Life

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Abstract: To the life, the most important are two points: live and die. Conventionally, everybody of us thinks that all the life has a beginning as the birth and the end as the die. All plants and animals, including all the people must die. But, it is found that there is an animal named Turritopsis nutricula (a jellyfish) is immortal and this jellyfish can live forever. So the concept of our life property must be changed. Life is a physical and chemical process, it can be changed to non-life, also can keep the life forever. [Academia Arena, 2009;1(2):72-84]. ISSN 1553-992X.

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1. Introduction

We are life. To understand the nature of life is always a exciting topic in the human history. But, what life is? It never has a clear answer in the human history. As most people agree, life is a condition that distinguishes organisms from non-living objects, such as non-life, and dead organisms, being manifested by growth through metabolism and reproduction. Some living things can communicate and many can adapt to their environment through changes originating internally. A physical characteristic of life is that it feeds on negative entropy. In more detail, according to physicists such as Erwin Schrödinger, John Bernal, Eugene Wigner and John Avery, life is a member of the class of phenomena which are open or continuous systems able to decrease their internal entropy at the expense of substances or free energy taken in from the environment and subsequently rejected in a degraded form. From the biochemistry and molecular biology points, life is the chemical materials to exist in the earth that has neither special physic nor chemical property which is different from non-life. I insistant this point (Ma and Cherng, 2005).

From ontology aspect, the world is timeless and the life exists forever as any other body in the nature (Ma, 2003). The nature of life is that life is a process of negative entropy, evolution, autopoiesis (auto-organizing), adaptation, emergence and living hierarchy. Up to now, there is no scientific evidence to show that life body and non-life body obey the same natural laws. But, all the researches are made by the methods of biology, biochemistry and molecular biology, etc. It is very possible that the life and non-life are essential different in the biophysics, i.e. the quantum level. In the future, it is possible to make artificial life by either biological method or electronic technique, and keep life live forever, like Turritopsis nutricula.

Life is unique in the known universe, which is in a diversity of forms ranging from bacteria to human. The life organisms exist in everywhere of the earth. The first forms of life on earth spontaneously arose out of a preexisting prebiotic chemical soup. Individual living organisms maintain their self-identity and their self-organization while continually exchanging materials and energy and information with their environment. It is really different between the life and non-life bodies, but nobody knows what the exact difference it is, even this is one of the most important issues that attracted people in the whole human history. There are millions of people are working in life science researches, many with Ph.D. degree. More money has been spent in the life science studies than that spent in any other fields. Nature, Science, and other big journals published more papers in life science than the papers in any other topic. But, there are very few people are thinking about the nature of life. This topic has attracted thinkers since the beginning of human history, but ignored by the modern society. Most philosophers ignore the issue today, perhaps because it seems too scientific. At the same time, most scientists also ignore the issue, perhaps because it seems too philosophical. The nature of life is not clear for the current intelligence. It is a topic of philosophy, and also of biology (Bedau, 2005). However, it is very difficult to get financial support for the study of nature of life.

On the Earth, common life normally are: plants, animals, fungi, protists, archaea and bacteria, viruses, etc. All the life are composed of carbon, water, etc. to form the cells form with complex organization and heritable genetic information. The life undergoes metabolism, possess a capacity to grow, respond to stimuli, reproduce and, through natural selection, adapt to their environment in successive generations. An entity with the above properties is considered to be a living organism. However, not every definition of life considers all of these properties to be essential. In the life, virus is not cell.

2. Definition of Life

As the life is too complex and too many things are not clear, there is no universal definition of life. There is debate in the definition of the life. It is difficult to give an exact definition for the life, as the nature of life is not clear. As the references, here I give the definition from some dictionaries:

(1) My definition on the life

- Spiritual existence transcending physical death; the period from birth to death; the quality that makes living animals and plants different from dead organisms and inorganic matter. Its functions include the ability to take in food, adapt to the environment, grow, and reproduce (Encarta® World English Dictionary, 2005).
- The condition that distinguishes animals and plants from inorganic matter, including the capacity for growth and functional activity (Compact Oxford English Dictionary, 2005).
- The property or quality that distinguishes living organisms from dead organisms and inanimate matter, manifested in functions such as metabolism, growth, reproduction, and response to stimuli or adaptation to the environment originating from within the organism (Dictionary.com, 2005).

(2) Conventional definition:

Life is a characteristic of organisms that exhibit the following phenomena:

- **Homeostasis**: Regulation of the internal environment to maintain a constant state; for example, sweating to reduce temperature.
- **Organization**: Being composed of one or more cells, which are the basic units of life.
- **Metabolism**: Consumption of energy by converting nonliving material into cellular components and decomposing organic matter. Living things require energy to maintain internal organization (homeostasis) and to produce the other phenomena associated with life.
- **Growth**: Maintenance of a higher rate of synthesis than catalysis. A growing organism increases in size in all of its parts, rather than simply accumulating matter. The particular species begins to multiply and expand as the evolution continues to flourish.
- **Adaptation**: The ability to change over a period of time in response to the environment. This ability is fundamental to the process of evolution and is determined by the organism's heredity as well as the composition of metabolized substances, and external factors present.
- **Response to stimuli**: A response can take many forms, from the contraction of a unicellular organism when touched to complex reactions involving all the senses of higher animals. A response is often expressed by motion, for example, the leaves of a plant turning toward the sun or an animal chasing its prey.
- **Reproduction**: The ability to produce new organisms. Reproduction can be the division of one cell to form two new cells. Usually the term is applied to the production of a new individual, although strictly speaking it also describes the production of new cells in the process of growth.

