

Life and Substance

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How life is born from substance, and mind comes out of life? A philosophical thought “what is life?”. Life is a force to create order and unity, and substance has the same force. When substance’s unifying force functions, it rises as life with mind. A natural philosophical view attempting to capture true nature at work.

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1. Evolution of substance and life

Before the creation of life

Where did life come from?

Louis Pasteur's well-known experiments that proved that all life on earth were born from other life, and they did not emerge by itself, denied conventional spontaneous theories. Yet if it is true, the next question is where the very first life came from. Here the genesis of life became a problem.

If one traces back phylogenetic tree, it is inevitable to come to a conclusion that everything has a common ancestor and life is a result of evolution of one primitive form of life. This is why all life have surprisingly similar structural uniformity. Therefore, it would be reasonable to assume that the first primitive life which is the origin of all life on earth generated in a certain environment of primitive earth. In other words, there is a sufficient reason to believe that organisms generated from non-organisms on primitive earth, from which high molecular were born and the first primitive life was produced by the organic high molecules. Pasteur himself didn't deny that there was an emergence of the first life on primitive earth. Here, spontaneous generation theory comes up again.

Today's cosmology explains that galaxies are getting further away each other with outer space being expanding. This causes a gas to form and accumulate around galaxies in space and to become stars, and gassy clouds become planets. In this way, the sun was born 5 billion years ago and the earth 4.5 billion years ago. Because of its perfect location in terms of the distance from the sun, the earth, absorbing plenty of solar energy, had vigorous reactions of various substances on its surface. The earth worked as an open system where energy and substances come and go. It created the best environment for substances who gathered to develop highly sophisticated organizations, which eventually produced the first life.

The first atmosphere of the primitive earth is assumed to have evaporated to outer space, because it was too light to settle. Atmosphere that covers the earth today is made of gas and water vapor that spewed from inside of the earth.

However, this atmosphere didn't have oxygen at first. When temperature went down, cooled vapor in the air caused rainfall onto the ground and formed the sea. The temperature of primitive sea water was much higher than that of today. Meanwhile, as the ground temperature declines, thin plates began to cover the surface of the earth, which gradually grew thicker and, through integration and disintegration processes, formed continents. Thus, an environment to nurture the first life was gradually built on earth, with formation of such things as atmosphere, sea, and continent. It all happened four billion years ago. Afterward, the earth stayed in relatively stable condition for life.

When primitive life appeared, there was no ozone layer, and the earth was directly exposed to ultraviolet rays and cosmic radiations. Therefore, the first life is considered to be born in the sea. This can be deduced from the fact that present living beings have similar compositions of primary elements to the elements consisting sea water.

It is also convincing that seeds of life came from space, considering the fact that space matters such as interstellar objects, meteorites or comets contain plenty of substances as adenine and guanine, which are ingredients of DNA, and they even have organic materials as amino acid. However, to prove this, detailed research is necessary on the process of how the seed of life itself was produced in space.

Chemical evolution

In any case, if primitive lives came from the sea as is commonly believed, the process of their generation could have been along the following steps.

First, chemical evolutions of carbon, hydrogen, oxygen and nitrogen that happened in atmosphere or sea, prompted generations of such simple organic compounds as amino acid, nucleobase and glucose. Then, possibly in the sea, these organic compounds further evolved to protein, nucleic acid and polysaccharide. Finally, these organics integrated in membrane-bounded environment to become life that have functions such as metabolizing or reproduction.

It is widely known that Alexander Oparin had already proposed his hypothesis by 1920s that biogenic substances could have formed from high polymeric substances that were produced during the process of synthetic reaction in the atmosphere of the primitive earth. J.B.S. Haldane, too, argued similar hypothesis. Haldane's argument was that ultraviolet rays from the sun lead to the generation of organic compounds such as amino acid and glucose on the surface of the primitive earth, and these organics accumulated in layer at the bottom of the sea to became the womb for the first life.

