capable of developing into plants (*vanaspatikāy*), whereas *nitya nigod*, eternally move in cycles or loops between *achitta-sachitta* stages, devoid of consciousness and conscious stages (discussed later), and are never able to become full fledged jiva, habitating a soul. This necessitates stage wise, reversible development of living systems, from *achitta* to *sachitta* to *sajiv* to *nirjiva*, back and forth with grades of consciousness, on a scale of 0 to 10, we might assume, for sake of quantifying them according to development of their consciousness. *Ajiva* should be distinguished from *nirjiva* because *ajiva* is incapable of ever becoming conscious or living.

The five senses, sequentially, are that of touch, smell, taste, vision, and auditory systems. In this scheme of things, water, air, soil, fire and nigodia are considered to be one, sensed living beings, having the sense of touch (T), but no smell, taste, vision or hearing faculties. The Jain biology also predicts that *vanaspatikāy* (plant kingdom, which includes algae, fungus etc.) are the first, primary, jiva to evolve from nigod, out of which all jivas have evolved, depending on their *karmik* load. We also discuss if Jain biology is consistent

with a special abiogenic origin of life, invoking a three body system, including soul (*ātmā*) as an essential component. We will also compare (in a following article) the Jain classification with taxonomy used in modern biology to get an insight into various propositions (Parikh and Bhandari, in preparation).

As far as plants are concerned, they belong to one sensed-touch group of living beings, but observations show that sometimes they behave as if they have the emotional faculties corresponding to several other senses (*bhavendriya*), without having physical organs (*dravyendriya*). They seem to have sensory systems with different electro-optico-chemical and mechanical pathways, mechanisms, receptors and response systems to express their sensitivities (Parikh and Bhandari, in preparation). Therefore plant kingdom should be classified in a separate, special category, and not grouped with emotion-less air, water etc. Furthermore, they do not commit any violence even for their food, which is a common practice in all other living beings. This is the subject matter of another article (Ashesha Parikh and Bhandari, 2022)

There are many other basic differences between Jain concepts and modern biology, including those related to reproduction in which soul plays the critical role, Darwinian evolution, (Bhandari et al., 2022), rebirth, role of karma, various realms of existence (*Gati*) including heavenly beings (dieties), hellish beings, but in this article we will confine to the definition of life, according to Jain philosophy and see how it can resolve some of the discrepancies described above.

At a gross level, we can easily distinguish living from non-living, by their activity, without being able to define them. In medical science and biology attempts have been made to define life based on its structural and functional characteristics. Fundamental functions of anything living are intake of food or energy, growth, reaction and reproduction etc. Life, or living beings, are capable of performing innumerable, almost infinite, functions, both physical and mental, and therefore it is difficult to provide a correct or ‘complete’ definition of life. We think that interaction with and adaptation to the environment and Darwinian (physical) and conscious evolution or devolution may be considered as the deciding prerequisites for something to be qualified as living. Faculty of cognition, i.e. the one who knows, i.e. a ‘Knower’ can be considered to be alive and one who does not know is dead matter, according to Samaysar. Furthermore, according to Jainism, there are six characteristics of Jiva. They are *gyan*, *darshan*, *charitra*, *tapa*, *virya* and *upayog* (ज्ञान, दर्शन, चरित्र, तप, वीर्य, उपयोग) and every soul have these faculties. They are not innate to matter. They apparently seem to arise in a material body by virtue of the presence of a soul. Presence of any one or more Paryapti (पर्याप्ति): qualifies it to be considered as living whereas medically, several functions like intake of energy, reproduction, evolution, are the requirements which can qualify something as living. Functional definition of living is the capability of intake of food, body, sensory organs, breathing, speech and mind (आहार, शरीर, इन्द्रिय, श्वासोच्छ्वास, भाषा, और मन), according to Acharya Vijay Nandi Ghosh ji (2020). Since some machines can reproduce themselves mechanically till supply lasts, reproduction may be a necessary but not a sufficient criterion.

A living being cannot survive without intake of energy or food from surroundings and therefore a biological system cannot exist as an isolated system. Growth in terms of size and transmutation resulting in evolution are also characteristic features of living beings. Reaction to stimulus and reproduction, both require sequential, multi-stage processing. Reaction involves cognition, reflection, memory, response and learning. However much we may try to explain reproduction scientifically, if we take the example of mammalian reproduction, it remains a miracle, involving transmutation and Darwinian evolution and defies law of conservation, not in the physical sense, but in the sense that it

results in a ‘whole being’, complete in all respects, out of a ‘whole being’ without any reduction in the contents or capabilities of the ‘parent’. Howsoever miniscule it may be, every generation represents an evolution over the previous one.