(2) Proposed definition:

- Living things are systems that tend to respond to changes in their environment, and inside themselves, in such a way as to promote their own continuation.
- Life is defined as a network of inferior negative feedbacks subordinated to a superior positive feedback.
- Life is a characteristic of self-organizing, self-recycling systems consisting of populations of replicators that are capable of mutation, around most of which homeostatic, metabolizing organisms evolve.
- Type of organization of matter producing various interacting forms of variable complexity, whose main property is to replicate almost perfectly by using matter and energy available in their environment to which they may adapt. In this definition almost perfectly relates to mutations happening during replication of organisms that may have adaptive benefits.

- Life is a potentially self-perpetuating open system of linked organic reactions, catalyzed simultaneously and almost isothermally by complex chemicals that are themselves produced by the open system.

3. Essential Conceptions of Life

The biological world is viewed as a hierarch of levels. These levels include chemicals, organelles, cells, organs, organisms, and ecologies. There are three conceptions for life: as a loose cluster of properties, a specific set of properties, and metabolization. There are many other opinions of life, such as that life is something of autopoiesis and self-replication, etc. Several hundred years ago, people thought that there was a vitalism inside life bodies that keep the body to be a life. The scientific results absolutely denied the existence of vitalism. The demise of vitalism told us that no super physical substance or force or spirit to distinguish any life from non-life. For all we know, all life phenomena obey to all the natural laws (physical and chemical) that adapted to the non-life world. There is no any extra natural law for the life world only. Life is no more unified than a collection of overlapping properties from overlapping disciplines, such as, biophysics, biochemistry, molecular biology, genetics, evolution, ecology, cytology, microbiology, physiology, anatomy and heredity, etc. However, the biophysics is poor result.

Farmer and Belin listed eight characteristics of the life: process, self-reproduction, information storage of self-representation, metabolism, functional interactions with the environment, interdependence of parts, stability under perturbations, and the ability to evolve. According to Farmer and Belin, life is a pattern of spacetime, rather than the specific identities of the atoms (Farmer, 1992).

Taylor described the properties of life: "Each property by itself, even when considered with others, is unable to clearly delineate the living from the non-living, but together they do help to characterize what makes living things unique" (Taylor, 1992).

Monod listed three characteristics of life: teleonomic or purposeful behavior, autonomous morphogenesis and reproductive invariance (Monod, 1971). Crick focused on the points related to: self-reproduction, genetics, evolution and metabolism (Crick, 1981). Küppers pointed life as: metabolism, self-reproduction and mutability (Küppers, 1985). Maynard Smith gave life two properties: metabolism and parts with functions (Maynard, 1986). Ray cited two aspects: self-reproduction and the capacity for open-ended evolution (Ray, 1992).

Mayr thought that the process of living could be defined by a list of the kinds of characteristics by which living organisms differ from inanimate matter:

(1) All levels of living systems have an enormously complex and adaptive organization.

(2) Living organisms are composed of a chemically unique set of macromolecules.

(3) The important phenomena in living systems are predominantly qualitative, not quantitative.

(4) All levels of living systems consist of highly variable groups of unique individuals.

(5) All organisms possess historically evolved genetic programs which enable them to engage in teleonomic processes and activities.

(6) Classes of living organisms are defined by historical connections of common descent.

(7) Organisms are the product of natural selection.

(8) Biological processes are especially unpredictable (Mayr, 1982).

(8) Life is continuum.

(9) All life organisms are programmed to death naturally, which is called apoptosis (Ma, 2005b).

Schrödinger persisted that the second law of thermodynamics plays key role in the process of metabolization. The following sentences give his opinions: What is the characteristic feature of life? When is a piece of matter said to be alive? When it goes on doing something, moving, exchanging material with its environment, and so forth, and that for a much longer period than we would expect an inanimate piece of matter to keep going under similar circumstances. How does the living organism avoid decay? The obvious answer is: By eating, drinking, breathing and assimilating. Linguistically, the scientific term of life is metabolism. The essential thing in metabolism is that the organism succeeds in freeing itself from all the entropy (Schrödinger, 1969).

4. Origin of Life

Life on Earth has existed for about 3.7 billion years. Plausible pre-biotic conditions result in the creation of the basic small molecules of life. This was demonstrated in the Miller-Urey experiment, and in the work of Sidney Fox. Phospholipids spontaneously form lipid bilayers, the basic structure of a cell membrane. Procedures for producing random RNA molecules can produce ribozymes, which are able to produce more of themselves under very specific conditions.

When the earth formed about 4.6 billion years ago, it was a lifeless place. A billion years later it was teeming with organisms such as blue-green algae. How did life begin? The discovery of self-replicating RNA was a critical milestone on the road to life. Before the mid-17th century, most people believed that God had created humankind and other organisms by mud. For the next two centuries, those ideas were subjected to increasingly severe criticism.