In addition, 30 years after Oparin proposed his theory about the biggening of life, Stanley Miller, an adherent of Oparin's theory, succeeded to produce organisms in an artificial atmosphere. He confirmed that acids like glycine, alanine or formic acid and several other organic substances are produced when filling a tank with mixed air of methane, ammonia, hydrogen and vapors, which is an artificially created primitive earth's atmosphere, and running electricity in the tank as a reproduction of primitive earth lightnings. He also discovered that different substances are produced with different mix of air, and he managed to produce several types of nucleobases as well as glucose and ATP (adenosine 3'-phosphate).

If it was the case, primitive atmosphere would have been able to produce such things as amino acid, nucleobases and glucose that are capable of producing life, by receiving interferences from ultraviolet rays, heat, cosmic rays and discharged electricity from thunder. It seems reasonable to think that these substances piled at the seabed and formed primitive-soup in which, with further chemical reactions, high polymeric substances that can become life were formed.

Furthermore, according to J. D. Bernal, clay might have played a critical role in condensing these primitive organic substances. Clay contains various minerals and can work as a medium to induce chemical evolutions. Recent studies suggest that hot water springs in the deep sea also helped create an ideal environment for promoting such evolutions. Because hot water springs gushing out high temperature water contain high-concentrated metallic ion that leads to chemical reactions. Indeed, it is known that an experiment in the environment similar to

deep sea, hot spring produced peptide from amino acid.

On the other hand, producing even the simplest life requires a space shielded by a bordering membrane as a container of numerous elements of life. Also, the container needs to be the place that allow substances or energy to metabolize and multiply themselves.

Oparin assumed coacervate as a model for such cellular membrane. It is in liquid form and works to separate thick solution. But such questions have not yet fully answered as the creation processes of orderly cells from inordinate coacervate and the relation between nucleobases and protein in it.

In addition, microsphere that Renee Fox proposed was a liquid made from high polymeric substances with double membrane structure and occasionally produced buds. It had the similar stainability to germs and excel coacervate as a model of cell membrane. But, again, the processes of producing orderly high polymeric substances and developing into cells with complicated structures is still uninterpreted.

Another discovery was made by Mitsubishi Kagaku Institute of Life Science (closed in 2010). It was a microscopic sphere called mariguranules, which was obtained by heating or giving pressure on artificially processed sea water containing similar substances as of deep-sea hot spring. It also had connected structure due to its sprouting nature which is similar to membrane cells. Also, in this case, detailed explanations haven't been made either.

On the other hand, even a most primitive life form with only one cell to be formed, proteins with various functions and membrane cells are required. Protein can be synthesized artificially by adding heat and pressure on primitive-sea-like water solution. It is assumed that several types of amino acid contained in primitive-sea-water soup concentrated and produced simple proteins, and then these proteins would merge to gain further sophistication.

Actually, there are numerous types of proteins working in life on earth, each of them has unique structure and have wider physiological functions than just becoming hormone and enzyme. Furthermore, each protein has strict structural

order of amino acid according to its function. What defines this unique order of amino acid and specific nature of each protein has not yet fully explained. It is said that even if researchers kept experimenting for 1 trillion years spending all the substances of the entire universe, they wouldn't be able to freely manipulate proteins as long as they rely on coincidences. Even the formation processes of single molecule proteins such as enzymes and antibodies have not been fully explained. It will take time until we understand collective form of structural proteins.

Generation of RNA and DNA

Even the most primitive lifeform is not produced only with membrane cells and proteins. RNA (ribonucleic acid) and DNA (deoxyribo-nucleic acid), which assume bioinformation, are also essential requirements to form life.

According to the popular view, RNA system predates DNA system, because of the discovery of RNA functioning both as mold to copy itself and as enzymes. Nucleobases such as adenine, guanine, cytosine and thymine can be easily synthesized by experiments in artificially made primitive atmosphere. Also, from these nucleobases, RNA chains can be obtained, and it was also discovered that nucleobase mediates RNA to make longer chains and the chain has spiral structure. RNA's self-catalytic ability to develop itself in chain form without help from proteins suggests the possibility that the first life might have started from RNA. Having a self-catalytic ability means that it can transmit gene information and make copy of itself. Now, activities of a system get accelerated by its own activity and develops into more complicated organization. How life acquired reproduction system was a long-standing question. However, the discovery of RNA having an ability to copy itself could provide a significant lead.