Medically it is taken to be a two body process (union of sperm and ova), but Jain philosophy defines life based on its functional properties and for this purpose it invokes a three body system, involving karma, yoni, and atma (soul and chetana (consciousness)), parents being only incidental or catalytic agents. Jain model of shrishtivad, in contrast, assumes independent existence of Jiva, as a real, in the universe and karma based biogenesis (Acharya Mahapragna; Bhandari et al., 2022), *Ātmā* being an inescapable and basic constituents of living beings (Bhandari et al, 2022). *Ātmā* has infinite powers and some of the more important ones are used to define life, like power of knowing (*jnān*), power of surviving (*jivatva*), power of perception (*darshan*), power of creation (*virya*) et. cetera. Jain philosophy does not consider reproduction as an essential characteristic of living beings; one can be alive, without being able to reproduce.

In this article we describe the scientific and Jain models of life and try to define biological or living systems, based on order and entropy, to attain an insight into the two approaches.

Materialistic view of life

Medical science recognises only two entities in the universe, living and non-living. The non-living includes two entities: matter and space, both being 3-dimensional. Time is taken as a psychological phenomenon, a construct of mind and not a real (Prasanna, 2017). Materialistic hypothesis assumes that everything else, including the living, arises from matter. This model, adopted by most scientists as a working hypothesis, believe in abiogenesis i.e. consciousness can spontaneously arise from material ingredients, i.e. suitable elements, like carbon, oxygen, nitrogen, hydrogen etc., long chain organic molecules, like amino acids, sugars etc. popularly termed as building blocks of life, given adequate time, under suitable environment in which energy is available. The Urey-Miller synthesis (Miller and Urey, 1956) of complex organic compounds like amino acids, sugars and fatty acids, the essential building blocks of life, in the laboratory from simple chemicals like ammonia, water, methane, hydrogen etc. was an important step in this direction, although it failed to produce any living entity, even the simplest one. Taking clues from Jain scriptures, we propose that if chlorophyll ($C_{55}H_{72}O_5N_4Mg$) is added to Miller’s concoction and intense light is shone for a long time, some primitive plant variety, may be some algae, should be formed. Abiogenesis and gradual, directional Darwinian evolution are the two planks of the materialistic theory.

Some scientists assume that when the neural network in the brain attains a certain level of complexity, consciousness spontaneously arises, like the Djinn of Aladdin. This brings us to the question of what is consciousness? The most critical question is how can consciousness arise when there is no brain or neural network as in algae? Some scientists define consciousness is nothing but an ability to take decisions or choose an option from several possibilities. They invoke probabilistic quantum mechanics in nano sized tubulins in the neurons for this purpose (Hameroff, 2012; Hameroff and Penrose, 2014). It must be recognised that decision making is only one function of consciousness, among the many related to the processes of cognition, memory, judgement, distinction, and reaction etc.,

which is elaborately discussed in Jain philosophy, where *ātmā* (soul) is invoked as the knower and consciousness is its main activity.

We therefore first discuss the Jain model of Jiva.

Jain model of Jiva:

In comparison, Jainism has propounded six reals: Jiva (living or conscious beings, or soul) is a basic, distinct, independent constituent of the universe, a real which cannot be derived from any other real, and there are five other reals : matter, space, time, motion and rest. We can justify the need for these six reals, for they have different innate properties, none of which can be derived from any other real because of the overpowering law of conservation. We see matter, a physical entity made of atoms and molecules and need for space to accommodate it; According to the Newton's laws of motion, momentum and rest have to be conserved and therefore Jain philosophy postulates two reals, termed Dharma and Adharma, related to motion and rest. Thus we need these two reals to enable matter to move or stay in the position of rest. Time cannot be derived from any of these five reals i.e. space (Akash), matter (Pudgal), jiva (soul), Dharma and Adharma and therefore kāl has been postulated as another real. Time has a special function in Jain philosophy, that it acts on everything, all other reals. It can not exist alone, in nothingness, by itself, but with exists with other reals and in this sense it is not an independent real. It can be likened to a kind of force; it acts on living (jiva) and give rise to the phenomena of birth, aging and death; it acts on matter and gives rise to its transformation in different modes; It acts on *Dharmāstikāya* and *Adharmāstikāya* and give rise to the phenomena of motion and rest.

Consciousness and Concept of soul

Every Soul has many amazing, unbelievable faculties; the two most amazing features are: (i) all souls in the universe, and there are infinite number of them, are identical in all respects including their potential and at the same time they are all independent i.e. retain their individuality. Strangely, Jiva depend on each other for their survival as enunciated by the sutra *Parasparopagraho Jivānām* (Tattvartha sutra of Umaswati) but every Self or *ātmā* is only and fully responsible for itself, and (ii) not only it knows everything in the universe but also itself (self-awareness) *swa-par prakashak* or illuminator of self and everything else. Knowing itself is self realisation, and knowing self is knowing everything else in the universe. In Jain and Buddhist philosophy, *ātmā* is likened to a mirror where image of everything in the universe is truthfully formed or reflected in it, as it is, without any alteration or modification (called quality of *swachchattava*). Some scientists have likened it to the holographic nature of *ātmā* (Pokharna and Shah, 2022; Pokharna, S.S. 2022) by which everything in the universe makes a hologram in every soul. All we can say is that strange is the world of *Ātma* and holographic projection is only one of the many powers of *ātmā*. It not only reflects the physical features but also innate qualities it possesses, besides their transformations in the past and future as well. Thus *Ātma* is more than a just a physical hologram, a temporal hologram, and holographic reflection is only one of its many powers. It may be appropriate to call it an *Ātmāgrām*, rather than a hologram, to include the present state, all the qualities (nature i.e *swabhava*, Guṇa etc.) everything possesses and their past and future states as well. *Ātma* is likened to a perfect mirror in which the true nature of everything in the universe, including itself, is reflected, but the mechanism may be non-physical, may be through Leshyas and the nature of *Ātmāgrām*, must be distinguished from the physical nature of a hologram.