In 1903, Svante Arrhenius proposed that life on the Earth was seeded by spores originating from another planet. In 1905, the astronomer Simon Newcomb proposed that because the Earth was a representative planet orbiting a representative star Sun, life could be abundant throughout the universe (Zubay, 2000). But up to now, there is no discovery of the life existing in another planet.

All living things consist of similar organic compounds. Proteins in all organisms are consisted by one set of 20 amino acids. These proteins include enzymes that are essential to live, develop and reproduce, and the protein that essential to the organism structure. Organisms carry their genetic information in nucleic acids RNA and DNA, and use them as the same genetic code. This code specifies the amino acid sequences of all the proteins and peptides in each organism. The nucleotides consist of a sugar (deoxyribose in DNA and ribose in RNA), a phosphate group and one of four different bases. In DNA, the bases are adenine (A), guanine (G), cytosine (C) and thymine (T). In RNA, uracil (U) substitutes for T. The bases constitute the alphabet, and triplets of bases form the words as the genetic codes. As an example, the triplet CUU in RNA instructs a cell to add the amino acid leucine to a growing strand of protein when the protein is synthesized. Organisms store genetic information in nucleic acids that specified the composition of all sythesized proteins. It relies on proteins to play the biological metabolism processes.

There is a paradox. Nowadays nucleic acids are synthesized only with the catalyzing of proteins, and proteins are synthesized only with the coding of nucleic acids. It is impossible that proteins and nucleic acids arose spontaneously in the same place at the same time. It is also impossible to have one without the other. And so, at first glance, one might have to conclude that life could never have originated by chemical means. In the fact, RNA came first and established what is now called the RNA world - a world in which RNA catalyzed all the reactions necessary for a precursor of life's last common ancestor to survive and replicate. RNA has developed the ability to code amino acids to synthesize proteins. The modern RNA viruses are still use RNA as their genetic codes. The ribonucleotides in RNA are more readily synthesized than are the deoxyribonucleotides in DNA. Moreover, DNA could evolve from RNA and then take over RNA's role as the heredity. In fact, RNA came before proteins. In 1983 Thomas Cech at University of Colorado and Sidney Altman at Yale University discovered the first known ribozymes, enzymes made of RNA. The first ribozymes identified could do little more than cut and join preexisting RNA. Nevertheless.

As the experiments to reveal the original origin of life in the Earth, in the early 1950s Stanley Miller, working in the laboratory of Harold C. Urey at the University of Chicago, did the first experiment to clarify the chemical reactions that occurred on the primitive earth. In the flask at the bottom, he heated water and forced water vapor to circulate through the apparatus. The flask at the top contained an atmosphere consisting of methane (CH4), ammonia (NH3), hydrogen (H2) and the circulating water vapor. Next he exposed the gases to a continuous electrical discharge, causing the gases to interact. Water soluble products of those reactions then passed through a condenser and dissolved in the mock ocean. The experiment yielded amino acids and enabled Miller to explain how they had formed. For instance, glycine appeared after reactions in the atmosphere produced simple compounds formaldehyde and hydrogen cyanide that participated in the set of reactions that took place. For the above experiments, one heavy critics is that the so called amino acid products coming from bacteria contamination. Bacteria exist everywhere in the Earth and it is very possible to get the bacterial contamination in the experiments.

Stem cell is the origin of an orgnism's life. Stem cells have the remarkable potential to develop into many different cell types in life bodies, that are exciting to scientists because of their potential to develop into many different cells, tissues and organs. Stem cell is totipotent and it is a single cell that can give rise to progeny that differentiate into any of the specialized cells of embryonic or adult tissue. The ultimate stem cells (fertilized egg) divides to branches of cells that form various differentiated tissues or organs. During these early decisions, each daughter cell retains totipotency. Through divisions and differentiations the embryonic stem cells lose totipotency and gain differentiated function. During normal tissue renewal in adult organs, tissue stem cells give rise to progeny that differentiate into mature functioning cells of that tissue. Stem cells losing totipotentiality are progenitor cells. Except for germinal cells, which retain totipotency, most stem cells in adult tissues have reduced potential to produce cells of different types (Ma, 2005c).

The Panspermia hypothesis proposes that life originated elsewhere in the universe and was subsequently transferred to Earth perhaps via meteorites, comets or cosmic dust. There are many different hypotheses regarding the path that might have been taken from simple organic molecules via pre-cellular life to protocells and metabolism. Many models fall into the "genes-first" category or the "metabolism-first" category, but a recent trend is the emergence of hybrid models that do not fit into either of these categories.

5. Nature of Life

As it was described in another paper “The nature of time and space”: From the ontology (or naturalism) angle, time and space are absolute (existed) and the universe is a timeless world, which means that all the past, the present and the future exist eternally. Everything in the universe will never change. Time and motion are nothing more than illusions. In the universe, every moment of every individual's life - birth, death, and anything in between - exists forever. Everyone is eternal. That means each and every one of us is immortal. The universe has neither past nor future. All the things in the past, present, and future exist forever. The concepts of past, present and future are depended on the human brain” (Ma, 2003). Life is something (substance) existing in the timeless world. So that, all the life processes are the simple existence of something in the universe, like a movie in a tape – exist already and forever. This is the essential nature of life, in the ontology point. Under the timeless principle, there is only existence in the universe, not something complexity and other thing simplicity. The life is not more complex than non-life from the ontological concept. However, in the timeless world, there are natural connections among the all the existence. All the scientific studies, philosophical ratiocinations and religious believe are the trial to reveal the natural rules.