With all these facts, the generation of life is now considered to have happened in the following way. First, nucleobases were produced in the primitive soup, which is believed to have formed in the primitive sea water. These nucleobases then developed into nucleotides or polynucleotides by continuous merging of each other,

and self-sufficient RNA was also born. RNA used itself or other RNA nucleus as mold to produce copies of itself. These copies eventually acquired an ability of catalyst, and types of RNAs that survived natural selections came to form sort of communities of RNA. These RNAs further evolved to be able to produce proteins and DNA, and, in the process, DNA took over the information transmitting role.

This can be deduced also by the fact that retroviruses still exist today. To produce a copy, retroviruses once turn its own RNA to DNA with the help of reverse transcriptase enzymes and slips it into the DNA of other life in which the virus produce its copies. The same enzymes have been found from other viruses, and also similar nucleotide sequences in DNA. Furthermore, the assumption that DNA predates RNA is strengthened by the fact that small RNAs called primer RNA are actively working when DNA start self-copying processes.

However, there are still unknown areas in RNA's generation. Even today, artificially synthesized RNAs need its base sequence adjusted in advance according to the computer-analyzed genome data obtained from already existing viruses. How RNA acquires metabolizing function has yet to be clearly explained either. The advocators of the origin of life theory tend to explain it by a sudden mutation of RNAs or natural selections that occurred over the long period of time. But those theories are often used as excuse for the unknown rather than explanations to unveil the structures of birth of lives in detail.

The sequences of molecule inside of organic cells are literally complex, and life cannot be easily produced from data obtained from experiments ever conducted. While it is possible to produce elements like cell membrane, protein and nucleic acid, there are still many objectives to integrate them into a single system. Even when in the most primitive form, life is an organic system that keeps integration, metabolizes substances and energy and proliferate itself. Whether it is nucleic acid or protein, only gathering materials will not make them automatically and conveniently develops into a usable system or produce complicated integrated cells. It has not been completely understood that how such complex systems were

developed through chemical evolutions in the primitive soup.

Life as an integrating force

Indeed, the body of plants, animals and other life are made from such substances as protein, nucleic acid and sugar. These organic high molecular produce materials including several types of enzymes, RNA, DNA, cell membranes, and others, which form life collectively. However, life is not made only with these things. For the formation of life, these organics need to be structured organically based on a logical system. The phenomenon of life is a logical system structured with these materials and is not a substance itself. A life is an integrating force that organizes substances and give each of them meanings in the organization. Life is nothing but an organizational power that constructs an orderly system consisting of multiple molecules. Thus, intricate structure of life will not be fully understood only by studying in details of substances, focusing only on its materials.

Life is not made by mechanically connecting earthly substances but by connecting them in order to fit in the purpose of the life. Even in the level of molecules, amino acid, base and sugar are not randomly combined to synthesize protein, nucleic acid and polysaccharide. Neither protein, nucleic acid and polysaccharide are not automatically connecting to produce life. There should be a force that sets things in order to match their purposes. It is with such purpose-oriented order formation force that life acquire functions such as energy transmission, self-preservation and proliferation.

This is why, at any level, life works as a unit of organically related components and shows abilities that are not found in each component. Life is capable of integrating separated parts and organizing them as a whole. Also, life is a fluid order whose components, while functionally integrated, interact constantly inside and outside of the organization, adjusting inner structures against outer environment to preserve itself. If so, the true essence of life is in the integrating force that organize and relate substances in order.