Equilibrium and Entropy based definition of Life

We can distinguish two types of systems in the world: physical and biological and there is a fundamental difference between the two. Biological systems require energy to create order, to carry out orderly functions to survive or evolve. They can take the required energy from their environment or the surrounding physical systems to survive whereas physical systems can provide energy and tend towards an equilibrium state.

The universe is far from being in equilibrium. Equilibrium means everything is similar throughout the universe, content and energy wise, equidistribution of energy in all the contents, and implies chaos, randomness and absence of order (Prigogine, I., 1967). Order implies energy differences in contents and in their spatial distribution and its every entity is pure and isolated. Order of a physical system can be defined by degree of purity of its contents and has been defined by the term 'ordropy'. Energy can be internal or external and all systems in the world need energy for performing their functions.

In contrast to physical systems, which can be in equilibrium or chaotic, one well recognised characteristic of any living, biological system is order. It is thought that consciousness is responsible for this order. A random or chaotic system cannot become a living system. Not only every biological system is orderly but its degree of orderliness improves with time. When orderliness disappears, the system becomes dead. A biological system is in constant interaction with its physical surroundings and cannot exist in isolation. Whereas the entropy of the biological system decreases with time, the entropy of the physical system increases much more and overall the entropy of the whole system (biological+ physical environment) increases with time. At the heart of this is the second law of thermodynamics or known as the arrow of time. We can therefore define life or a living system based on consideration of entropy. Entropy is often interpreted as the degree of disorder or randomness in the system. Order means decrease in Entropy and increase of disorder is increase of entropy (Brillouin, Leon, 1953).

Now we discuss the first characteristic, intake of energy or food as an essential requirement of living beings. We illustrate this concept by some examples. Every system has some energy, but not all the energy can be converted into useful work. Heat (or thermal energy) can be used for doing useful work, as for example in steam engine, but there is a loss of heat in the process and a part of the energy is wasted. This operation i.e. cooling of steam for running the steam engine can be expressed by saying that the entropy has increased. This is equivalent to saying that a hot system will cool, unless something is done to stop it.

Stated another way, a system at some temperature has capacity to do some work. We can say that it has some entropy. When this heat capacity is used to do work, there are some losses. Not all the capacity can be used for doing work and we express it by saying that entropy has increased. With the increase in entropy the order has decreased.

Hot things cool down, a smell diffuses through air, eggs scramble but never spontaneously unscramble; these are irreversible processes. In short, energy tends to disperse or spread out as time progresses. Entropy is a measure of this tendency of irreversible processes. There are more ways for energy to be spread out than for it to be concentrated. Eventually, any system arrives at a state of maximum entropy called "thermodynamic equilibrium," in which energy is uniformly distributed throughout its contents. Structural organization is the hall mark of living systems by means of which strongly driven systems ramp up their ability to dissipate energy. The energy state of a system is thus defined by its entropy, or capacity to do work. In a physical system, as it tends to move towards equilibrium, by exchange of energy with its surroundings, this capacity of doing useful work decreases and entropy increases. A cup of coffee and the room it sits in eventually attain the same temperature, for example. As long as the cup and the room are left alone, this process is irreversible. The coffee never spontaneously heats up again because the odds are overwhelmingly stacked against so much

of the room's energy randomly concentrating in its atoms. A plant, for example, absorbs extremely energetic sunlight, uses it to build sugars, and ejects infrared light, a much less concentrated form of energy. The overall entropy of the universe increases during photosynthesis as the sunlight dissipates, even as the plant prevents itself from decaying by maintaining an orderly internal structure.

Thus order and entropy are inversely related. In biological systems, the order increases and entropy decreases, at the cost of entropy of the surroundings, which increases. This leads to the concept of negentropy or negative entropy. Other concept relevant to biological systems is centropy, which is a combination of 'centration', i.e. concentration, and 'negative entropy', meaning order. Thus, energetic tendency for particles of a system to come together in an organised manner is defined by centropy. These terms can be used with advantage to understand 'Jain concept of life' (Wikipedia).