The second law of thermodynamics was formulated in the middle of the last century by Clausius and Thomson, which could be formulated in four different ways:

(1) Heat cannot flow from a colder body to a hotter one without energy input.

(2) Entropy must increase in a closed system.

(3) No cyclic process can convert heat entirely to work.

(4) In any cyclic process the heat Q transferred to the system from its surroundings at the temperature T must obey an inequality: $\oint dQ/T<0$ (Ma, 2003).

Above the four points, the principle concept of the second law of thermodynamics is to say that in the closed system all the natural processes increase entropy (decrease order). So, the second law of thermodynamics can be called the entropy law or law of entropy. However, life violates the second law of thermodynamics. In the natural world, the life process is negative entropy one. In the life process, the entropy decreases, which means that the order increases. More importantly, there is no evidence to say that the entropy decrease of life costs by the entropy increase of environment. The conclusion is that the life process does not obey the second law of thermodynamics. For all we know that all life phenomena obey to the entire natural laws that adapted to the non-life world. How can we say that life violates the second law of thermodynamics? Is there any conflict? The answer is that there is no conflict here. As it was described in the article “The nature of time and space”, “the second law of thermodynamics is a statistical result, ……, the basic statistical principles and the second law of thermodynamics are useful tools in human practice, but they are not the true natural existence” (Ma, 2003). The fact is that the life process does not obey the second law of thermodynamics, but it obeys all the natural laws. The second law of thermodynamics is not a natural law, but a technical tool.

Autopoiesis is the process whereby an organization produces itself. An autopoietic organization is an autonomous and self-maintaining unity which contains component-producing processes. The components, through their interaction, generate recursively the same network of processes which produced them. An autopoietic system is operationally closed and structurally state determined with no apparent inputs and outputs. A cell and an organism is an autopoietic system. Autonomy is the condition of subordinating all changes to the maintenance of the organization. Self-asserting capacity of living systems maintain their identity through the active compensation of deformations. Allopoiesis is the process whereby an organization produces something other than the organization itself. An assembly line is an example of an allopoietic system (Varela, 2005). Life is an emergent property of autopoietic, dissipative systems. Life is an autopoiesis (auto-organizing) complex, which can organize itself without energy input, even without information input. Active life process costs energy and uses information. However, the cost of energy is not the requirement of energy by the second law of thermodynamics. It cannot stay long period without energy and information input. After a while without exchange energy and information with outside world, the active life will die.

6. Evolution, Creation and Adaptation

Evolution theory is one of the most important theories in science. The evolution of life shows a remarkable growth in complexity. Simple prokaryotic one-celled life leads to more complex eukaryotic single-celled life, which then leads to multicellular life, then to large-bodied vertebrate creatures with sophisticated sensory processing capacities, and ultimately to highly intelligent creatures that use language and develop sophisticated technology as human. Creation theory is to say that the life is not evolution but created by God, and all the species do not change forever. The interest thing is that many scientists are strongly believe creation in their non-work time, which means that the scientists believe Bible when they are in their churches in their religious time (normally in the weekend) or when they spend time in their Bible studies. However, these scientists never do anything following creation theory in their work time, which means that they never do any experimental or publish any thing in the academic journals or teach students to support creation opinions. In the work time they need to do something that positive for their life as their income comes from the work, and non-work time they can do anything what they want.

Gene transfer is to transfer a gene from one DNA molecule to another DNA molecule, which can change the genetic background of an organism in anyway we want (Ma, 2005a). The evolution happens naturally, and also can happen artificially by gene transfer technique. Cloning creates a genetically identical copy of an animal or plant, which can be done in all the kinds of living things, including human being. Transgenic animal and clone for the study of gene regulation and expression has become commonplace in the modern biological science now (Pinkert, 1999). The sheep Dolly was the world's most famous clone animal, but it was not the first one. Many animals - including frogs, mice, sheep and cows had been cloned before Dolly. Plants have been often cloned since ancient people. Human identical twins are also clones. Dolly was the first mammal to be cloned from an adult cell, rather than an embryo. This was a major scientific achievement of Dolly, but also raised scientific and ethical concerns. Since Dolly was born in 1996, many other animals have been cloned from adult cells, such as mice, pigs, goats and cattle, etc. Cloning by interspecies nuclear transfer offers the possibility of keeping the genetic stock of those species on hand without maintaining populations in captivity (Lanza, 2002) and change the species, but also possibly creates the risk of biological calamity (Ma, 2004).

Adaptive evolutionary explanations are familiar to all of us from elementary school biology. A classic application of adaptationism is to explain the giraffe’s long neck as an adaptation for browsing among the tops of trees, on the grounds that natural selection favored longer-necked giraffes over their shorter-necked cousins. There are alternatives to adaptive explanations, such as explanations appealing to allometry, genetic drift, developmental constraints, genetic linkage, epistasis, and pleiotropy. The presupposition that a trait is an adaptation and so deserves an adaptive explanation is usually treated as unfalsifiable. The adaptationist perspective on evolution emphasizes natural selection’s role in creating the complex adaptive structures found in living systems. The important feature for all life is the evolutionary process of adaptation. For the evolution, it is sometimes the blind operation of natural selection, sometimes the general process of evolution, and sometimes the adaptation produced by the evolution. Normally the life should have the ability to adapt appropriately to unpredictable changes in the environment. It is the force of adaptation and selection that makes the evolution happens. The adaptation is supple.