The force is not existing away from the life. It must be inside of life and the substances that form the life. If such ordering forces are working in substances, it

is very understandable that those substances create high-level molecules which integrate organically to produce life and acquire numerous functions including self-copying ability. Purpose-oriented order that life automatically produces is based on the formation force inherent to earthly substances. Life is a force to organizes substances, forms individual objects and species and brings itself as far as it could, and its source should be found in substance itself.

Life as information

The studies on the beginning of life to date have discovered only generations of materials that produce life and have not really succeeded to explain how complicated lifeform are created from them. Even if the origin of life was explained in terms of substances, it would not be enough to reveal the secret of life. Substances are only ingredients, and they are not life in their own right. In fact, in many experiments and attempts about the origin of life, researchers are trying to grasp it from the physical chemistry point of view, replacing the origin of life to the origins of the ingredients of life. That should be described as a reductionistic attitude.

There are aspects of life that become obscure when focusing only on materials. Life is a force to combine, organize and integrate materials, and it is not something simply made by combining materials. Getting many ingredients doesn't mean a fancy meal to be quickly served. To achieve the goal, those ingredients need be processed and organized towards a certain direction. Life, too, is made from numerous ingredients that are organically linked each other, and there is a plan for those ingredients to be linked. Life is, in other word, the plan of organically connecting each part together.

It is true that today we have become able to analyze the base sequence of RNA or DNA of relatively simple viruses and bacteria and, by using the obtained information, manipulate such RNA and DNA in test tubes to synthesize artificially viruses such as poliovirus and mycoplasma. However, even so, without registering the information of already existing living things, nothing can be produced. That means, even to produce a simple virus or bacteria, information is required to

organize each material. This information is the very main body of life, only it is not visible nor solid.

It is still unknown that how this organized ordered information was installed in RNA and DNA. The mechanism will not be unveiled simply by studying materials. RNA produced DNA, and then DNA produced several types of proteins. Even so, during the hundreds of millions of years from the birth of the earth to the birth of creatures, how it happened was not fully understood. It is also unknown how the relationship was formed between nucleotide sequences of nucleic acids that make up RNA and DNA and amino acid sequences of protein. To constitute life, nucleic acids and proteins are not sufficient just being as they are, but there have to be sequences of units in constituting it and a precisely defined relational order between acid and protein. Life is, rather, information and meanings installed in these sequences. Such information and meanings can not be captured by material-oriented or mechanism-oriented way of research.

Life is a fluid process that emerges in various forms following the steps of birth, growth, aging and death. Life is a form, change and generation. Ignoring the aspects of form and process, one can never understand life. What is important for life is how to install information into genes so that it can freely express itself as a fluid form, and as long as this purpose is fulfilled, any material would have done. Only because there were useful elements to produce nucleic acids, proteins and sugar on earth, life utilized them and expressed itself. Therefore, it is no wonder that if there exist life that express themselves with totally different materials in other planets. Life is a tendency to express itself toward a certain direction and a forming force that organize substances accordingly. Such force will not be understood by studying only substances.

If so, it seems the only way to think that there is inherent force of producing life under certain environments in space and the force is omnipresent. A few substances among others that constitute life on earth are not necessarily stable entities nor are they more capable for that purpose. On the contrary, those substances are very instable and always likely to change its form to something else. Nevertheless, life continue to exist based on the unstable substances, creating

a flexible balance. That is, the forming force which universally exists in the space has an ability to active organizations from whatever materials when conditions are right, and it never happens by chance.

Jacques Lucien Monod made a hypothesis that a life with an ability to copy itself had been created on earth as a result of the least likely coincidence, and due to its mechanism of copying itself, it continued to proliferate and eventually filled the earth with life. (*1) This theory is totally wrong. Substances existing in space should be regarded as having a tendency to produce organic bodies like life, and being able to produce organizations that is capable of copying itself in any environment under certain conditions. In fact, whether it is the generation of protein by amino acid or that of nucleic acid by nucleobase, it could not have happened by chance. If it is, there are not enough amino acid and nucleic base in the entire space. There should be inevitable workings that structure things and organize them in order.