Negentropy and Free energy

Way back in 1944, Erwin Schrödinger, Nobel Laureate in physics and the formulator of wave nature of particles, wrote a book entitled what is life, in which he stated that life feeds on negative entropy, or negentropy. The general struggle for existence of animate beings is not a struggle for raw materials – these, for organisms, are air, water and soil, all abundantly available – nor for energy which exists in plenty in any body in the form of heat, but a struggle for [negative] entropy, which becomes available through the transition of energy from the hot sun to the cold earth. Later, Léon Brillouin shortened the term of "negative entropy" to negentropy. In 1974, Albert Szent-Györgyi proposed replacing the term negentropy with syntropy. Thus negative entropy, negentropy and syntropy are the same.

These few terms viz. entropy, negentropy or syntropy, discussed above and free energy, enthalpy, ordropy and second law of thermodynamics must be defined before we can proceed further; these terms are all related to each other.

The second law of thermodynamics relates heat and loss in its conversion. Entropy, the measure of a system's thermal energy per unit temperature that is unavailable for doing useful work. Because work is obtained from ordered molecular motion, the amount of entropy is also a measure of the molecular disorder, or randomness, of a system.

Quantitatively, entropy (S) is defined in terms of the system's thermal energy which cannot be converted into mechanical work. Entropy of every physical system increases with time, that is disorder increases, leading to lack of order or predictability. This has been formulated as The second law of thermodynamics which states that entropy always increases with time.

We will try to define a few terms mathematically for sake of precision. The entropy,

S, is given by

$$S = \int dQ/T$$

where dQ= a differential amount of heat passed into a thermodynamic system
and T=absolute temperature.

Rather than discussing absolute entropy, it is easy to define a system by change in entropy (ΔS). In an isothermal system, whose temperature does not change (remains constant), $\Delta S = Q/T$, where Q is change in heat.

In a later edition of his book, Schrödinger introduced the concept of Free energy as the source of negative entropy of living systems. We can understand it in terms of Enthalpy (H), which is defined as the sum of the internal energy of a system and the product of its volume, V, multiplied by the P, pressure (PV) or we can say that Enthalpy is the measure of total heat present in the thermodynamic system where the pressure is constant. It is represented as.

$\Delta H = \Delta E + P \Delta V$. where E is the internal energy. Entropy is the measure of disorder in a thermodynamic system

The thermodynamic interpretation of evolution in relation to entropy has utilized the concept of the Gibbs free energy, rather than entropy. This is because biological processes on Earth take place at roughly constant temperature and pressure, a situation in which the Gibbs free energy is a useful way to express the second law of thermodynamics.

The Gibbs free energy of a system at any moment in time is defined as the enthalpy of the system minus the product of the temperature times the entropy of the system. $G = H - TS$ or change in free energy

$$\Delta G \equiv \Delta H - T\Delta S$$

S=entropy

H = enthalpy passed into a thermodynamic system

G = Gibbs free energy

T = absolute temperature

The minimization of the Gibbs free energy is a form of the principle of minimum energy, which follows from the entropy maximization principle for closed systems. Moreover, the Gibbs free energy equation, in modified form, can be utilized for open systems, like biological systems.

In the book, Principles of Biochemistry, the American biochemist Albert Lehninger (1944) 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. In short, "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. Entropy means disorder: Less entropy compared to surroundings leads to orderliness defined by ordropy (Wilbur,1993). Thus we come to the conclusion that Order is living ; randomness is non living.

Origin and evolution of Life: Jain view

Jain philosophy considers jiva to be eternal and hence does not subscribe to the concept of origination of soul or life just as it does not subscribe to the concept of origination of the pudgal (matter) or the Universe; Jiva, like matter and the Universe, existed since eternity and will continue to exist for ever, albeit with continuous transformations. The universe or Loka consists of infinite number of souls. Soul and matter, in form of karmanus interact, attach and detach with each other and provide a purpose for existence of the universe as well as its cause. All the possible number of species exist all the time; there is no creation or origination, but there is transformation from one species into another, dictated by the karmas. This topic of Shrishtivada has been discussed elsewhere in detail (Bhandari et al, 2022) This is the Jain Steady State Theory of the universe, perennial, everlasting, without beginning or end.

Life in the Universe

According to Jainism, there are two reservoirs in the universe, where infinite number of souls exists: nigoda (extremely impure souls, with high karmic load) and siddha (pure souls). Nigoda is a single sensed *jivāstikāya*, with only one sense organ of "touch" having the lowest manifestation of consciousness and Siddha is the pure soul, *ātmā*, with consciousness fully manifested with no material particles (*karmānus*) attached. Jainism postulates that immobile nigoda souls can be embodied by earth, air, water, energy and plants and recognise 5 types of immobile living-beings, viz, earth-bodied (*prithvikāya*), water-bodied (*apkāya*), radiance-bodied (*Teukāya*), air-bodied (*vayukāya*) and plant-bodied (*Vanaspati kāya*) and all these are alive, with identical *ātmās*, similar to humans and other living beings; only their sensory organs have limitations. Earth, air, water, energy and plant products can exist in two forms: *sachitta* (conscious) and *achitta* (devoid of consciousness). Scientific models do not support this concept and, in contrast, claims that earth, air, water and energy are inert, non-living, material entities; only a century ago plant kingdom was recognised as living (J.C.Bose, 1926). But this is a very fundamental inference and we argue that this rises from the way life is defined. In Jain philosophy, any organised structure having negative entropy compared to its environment is defined as living or *sachitta*. Jainism proposes that when chemical, non-living, material structures are having a configuration suitable to sustain a particular type of life, an appropriate soul, from the Loka, descends in that molecular structure, called Yoni, and make it alive. Yoni is a pre-zygote-stage structure, capable of giving birth to a particular species. Such a scheme of structures exist for liquids, and gases, earth etc. also as mentioned by Jeo Raj Jain. Dr. Jack Szostak has also proposed similar mechanism for origin of life. We illustrate the concept of *achitta* and *sachitta* by discussing two cases: i) an electrolytic solution and ii) water which exists in three forms, steam, water and ice.