Both living systems and artificial life models are commonly said to exhibit emergent phenomena. Emergent phenomena share two characterizations: they are constituted by and generated from underlying phenomena, and they are autonomous from those underlying phenomena. There are three main points for emergent properties. The first key point of emergence is simply the idea of a property that applies to wholes or totalities but does not apply to the component parts considered in isolation. The second key point of emergence is to insist that emergent properties are supervenient properties with causal powers that are irreducible to the causal powers of micro-level constituents. The third key point of emergence is poised midway between the other two.

7. Classification of Life

The hierarchy of scientific classification's major eight taxonomic ranks. Life is divided into domains, which are subdivided into further groups. Intermediate minor rankings are not shown. Traditionally, people have divided organisms into the classes of plants and animals, based mainly on their ability of movement. The first known attempt to classify organisms, as per personal observations, was conducted by the Greek philosopher Aristotle.

He classified all living organisms known at that time as either a plant or an animal. Aristotle distinguished animals with blood from animals without blood, which can be compared with the concepts of vertebrates and invertebrates respectively. He divided the blooded animals into five groups: viviparous quadrupeds, birds, oviparous quadrupeds, fishes and whales. The bloodless animals were also divided into five groups: cephalopods, crustaceans, insects, shelled animals and "zoophytes". Though Aristotle's work in zoology was not without errors, it was the grandest biological synthesis of the time, and remained the ultimate authority for many centuries after his death. His observations on the anatomy of octopus, cuttlefish, crustaceans, and many other marine invertebrates are remarkably accurate, and could only have been made from first-hand experience with dissection.

The exploration of parts of the New World produced large numbers of new plants and animals that needed descriptions and classification. The old systems made it difficult to study and locate all these new specimens within a collection and often the same plants or animals were given different names because the number of specimens were too large to memorize. A system was needed that could group these specimens together so they could be found, the binomial system was developed based on morphology with groups having similar appearances. In the latter part of the 16th century and the beginning of the 17th, careful study of animals commenced, which, directed first to familiar kinds, was gradually extended until it formed a sufficient body of knowledge to serve as an anatomical basis for classification.

The Fungi have long been a problematic group in the biological classification: Originally, they were treated as plants. For a short period Linnaeus had placed them in the taxon Vermes in Animalia because he was misinformed: the hyphae were said to have been worms. He later placed them back in Plantae. Copeland classified the Fungi in his Protoctista, thus partially avoiding the problem but acknowledging their special status. The problem was eventually solved by Whittaker, when he gave them their own kingdom in his five-kingdom system. As it turned out, the fungi are more closely related to animals than to plants.

As new discoveries enabled us to study cells and microorganisms, new groups of life where revealed, and the fields of cell biology and microbiology were created. These new organisms were originally described separately in Protozoa as animals and Protophyta/Thallophyta as plants, but were united by Haeckel in his kingdom Protista, later the group of prokaryotes were split of in the kingdom Monera, eventually this kingdom would be divided in two separate groups, the Bacteria and the Archaea, leading to the six-kingdom system and eventually to the three-domain system. The 'remaining' protists would later be divided into smaller groups in clades in relation to more complex organisms. Thomas Cavalier-Smith, who has published extensively on the classification of protists, has recently proposed that the Neomura, the clade which groups together the Archaea and Eukarya, would have evolved from Bacteria, more precisely from Actinobacteria.

As microbiology, molecular biology and virology developed, non-cellular reproducing agents were discovered, sometimes these are considered to be alive and are treated in the domain of non-cellular life named Acytota or Aphanobionta, which are virus. All the primary taxonomical ranks are established: Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species. Since the 1960s a trend called cladistics has emerged, arranging taxa in an evolutionary or phylogenetic tree. If a taxon includes all the descendants of some ancestral form, it is called monophyletic, as opposed to paraphyletic, groups based on traits which have evolved separately and where the most recent common ancestor is not included are called polyphyletic. A new formal code of nomenclature, the PhyloCode, to be renamed International Code of Phylogenetic Nomenclature, is currently under development, intended to deal with clades, which do not have set ranks, unlike conventional Linnaean taxonomy. It is unclear, should this be implemented, how the different codes will coexist.

Living phenomena fall into a complex hierarchy of levels, what can be called the *vital hierarchy*. Even broad brush strokes can distinguish at least eight levels in the vital hierarchy:

(1) Ecosystems.
(2) Communities.
(3) Populations.
(4) Organisms.

(5) Organ systems (immune system, cardiovascular system).
(6) Organs (heart, kidney, spleen).
(7) Tissues.
(8) Cells.

Under the life hierarchy, there are molecules, atoms and quanta that are substance but not life constituents. Items at one level in the hierarchy constitute items at higher levels. Individual organisms are born, live for a while, and then die. The vital hierarchy raises two basic kinds of questions about the nature of life. First, we may ask whether there is some inherent tendency for living systems to form hierarchies. Why are hierarchies so prevalent in the phenomena of life? The second question concerns the relationships among the kinds of life exhibited throughout the vital hierarchy. Are there different forms of life at different levels, and if so then how are these related? How are they similar and different? Which are prior and which posterior? What is the primary form of life?