If coincident involves in the process, it would be in creation of environment. What type of elements exist around life is determined totally coincidentally. Environmental changes occur also by chance. That all the protein acids that the life is consisted of were made from L-type amino acid is also due to environmental coincidences when the first amino acid was produced. Even so, the organizing force of the space have created life with materials available on each spot in accordance with the environmental conditions, and have had them develop into millions of forms in the course of their self-maintenance effort with a lot of try and errors. There is definitely a sense of freedom of life and creativity.

Indeed, this process of creation of life can be seen as the process of self-organization of numerous substances with separatable structures, from the standing point of non-equilibrium thermodynamics as researchers like Ilya Prigogine. Whatever theory is taken to capture the essence with, the process occurs inevitably, and it seems that these substances are driven by the inner force

that they have inherently.

Birth of primitive life

Just as being driven by this inherent force, amino acids, nucleic bases, and sugar, simple organic compounds that generated on the primitive earth, then produced proteins, nucleic acids and polysaccharides which reacted each other in a limited space to be organically related. Consequently, primitive cells that are capable of metabolizing substances and energy, adjusting themselves to the environment and self-proliferating came to exist: the birth of primitive life. These first life probably would have been the simplest single-celled organisms with no core like procaryotes today.

Today, among the smallest living beings on earth are viruses, which are in between life and non-life. Virus is a simple life, consisted of nucleic base and protein, and causes disease by infiltrating the body of animals, plants and bacteria. But when it is outside of other life, it is crystalized and exists as a substance, unable to multiply by itself. Being able to copy itself though only inside of other life, virus has a character of life, but it has a character of substances, getting crystalized and unable to metabolize. Virus is spotted in the middle between life and object. It may be a sort of living fossil that indicates the consequential evolution from highly organized substances to life. The difference between life and substances is not very clear.

Even so, viruses are incomplete life in the respect that it can't multiply without parasitizing other living things. But looking closely at the way it parasitizes shows how artfully it does so. When a virus infiltrates other life's cell, it first slips into the core of a target and rewrites the information of the DNA of the target. As a result, the cell of the host then has no choice but to reproduce itself following the information rewritten by the intruding virus. Viruses produce self-copies in this way. Considering the artful reproduction processes that viruses take, it is no wonder coming to a conclusion that viruses are highly intelligent life. Perhaps, viruses too, would have been able to metabolize and multiply by themselves when they first appeared on the primitive earth. But they might have lost those abilities

over time as further evolved life appeared and they came to parasitize, and consequently developed only the intricate reproduction method.

The oldest fossil remains of life discovered to date is that of a group of blue seaweeds and it is estimated 3.5 billion years old. Given the fact that they were able to photosynthesize, these primitive seaweeds seem to be relatively sophisticated life. Based on this, the beginning of life is assumed to have been dated from 4 billion years ago.

The sea in the primitive earth around that time is considered to have been much warmer, under more pressure and more acid than the present sea, and it turned out a better environment to produce primitive life. That is proved also by the fact that simple bacteria that are found around hot-water spring in deep sea today live by taking carbon and sulfur in high temperature and high-pressure environment. Also, there was no oxygen in the primitive earth. Therefore, the first life would have been anaerobic procaryotes which are organotrophic acquiring energy by dissolving organisms.

It followed by the birth of autotrophic life, which can yield substances that it needs. One hypothesis is that at first there may be mere bacteria who photosynthesize with the help of sulfur or iron, and later types of life that photosynthesize to produce organic compounds from carbon dioxide. The efficiency of photosynthesis was rapidly brought up when procaryotes which do the process with chloroplast. This is the ancestor of green plants.

With the advent of photosynthetic life, a vast amount of oxygen was accumulated in the earth's atmosphere, which prompted life to take a leap. It led to the emergence of heterotrophic organism, which claim energy from oxidized organisms, utilizing oxygen in the atmosphere. This is the ancestor of today's animals. However, the appearances of photosynthetic orgasms followed by the release of massive amount of air into the atmosphere caused anaerobes on earth to go extinction or to be driven to the oxygen-free environment. Such anaerobic bacteria living in the seabed as methane bacterium in the seafloor mud are the ancestors of these primitive life who were relegated to such environment.