i) Case of ion chain formation in an electrolytic solution

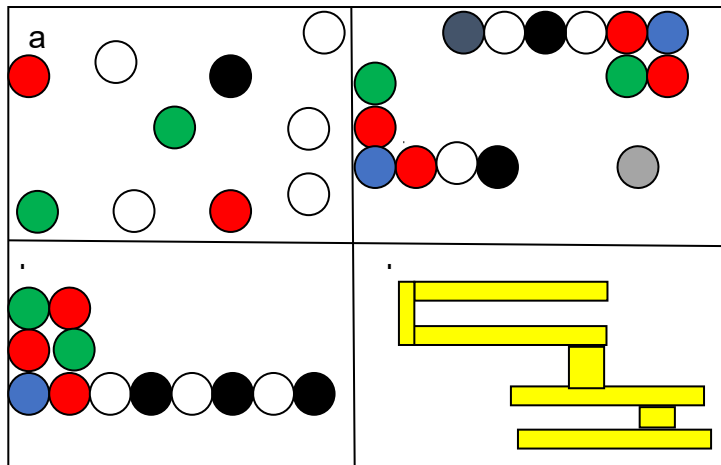


Fig. 1. Free floating ions, moving randomly exist in any electrolyte, as shown in upper left (a). Different cations and anions are shown by different colours. The energy is distributed uniformly, the motion is random and all components are in equilibrium. The liquid and ions can be considered as *achitta*, without any consciousness. The ions gradually come in contact with each other and form ionic chains, by partly satisfying their electrovalency (Lower left). A slight disturbance, such as vibration or heating disturbs and breaks these chains. And thus they can be supposed to have developed a sense of Touch. Given adequate time, they develop into long chains, by attracting different ions to fully satisfy their electrovalency, and subsequently multiply these chains. Subsequently, this can be thought to have developed a property of reproduction (right top). Ultimately they develop more stable configuration, longer chains and structures. The entropy decreases in this sequence, develop more negative entropy, and according to our definition become

sachitta. According to our proposed scheme this sequence represent sachitta grades 0, 1, 2, and 3. Such structures form in gases, liquids, soil, by electro-chemical bonding. whenever matter acquires any form of energy. large molecular structures thus acquire sachitta phase, but with a slight disturbance or vibration (touch), the structures break down and the matter becomes achitta. (from Wikipedia). This loop goes on, till it develops a yoni and a soul descends into it, making it sajiva. (Figure reproduced from Jain et al., 2017)

When a monovalent anion meets a monovalent cation, like Cl^- and Na^+ ions, they form NaCl but their valency is not fully (100%) satisfied, and some remnant valency remains dis-satisfied, leading to formation of chains due to delts bonds, with other suitable ion pairs. The same thing is true for divalent, trivalent ions etc. This is the basic mechanism by which long chains of ions can be formed. The entropy decreases sequentially as the chain grows and the system acquires more negative entropy. We can call it Sachitta, with a mild degree of consciousness, increasing gradually, as the chain grows. Such structures form in gases, liquids, solids etc, by electro-chemical bonding, whenever energy increases. Large molecular structures thus acquire sachitta phase, but with a slight disturbance or vibration (touch), the structures break down and the matter becomes achitta. This loop from sachitta to achitta and back goes on, till it develops a yoni, a structure suitable for sustaining some form of life, and a soul descends into it, making it sajiva. In this scheme of things, electrons, for example, when they flow in an organised manner and generate electricity, they can be considered as sachitta (living). This is the point when the living begins to emerge from non-living, by acquiring grades of chitta, and is consistent with Jain definition of living in which some forms of liquids, gases, solids (minerals), electricity etc. are considered to be life bearing. Some of them keep on oscillating between achitta and sachitta stages, depending upon their structural characteristics, phase and environment.

The cosmos may be extremely tenuous, a high vacuum state, but it is filled with all the elements of the periodic table, in cosmic proportion (see Jain, Jain and Bhandari, 2017). Because of the presence of stars which emit electromagnetic as well as corpuscular radiation, these elements exist in ionic form. The chance of their coming together is meagre but even so some ionic chains are expected to form under suitable conditions, in interstellar space, in molecular clouds and cis-stellar environment. Whether some of them make to the Yoni stage or not is debatable, but it is worth pondering over if these ionic chains constitute the nigodia jiva. This topic is beyond the scope of this paper and we confine here to the entropy based definition of life.

ii) We now take the case of water which exists in 3 temperature dependent phases, solid as snow and ice, liquid as water and steam as gas.