The theory supple adaptation reveals a two-tier structure with connected but different forms of life. The first tier is the primary form of life - the supplely adapting systems. At the second tier, entities that are suitably generated and sustained by such a supplely adapting system branch off as different but connected secondary forms of life. These secondary forms of life include organisms, organs, and cells.

8. Matter and Form of Life

The advent of the field of artificial life has focused attention on a set of questions about the role of matter and form in life. On the one hand, certain distinctive carbon-based macromolecules play a crucial role in the vital processes of all known living entities; on the other hand, life seems more like a kind of a process than a kind of substance. Furthermore, much of the practice of artificial life research seems to presuppose that life can be realized in a suitably programmed computer. This raises a number of related questions: Can a computer play all the functions of the organic life play? Is the natural life just substance properties what the substance has or life has independent proper that performs by the substance? Functionalism captures the truth about life. Furthermore, there is no evident reason why the functional structure specified the theory could not be realized in a suitably structured computational medium. If so, then a computerized "life" could in principle create a real, literally living entity. In fact, a computer can play many functions of the organic life play, but could not play all the functions of the organic life play, because the matter is essential different. The natural life is dependent on the substance of the life bodies.

According to the classic science, there are two independent existences in the world: matter and space. Matter occupies space and moves about in it and it is the primary reality. Space is a backdrop or container. Without furnished by material bodies, it does not enjoy reality in itself. This common sense concept goes back to the Greek materialists and it was the mainstay also of Newton's physics. It has been radically revised in Einstein's relativistic universe (where spacetime became an integrated four-dimensional manifold), and also in Bohr's and Heisenberg's quantum world. Now it may be considered that matter and space are unified. Advances in the new sciences suggest a further modification of this assumption about the nature of reality. In light of what scientists are beginning to glimpse regarding the nature of the quantum vacuum, the energy sea that underlies all of spacetime, it is no longer warranted to view matter as primary and space as secondary. In the modern concept there is no absolute matter, but only a matter generating energy field.

Could robot do all the things what human do? Could artificial electronic life play all the functions what the organic life play? Up to now, nobody can answer these questions. In 1966, John von Neumann made the first artificial life model with his famous creation of a self-reproducing, computation-universal entity using cellular automata. Von Neumann was pursuing many problems that are important in the artificial life today, such as understanding the spontaneous generation and evolution of complex adaptive structures. Originally, cybernetics applied two tools to the living system studies: the use of information theory and a deep study of the self-regulatory processes. Information theory typifies the abstractness and material-independence of artificial life, and self-regulation is one of the hallmarks of living systems studied in artificial life.

Biology studies have provided rich knowledge about actual living systems. Physics and mathematics have had a strong influence on artificial life, especially in the study of complex systems. Statistical mechanics and dynamical systems theory have improved artificial life's methodology. The real artificial life should be organic life, same as the natural life. Right now, people can synthesize simple organic molecules such as sugar and amino acids from the inorganic carbon, hydrogen and oxygen. Just after the technique developing, people will have the ability to make the real cells, tissues, organs and animals even a real human. This will be the real artificial life – everything is same as the natural life.

It is an essential philosophical question whether there is any intrinsic connection between life and mind. Viruses, plants, bacteria, worms, animals and human have various kinds of sensitivity to the environment, various ways in which this environmental sensitivity affects their behavior and various forms of inter-organism communication. Various kinds of what one could call mental capacities are present throughout the biosphere. Furthermore, the relative sophistication of these mental capacities seems to correspond to and explain the relative sophistication of those forms of life. It is reasonable to ask whether life and mind have some natural connection. The process of evolution establishes a genealogical connection between life and mind, but life and mind might be much more deeply unified. Since all forms of life must cope in one way or another with a complex, dynamic, and unpredictable world, perhaps this adaptive flexibility inseparably connects life and mind. In fact, the mind comes from brain that composes by the organic molecules and the organic molecules compose by inorganic matter. But, there is no evidence to say that the inorganic matter in the living organism is different from the inorganic matter out the living organism.

Up to now, no scientific evidence to show that life body and non-life body obey the different natural laws. By the classic physics and chemistry, there is no essential difference discovered in life and non-life. There is no lifeline defined by modern science, this means that we neither qualitate nor quantitate life by any current scientific method. However, all the researches are made by the methods of biology, biochemistry and molecular biology, etc., which means that all current biological and neurobiological descriptions of the life and brain are based on Newton's physics, even if it is well known that Newton's physics has its limitations. Biophysics has started for several decades and it did not get many achievements. Up to now, nobody tried to reveal the nature of life under the quantum level. It is reasonable to think about that the life and non-life are essential different in the biophysics, i.e. the quantum level. The life phenomenon, especially consciousness, is unlikely to arise from classical properties of matter. Quantum theory allows for a new concept of matter altogether, which may well leave cracks for life and consciousness, for something that is not purely material or purely extra-material. Interactions with the quantum vacuum may not be limited to micro-particles: they may also involve macroscale entities, such as living systems. The recognition of openness is returning to the natural sciences. Traffic between our consciousness and the rest of the world may be constant and flowing in both directions. Everything that goes on in our mind could leave its wave traces in the quantum vacuum, and everything could be received by those who know how to tune in to the subtle patterns that propagate there.