It is due to the emergences of photosynthetic life that a large volume of oxygen

exists on the earth with its components maintained at a certain level. As the amount of oxygen in the air grew, ozone layer was formed, which reduced the degree of ultraviolet radiation on earth, allowing, whether it's animal or plants, life to come out of the sea and expand its habitat range onto the ground.

Photosynthetic procaryote created a new environment on the earth and under the newly produced condition, life managed to make further progress. However simple it might be, life will adjust itself to the surrounding environment and make copies of itself. At the same time, life designs the surroundings in the way that it can develop itself most effectively. In this way, life sophisticates itself and evolve. Life produces itself in the interactions between itself and environment.

Life is not merely a substance that adjusts to the environment and lives on the earth. It is also an object that relentlessly evolves earth's environment. Life is both passive and active. Indeed, since its emergence, life has always been faced to crisis which were brought from outside by environmental changes but also from inside by reforming environment by itself. Nevertheless, life, on the contrary, have positively and resiliently survived until today, producing new forms and functions, even utilizing such crisis.

From eucaryote to multicellular organism

It is said that eucaryotes first came to exist on earth some 1.2 billion years ago. Eucaryotes are highly sophisticated single-cell organism that has cells to cover its genes, breaths with mitochondria, produces food with chloroplast, and can move with flagellum. It is an ancestor for both animals and plants. Eucaryotes also evolved such functions as mitotic division and sexual reproduction, that led to a birth of more efficient ways for reproduction. Lynn Margulis, an American biologist, argued that mitochondria, chloroplast and flagellum were originally different eucaryotes and, while staying together in the same cell with after each of them entering in it, they became merged as organs of the cell. (*2) Here, it seems that living together helped life take another leap. Competitions based on natural selection and the survival-of-the-fittest principle are not the only way that enables

life to progress.

Living together or coexisting was a drive also when multicellular organisms were born from eucaryotes. It is reasonable to say that multicellular organisms in the form of animals or plants are made up with many single-cell eucaryotes. A life is operated by cells who divide functions as organs that are organically interconnecting and work each other.

The presumption that, as a result of living together of many single-cell eucaryotes, multicellular organisms were born is convincing also from the study of slime molds. Slime molds are single-cell eucaryotes. They are like ameba when they can find food, but when they don't, they gather and take a slag-like form. Over hours, the slag extends the front part like a pole, and other cells climb the pole and spread spores from the top. These spores spread and those reached appropriate spots start reproducing itself. This is how they preserve themselves. While food is available, they live slime-molds live as single-cell eucaryotes, but they can get together to form a sort of organization with each cell taking up different functions. They are in the half way between. The likes of them might be commonly spotted when multicellular organs were beginning to make its appearance.

Then, finally, at the end of Precambrian era, more than 600 million years ago, were already simple multicellular organics in the seabed, from which a great diverse of life were born including trilobites in the Cambrian era.

In the Ordovician period, 490 million years ago, saw the first vertebrates (fish) and in the Silurian period, 430 million years ago, the first animal on the ground.

In the Devonian period, 400 million years ago, ancestors of fern grew and gymnosperms and amphibian animals appeared. Reptiles appeared during the Carboniferous period of 350 million years ago, needle-leaved trees in the Triassic era of 220 million years ago. In the Jurassic period about 180 million years ago, large sized reptiles flourished and archeopteryx and first mammals had their advent. Angiosperms came during the Cretaceous era about 135million years ago, and mammals well developed during the Tertiary era, 70 million years ago, finally we had humans about 7 million years ago.

Simple organisms made of a few earthly elements have evolved to this point over the time of 4.5 billion years since the earth was created.