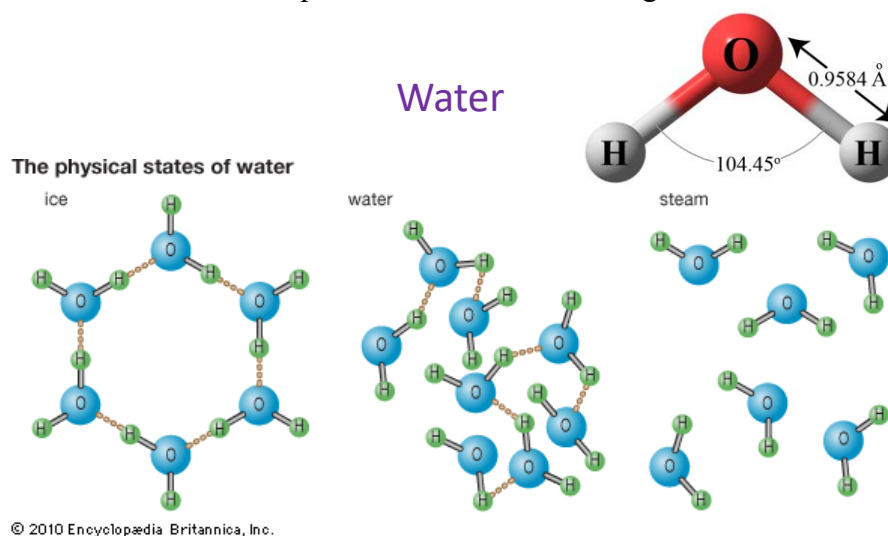


Fig. 2. A water molecule consists of two negatively charged hydrogen atoms (blue) at an angle of 104.5° , attached to a positively charged oxygen atom (red) through a chemical divalent bond. In steam, water molecule may float individually (lower right) but in liquid form (water) they do not remain independent and many of them join by a delta bond to form structures. At low temperature, as in ice, they form crystals. The entropy of structured water and ice crystals is negative compared to their surroundings. (Figure reproduced from Jain et al, 2017).

Thus with random motion of molecules, steam can be achitta, becoming sachitta when water molecules are organised and bonded together, further acquiring higher grade of chitta when it turns into snow crystals, entropy increasing sequentially in this progression. Boiling water, presence of some chemicals or mechanical disturbance may make it achitta whereas leaving it undisturbed may make it sachitta.

Thus we have shown that inorganic or organic molecular structures can have negative entropy compared to their surroundings, which keeps on decreasing as the orderliness increases, and, going through stages of increasing degrees of chitta and at some stage when it becomes a self sustaining system, a soul descends from the cosmos and can be called living or sajiva. This scheme may not be strictly in accordance with Agamic description, where in jiva and chitta (soul and its accompanying consciousness) are inseparable, but the graded sequence of sachitta helps us understand the physico-chemical processes and justify certain inert forms of matter as sachitta, as mentioned in Jain philosophy. We therefore believe that it is necessary to distinguish achitta, sachitta and sajiv phases, on one hand and jad and ajiva phases on the other, if we want to justify why certain inanimate phases of matter (fluids, gases, solids, energy forms, etc in certain orderly phases) are categorised as sachitta, in Jain philosophy. We may repeat here that according to the second law of thermodynamics, in purely physical structures, left to themselves, the entropy keeps on increasing with time. The Jain concept of living and non living is based on this concept of entropy.

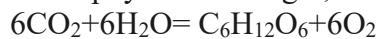
Discussions

According to Jain philosophy, the living beings consist of a sense-organ based, graded sequence starting with one-sensed to five sensed living beings, and ultimately to 5 sensed beings with psyche (mind). In this scheme, water, air, soil, energy, and plants are grouped together as single sensed organisms. The medical Sciences have long been denying that these

5 ‘things’ have life, consider them purely physical and disagreed with this classification that they are alive. We have argued above that a graded system starting with ajiva (non-living or Jad, incapable of developing into living), and gradually evolving in four stages i.e. achitta (non-living or devoid of consciousness, but capable of acquiring consciousness), Sachitta (conscious and capable of developing into living) and Sajiva (living) can explain many Jain concepts, like drinking only boiled water, life in water, gases, solids etc. as well as the latent energy content of certain compounds (Teu kāya), like fire wood, coal, nuclear energy, bioenergy, chemical energy etc. It all depends on the definition of life and if it accepted that order is a symptom of life, then everything falls in place. We may quote some recent thoughts of some scientists in this regard.