All the life organisms compose by organic molecules plus their inner environment such as inorganic water and ions (and specific fields) inside and outside the cells. The whole life world finally composes by an organic world, and even though all organic molecules compose by inorganic substance. But, nobody knows if the water in alive cells and around cells is same or different from the water far away from the cells (under the living meaning). It is possible that the inorganic environment of living cell is different from non-living environment in the quantum level. This is the principle task for biophysics doing to reveal the nature of life.

9. Apoptosis of Life

For all the things existed, including the life cells in the earth and universe itself, there is a time to live and a time to die. There are two ways in which cells die:

(1) Cells are killed by injury or disease.

(2) Cells suicide. Programmed cell death is also called apoptosis, which is cell suicide. Apoptosis is a mechanism by which cells undergo death to control cell proliferation or in response to DNA damage. Some types of cancers, such as B-cell chronic lymphocytic leukemia, follicular lymphoma (Tsujimoto, 1985) and tumors infected by human T-cell leukemia/lymphoma virus-1 (Hengartner, 2000) are characterized by defects in apoptosis leading to immortal clones of cells. Other malignancies have defects in the apoptotic regulatory pathways such as p53 (Kaufmann, 2001).

Apoptosis can be triggered by the following internal signals:

(1) In a healthy cell, the outer membranes of its mitochondria express the protein Bcl-2 on their surface.

(2) Bcl-2 is bound to a molecule of the protein Apaf-1.

(3) Internal damage to the cell (e.g., from reactive oxygen species) causes: Bcl-2 to release Apaf-1; a related protein, Bax, to penetrate mitochondrial membranes, causing; cytochrome c to leak out.

(4) The released cytochrome c and Apaf-1 bind to molecules of caspase-9.

(5) The resulting complex of cytochrome c, Apaf-1, caspase-9 and ATP is called the apoptosome.

(6) These aggregate in the cytosol.

(7) Caspase-9 is one of a family of over a dozen caspases. They are all proteases. They get their name because they cleave proteins — mostly each other — at aspartic acid (Asp) residues.

(8) Caspase-9 cleaves and activates other caspases.

(9) The sequential activation of one caspase by another creates an expanding cascade of proteolytic activity, which leads to digestion of structural proteins in the cytoplasm, degradation of chromosomal DNA, and phagocytosis of the cell.

Apoptosis can be triggered by external signals also:

(1) Fas and the TNF receptor are integral membrane proteins with their receptor domains exposed at the surface of the cell.

(2) Binding of the complementary death activator (FasL and TNF respectively) transmits a signal to the cytoplasm that leads to activation of caspase 8.

(3) When cytotoxic T cells recognize their target, they produce more FasL at their surface. This binds with Fas on surface of the target cell leading to its death by apoptosis.

Apoptosis is a universal event in the universe, that happens in all the life bodies and azoic things in the universe, including the universe itself. To understand apoptosis clearly will be important to the understand of the basic nature laws (Ma, 2005b). Apoptosis is the nature of life, and apoptosis is also the nature of nature!

10. Immortality of Life and Turritopsis nutricula

Can things be more or less alive? Serious reflection about life quickly raises the question whether life is a boolean property (zero or one) - whether it is a continuum property. We can say that a rat is alive and a rock is not alive. But it is difficult to say some condition of living body is alive or not, such as a virus which is unable to replicate without a host and spores or a frozen cell which remain dormant and unchanging indefinitely but then come back to life when conditions become suitable. Furthermore, we all agree that the original life forms somehow emerged from a pre-biotic chemical soup, and this suggests that there is very little, if any, principled distinction between life and non-life. In fact, life is continuum and it can be more or less alive. There is no absolute line between life and non-life. If life is considered as supple adaptation the most important life/non-life distinction involves a continuum because the activity of supple adaptability comes in degrees.

Turritopsis nutricula is a hydrozoan that can revert to the sexually immature (polyp stage) after becoming sexually mature. It is the only known metazoan capable of reverting completely to a sexually immature, colonial stage after having reached sexual maturity as a solitary stage. It does this through the cell development process of transdifferentiation. This cycle can repeat indefinitely tha offers it biologically immortal. Upto now, there is little academic report in the Turristopsis nutricula studies. To study the reason of the biological immortality of Turritopsis nutricula possibly supplies the way finding the biological immortality for human.

Turritopsis nutricula is a species of jellyfish with a very unusual quality: it is biologically immortal. Also known as the "Immortal Jellyfish," this fascinating animal, in theory, has the ability to sustain life indefinitely, so long as its nerve center remains intact.

Typically, jellyfish die after reproducing, but the Immortal Jellyfish is capable of returning to a polyp after producing offspring. This essentially means that this type of jellyfish is able to return itself to a much younger state. As a result of reversing its life cycle, the Immortal Jellyfish can evade death. If the jellyfish continues to reverse its life cycle following reproduction, it can live on for an indefinite period. In laboratory tests, the species reverted back to the immature polyp stage 100% of the time.