2. Substance, Life, Mind

From substance to life

Life is a forming force that organizes substances, an orientation that expresses itself in forms, and a system that, relating each part closely, works it in harmony. Such substances as nucleic acids, hormones and nerves are some of these expressions at different level of life. These are already playing out at the time of chemical evolutions and continue to do in every corner of numerous cross-points of life's evolution.

Parts of machines will never become a machine with certain functions by themselves. In order to work a machine, it needs men's hand operating it. On the contrary, life will create a life automatically using various organisms without help of others. And, using the life, it produces another life. Life is a such self-producing entity. This force is almost a miracle of space.

Some elements gather to create molecules and the molecules collectively create simple organisms. These simple organisms together produce high molecule and, after sophistication processes, finally they become living matters. In this process, physicochemical substances that can be defined simply by size, form, number and quantity, will acquire more advanced organizing qualities including metabolization, adjustment, responding and multiplication. In addition, once obtaining the qualities of life, substances rapidly develop its capabilities. Substance act following the physical law but life defy it. Plants grow against gravity and birds fly. The world of life is full of freedom and initiatives.

In other words, the sense of purpose of substances grows as it gets more sense of life. That substances take a leap to become life means they acquire teleological integration. Even slipper-animalcules know to move toward food and to avoid

danger. To get teleological integration or obtaining quality of life is as if the sole purpose of substances. Or, perhaps, it may indicate that substances keep inside such forces for pursuing goals and creativity. At least, we must say that it is not only life that is in the course of development but substance, too, is already in the process. This is why atom becomes molecule, molecule grow into high molecule and eventually sophisticated organism.

In the area of biochemistry, various organic reactions are regarded as simple responding processes of chemical substances, and in molecular biology as the work of nucleic acid polymer. But these reductionism views are clearly directed against the vector of generation from substance to living organism, therefore, not adequate to grasp the truth of life. Life is a tendency in which substances try and work to acquire freedom and purposes of existence, individuality and diversity, totality and complexity and form and integrity. This essence of life cannot be captured with reductionism based on physical chemistry. Because reductionism is a thought to reduce life to substantial reactions which is not living.

The process that multi-cells organisms was born from eucaryotes, which start from an elemental particle which develop to atom, molecule, high-molecule, organism, procaryote, eucaryote and finally multi-cell organism, is, in a way, consistent with the principle of coexistence. The development from substance to life occurs in an organization with pyramid structure where, at each level, cooperate works with its lower level are occurring. In this point, Whitehead's theory that substances are living organisms, considering true existence is not substantial but organic, is reasonable. (*3) The tendency of making more complicated structure by cooperating is set deep in substance itself.

Against the second law of thermodynamics that indicates that entropy (chaos) increases irreversibly, life has been trying to grow order and decrease entropy. Life's workings to create more complex organizations by cooperating can be regarded as an effort to reduce entropy. However, as the complication is seen also in the levels of substance, this tendency of reducing entropy and growing order is also held by substances. The mechanism of reducing entropy in the substantial level and that in the life's level seem the same. There is a strong vector toward

order also in the world of substance. Substances which are not yet life have inherent order-forming ability, and the ability pushes forward until it finally has substances transform into life.

Ilya Prigogine thought this phenomenon as a self-organizing process in dissipative structure and it is correct. In the open systems, which consistently exchange substances and energy in the environment, which is also far away from balance (dissipative structure), entropy's decrease and a phenomenon where structures undergo complication commonly occur. Dissipative structure climbs up the steps of self-organization by itself without drives from outside. (*4) This dissipative structure theory well-explains the process of how organisms are formed by substance's chemical transformation and how sophisticated organisms produce life. It shows that inside of substances are already set a function to produce life.

Self-organizing phenomenon is not unique to living organisms but is commonly seen also to substances as long as it has dissipative structure. It is a principle inherent to the universe which connects substance and life and work in both of them. Then, it is not a mere coincidence that life came out of substances. It was rather a necessity for an open system like the earth where, above a critical point, the state and quality of things changes in deferent levels and complication processes occur almost automatically.