Jeremy England, a physicist at MIT, has proposed the idea that life exists because the law of increasing entropy drives matter to acquire life like physical properties, or we can say order. From the standpoint of physics, there is one essential difference between living things and inanimate clumps of carbon atoms: The former tend to be much better at capturing energy from their environment and dissipating that energy as heat. One starts with a random clump of atoms, and if one shines light on it for long enough, we might get a plant,” Claims Jeremy England . A plant, an organised carbon containing material, is much better at capturing and routing solar energy through itself than an unstructured heap of carbon atoms.

Photosynthesis involves Carbon di oxide and water converting into sugar in presence of chlorophyll and sunlight, according to the reaction:



In context of Jain proposition itar Nigod can turn into vanaspati, with an extremely low probability. If we define Vanaspati kaya as one using photosynthesis than the first molecule to form from the cosmic ionic structures of itar nigod should be sugar ($\text{C}_6\text{H}_{12}\text{O}_6$) in presence of chlorophyll ($\text{C}_{55}\text{H}_{72}\text{O}_5\text{N}_4\text{Mg}$).

England also argues that under certain conditions, matter will spontaneously self-organize. This tendency could account for the internal order of living things and of many inanimate structures as well. “Snowflakes, sand dunes and turbulent vortices all have in common that they are strikingly patterned structures that emerge in many-particle systems driven by some dissipative process,”

“Natural selection doesn’t explain certain characteristics,” said Ard Louis, a biophysicist at Oxford University. These characteristics include a heritable change to gene expression called methylation, increase in complexity in the absence of natural selection, and certain molecular changes.

If England’s approach stands up to more testing, it could further liberate evolutionists from seeking a Darwinian explanation for every adaptation and allow them to think more generally in terms of dissipation-driven organization. Physical and chemical constraints may be overpowering factors leading to evolution as has been argued by Bhandari et al (2022). This may also resolve the biggest problem between Jain theory of living, termed as *shristivada* (creationism) and evolutionary modern biology.

We have thus argued that entropy based definition makes it logical to understand that orderly structures of matter, like ice crystals, rock minerals, chemical, electrical, nuclear and thermal energy, all those which has negentropy, all are alive. They are orderly because they have developed a kind of *chitta*, or conscious phenomena. Under certain conditions they can go back to *achitta* form and can oscillate between *achitta* and *sachitta* state, depending on their environmental state. Under this scheme *sachitta* has to be distinguished from *sajiva*, or a material body with a soul. In Jain philosophy, soul and consciousness are inseparable, but the

scheme presented here requires *chitta*, associated with orderliness to exist independent of soul. A few more suggestions have been made in this article. Water should be generalised to fluids, air to gases, *prithvikaya* to solids and *teukay* to all forms of energy like thermal, electrical, nuclear and chemical etc. All these have one sense of touch, because vibrations or heating them can destroy their orderliness. Disturbing them is also a kind of mild violence. The main conclusion is that Jain philosophy considers *sachitta* as alive and the modern medical science considers *sajiv* as alive.

Some of the ideas mentioned here may have to be modified or improved. The main point is that in this hypothesis, *Chitta* and *Chetana* are different. Whereas a kind of *chitta* can develop when matter is in organised form, independently of *ātmā*, whereas *ātmā* is always associated with *chetana* or conscious activity.

Acknowledgements:

I thank Ashesha Parikh, Dr. S.S.Pokharna and Dr. A.K.Jain for useful discussions and suggestions.

References

- Acharya Mahaprajna, Agam sahitya mein Shrishtivada (in Hindi)
- Acharya Nandi Ghosh Vijayji (2020), kya virus sajiva hai ki nahin (in Hindi), Ahimsa world, 04-05, 33-44, World Jain Conferderation, Ahmedabad.
- Bhagavati Sutra (Bhagvai) (2005) Acharya Mahaprajna (Ed.), Tr. Muni Mahendra Kumar and Nath mal Tatia, Jain Vishva Bharati, Ladnun.
- Bhandari, Narendra (2020) Jambu Dvip related description in Jain Agams and its identification based on features of the solar system, Proceedings of Jain Academy of Scholars, Ahmedabad.
- Bhandari et al., 2021, Content and Sructure of Jain Lokakash, Dodecahedron Universe and living systems, 82-98, Proc. Jain Academy of Scholars, Ahmedabad.
- Bhandari, Narendra (2022) Theory of Matter in Jain Philosophy, (submitted)
- Bhandari Narendra, Anil Kumar Jain and M. S. Sisodia, (2022) Speciation model based on Jain theory of Shriṣṭivāda and limited intra-species Darwinian evolution, Jain Journal, pp.1-23, Jain Bhavan, Kolkata, July, 2022 issue.
- Bose, J.C. (1926) Mechanism of plants
- Brillouin, Leon (1953) "Negentropy Principle of Information", J. of Applied Physics, v. 24(9), pp. 1152–1163
- England, Jeremy (2022)
- Hameroff Stuart (2012) consciousness, Neurobiology and Quantum Mechanics: The case for a connection, in Exploring Frontiers of the Mind-Brain Relationship, Mindfulness in Behavioral Health, by A Moreira-Almedia and Santss F S (eds), Springer Science+ Business Media, chapter 6.
- Hoyle, F., Burbidge, G., Narlikar, J. V. (1995). "The

basic theory underlying the quasi-steady state cosmological model”. Proceedings of the Royal Society A 448:191.