Turritopsis nutricula is capable of rejuvenating itself due to a process called transdifferentiation. Transdifferentiation occurs when a non-stem cell turns itself into another type of cell. For example, in salamanders it has been observed that if the lens of the eye is removed, iris cells can transform themselves into lens cells. Transdifferentiation is rare, and when it does occur, it most commonly occurs in parts of the organsism, like in the eye of the salamander. However, the Immortal Jellyfish has incorporated transdifferentiation into its lifecycle. In the process, all of the old cells are regenerated. At the end of the cycle, the Immortal Jellyfish is a young polyp, ready to start life anew (Wendy, 2009).

While colonial animals can have their immortality, solitary individuals are doomed to die. Hydrozoan cnidarians usually have a complex life cycle, wherein a colonial stage leads to the sexually mature, solitary, adult stage. Eggs and sperms from solitary, sexual, adult medusa (jellyfish) develop into an embryo and planula larva, and they then form the colonial polyp stage. Medusae are formed asexually from polyps. These medusae have a limited lifespan and die shortly after releasing their gametes.

The hydrozoan Turritopsis nutricula has evolved a remarkable variation on this theme, and in so doing appears to have achieved immortality. The solitary medusa of this species can revert to its polyp stage after becoming sexually mature (Bavestrello et al., 1992; Piraino et al., 1996). In the laboratory, 100% of these medusae regularly undergo this change. Thus, it is possible that organismic death does not occur in this species!

The cells that accomplish the building of a new stolon are probably those of the exumbrella (the upper portion of the jellyfish dome). Transformation into stolons only occurs in fragments that contain tissues of the exumbrella and the ring canals, and the exumbrella tissue is the only tissue of the medusa that can transdifferentiate into the perisarc-secreting epidermal tissue of the stolons. The endoderm of the ring canals probably becomes the endoderm of the stolon and polyps. It is not known whether the sensory cells, myoepithelial cells, and cnidocytes are derived from the exumbrella or the endodermal component.

Everything in earthly existence, including human life, is involved in a process of ongoing change. Hence, permanence seems unattainable, and thereby especially desirable. The wish for immortality thus becomes one of the most important original reasons for the appearance of religions, and the motives of many scientific research fields can also be traced to this motive. Since very ancient times humans have wondered if after their deaths in this world they might continue to exist forever in some next and unchanging condition (Edmondson, 2005).

11. Discussions

There are plenty of puzzles about the concept of life. The concrete objects ready to hand are usually easily classified as living or non-living. Fish and ants are alive while candles, crystals and clouds are not. Yet many things are genuinely puzzling to classify as living or not. Viruses are one borderline case, biochemical soups of evolving RNA strings in molecular genetics laboratories are another. Extraterrestrial life forms, if any exist, might well not depend on DNA-encoded information or, indeed, any familiar carbon chemistry processes. How would we recognize extraterrestrial life if we found it? We have no reason to suppose it will have any of the accidental characteristics found in familiar forms of life. What, then, are the essential properties possessed by all possible forms of life? The search for extraterrestrial life needs some answer to this question, for we can search for life only if we have a prior conception of what life is.

The phenomena of life raise a variety of subtle and controversial questions. Early life forms somehow originated from pre-biotic chemical soup. Does this imply that there is an ineliminable continuum of things being more or less alive, as many suppose? Another subtle question concerns the different levels of living phenomena, such as cells, organs, organisms, ecosystems and asks in what senses the concept of life applies at these various levels. Does the essence of life concern matter or form? On the one hand, certain distinctive carbon-based macromolecules play a crucial role in the vital processes of all known living entities; on the other hand, life seems to be more in the nature of a process than a kind of substance. The relationship between life and mind raises another question. When we consider plants, bacteria, insects, and mammals, for example, we apparently find different kinds of mental activity, and it seems that different degrees of behavioral sophistication correspond to different levels of intelligence. Might the various forms of life and mind be somehow connected? To answer questions like these above and make sense of the puzzling phenomena of life, we need a sound and compelling grasp of the nature of life. Can any property embrace and unify not only life's existing diversity but also all its possible forms? What is the philosophically and scientifically most plausible way to account for the characteristic life-like features of this striking diversity of phenomena? How can we resolve the controversies about life? The concept of life as supple adaptation, explained below, is my attempt to address these issues.

Notice that our ordinary, everyday concept of life does not settle what the true nature of life is. Thus, we are not concerned here with careful delineation of the paradigms and stereotypes that we commonly associate with life. We want to know what life is, not what people think life is. Glass does not fall under the everyday concept of a liquid, even though chemists tell us that glass really is a liquid. Likewise, we should not object if the true nature of life happens to have some initially counterintuitive consequences.

Four questions are important to answer:
(1) How are different forms of life at different levels of the vital hierarchy related?
(2) Is there a continuum between life and non-life?
(3) Does life essentially concern a living entity's material composition or its form?
(4) Are life and mind intrinsically connected?

For now, many people, including biologists and other scientists still believe that God created the life, even they never publish any academic articles to describe that. The ridiculous things are that many biologists always write articles and teach students evolution in their work time but believe creation theory (deny evolution) in their weekend church time. Depending on the academic articles, they make their career and life, but depending on the Bible, they come back non-experiment believe. The fighting between science and religion is still a heavy topic in the modern time.

Absolutely to say, there is no real line between life and non-life. Life can live forever, and the die is not absolutely necessary.

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