Hameroff Stuart and Penrose Roger (2014) Consciousness in the universe A review of the ‘Orch OR’ theory, Physics of Life Reviews 11, 39–78.

Jain A.K. and Jain J.R. Earth Bodied Beings: Air- Bodied Organisms: Spontaneous Beings (Sammurchhana Jiva):

Jain Rajmal, Jain, J.R. and Narendra Bhandari (2017) Modern and Jain cosmology: A comparison, In scientific Perspectives of jainism, SamaniChaitanya Prajna, narendra Bhandari and N.L.Kachhara (Eds),461-488, jainnVishva Bharati institute, Ladnun.

Jain Jeo Raj, Dhovna water

Jain J.R., Bhandari, N. and Surana J.K. (2017) Jain Geography: a reappraisal, In Scientific Perspectives of Jainism, Samani Chaitanya Prajna, Narendra Bhandari and N.L.Kachhara (Eds). Jain Vishva Bharati, Ladnun.

Jain, R.M., Jain, J.R. and Bhandari, N. (2017) Modern and jain cosmology: A comparison, In Scientific Perspectives of Jainism, Samani Chaitanya Prajna, Narendra Bhandari and N.L.Kachhara (Eds), Jain Vishva Bharati, Ladnun. 460

Michaelian, K. (11 March 2011). ["Thermodynamic dissipation theory for the origin of life"](#). Earth System Dynamics. 2 (1): 37–

51. [arXiv:0907.0042](#). [Bibcode:2011ESD.....2...37M](#). [doi:10.5194/esd-2-37-2011](#). [ISSN 2190-4979](#). [S2CID 14574109](#).

Michaelian, Karo (2009). "Thermodynamic Origin of Life". Earth System Dynamics. 2 (1): 37–

51. [arXiv:0907.0042](#). [Bibcode:2011ESD.....2...37M](#). [doi:10.5194/esd-2-37-2011](#). [S2CID 14574109](#).

Miller, Stanley L. and Harold C. Urey (1959). "Organic Compound Synthesis on the Primitive Earth". [Science](#). **130** (3370): 245–51. [Bibcode:1959Sci...130..245M](#).

Narlikar, J. An Introduction to Cosmology ISBN-13:978-0521793766

Pokharna,S.S. and Romesh shah (2022) Forty seven powers of Aatma described in Jainism indicates its holographic structure” presented as a digital poster at the 27th international conference on The Science of Consciousness TSC2022, organized from April 18-22, 2022 by Center for consciousness studies, University of Arizona.

Pokharna, Surendra Singh (2022) “A comparative study of concept of consciousness in science and Jain Philosophy” project report submitted to Indian Council of Philosophical Research (ICPR), New Delhi.

Prasanna, A.R. (2017) The Enigma of time, In Scientific Perspectives of Jainism, Samani Chaitanya Prajna, Narendra Bhandari and N.L.Kachhara (Eds). Jain Vishva Bharati, Ladnun. 489-508.

Prigogine, I. (Ilya) (1967). Introduction to thermodynamics of irreversible processes. Interscience. [OCLC 1171126768](#)

Rangarajan, R. (2017) Cosmology :The story of our universe 447-460. In Scientific Perspectives of Jainism, Samani Chaitanya Prajna, Narendra Bhandari and N.L.Kachhara (Eds), Jain Vishva Bharati, Ladnun.

Samani Chaitanya Pragya (2017) Acharya Mahaprajna's Views on theory of Creation (srstivāda) in Jain Canonical literature, In Jain Philosophy : A scientific approach to reality, proc. Of International Conference on Science and Jain Philosophy, Mumbai, 2016. (Ed. Samani Chaitanya Prajna, N.L.Kachhara, N.Bhandari and K.P.Mishra, 1-21, Jain Vishva Bharati Institute, Ladnun.

Sarvartha siddhi, Acharya Puja Pad (1997) translated by Siddhantacharya Phoolchand Shastri, Bhartiya Jnana Pith, Delhi.

Schrödinger, Erwin, (1944) What is Life – the Physical Aspect of the Living Cell, Cambridge University Press,

Szent-Györgyi A. (1974)

Szostak J. (2014) The Origin of Life - Abiogenesis - www.youtube.com/watch?v=U6QYDdgP9eg

Tiloy Pannati by Acharya Yati Rishabh (ca. 6th century CE), Vol I, II and III, Hindi translation by Aryika Vishuddhimati Mataji, Shri Chandraprabha Digambar Atishay Kshetra Dehra, Tijara Alwar (Rajasthan)

Wikipedia. https://en.wikipedia.org/wiki/Entropy_and_life

Wilbur, Ken (1993) The spectrum of consciousness, Quest Books.