Boundary between substance and life

The transformation from substance to life is gradational and its border is unclear. Substance and life are not clearly separated. The world of life is deeply rooted in the world of substance. On the other hand, the world of substance obtains rich sense of purpose and organic nature by touching the root extended from the world of life.

If the border between life and substance is not so clear, principle of life is rather likely to be found in substance. Nature is, in theory, a living organism and early signs of life can be found everywhere. The formation of organic life with a highly sophisticated system is only a blossoming of the self-formation ability inherent to

substance from the very beginning of the earth.

Similar phenomenon is occurring in the substance world. Crystal's solid geometrical atom structure is a good example of substance naturally self-organizing. Crystals have geometrical form and stable structure. Furthermore, crystals have also an ability of recovering its form automatically even if getting pressed from a certain direction. Also, it can reproduce and fix damages with its own molecules as well as produce copy of itself and multiply. Like this, crystal of substance works in the similar ways as living things in self-controlling, self-recovering and self-coping. Matured organisms do the same. Particularly, highly sophisticated organisms are placed in the border zone between substance and life in terms of its abilities. Nucleic acid polymers such as RNA and DNA also have crystallin structure as well as self-multiplying function, which is obviously a very similar entity to viruses that self-multiplies and crystalizes.

Crystals also work as a medium that help other substances crystalize. For example, as John Desmond Bernal pointed out, clay that contain a lot of crystalized minerals would have facilitated vigorously chemical evolutions that occurred in the pre-life earth. Indeed, some evidences have been found that certain type of clay mediated amino acid to form polypeptide chain and to create nucleic acid. Crystals contained in clay is already equipped with multiplying function, so the nucleic acid produced by it also has multiplying function. It is impossible here to distinguish substance from life.

Clay and crystals are not the only examples for this. The world of substance embraces numerous self-organizing and organizing things. Not only the development of elementally particle to atom, molecule and high-molecule occurs, but also water whirls in the sea and rivers, vapor accumulates to form cloud currents and ground bents and forms mountains and rocks. Organizing force is working also in the substance world as it does in the life world. Then, it would not be such a big jump of thoughts to think the root of life is in substance itself and substance is a life.

The concept of seeing substance as a static existence, follows only physical laws,

and is determined only by initial condition, attributes to the mechanical view of nature that has been dominating in Europe since the 17th century. But it is another matter whether the view truly captures the essence of nature, or not. True nature never stops working. It moves, changes, generates, dies, and doesn't stay even a second. Nature is fundamentally protean. Terms such as *materia* (substance) and *natura* (nature) that originally meant <what produces> present original views of nature that the 17th century modern European natural-scientific nature views have long forgotten. In Asia, the concept of <nature> originally meant <to become naturally>. The concept of <self-organization> is close to this. Only when understood in this way, the true meaning of <nature> recovers. As Friedrich Schelling thought, nature is an infinite force of production and unlimited drive for creative activities. (*5)

Creation of mind

In the evolutionary current of life and substantial evolution spanning from atom, molecule, high molecule, prokaryote, eukaryote to multi-celled organism, the root of life that exists in substances have eventually produced the work so called consciousness or mind. Especially, in the process of evolution toward animal like fish, amphibia, reptiles, birds, mammals and humans, more typically as the degree of sophistication rises, such works as sense, perception, recognition, judgement, inclination. They are generally called as consciousness, and in case of human, it is represented in the form of highly psychotropic expressions of inclination, emotion and thoughts. The creation of mind is a manifestation of life's unlimited creation power together with its creation of complicated forms.

Sure, psychotropic expressions like inclination and emotion belong not only humans but also to animals. Animals, too, feel joy, anger and sorrow and enjoy its life, having inclination and thinking to live. Even the simplest single-cell creatures without nerves and eyes take appropriate actions, running from enemies, finding and getting food, judging friends and enemies and itself and others. It is obvious

that consciousness, sense, perception, recognition, judging and inclination, is given to primitive single-cell creatures, too. Furthermore, their actions are the most primitive conscious responses also shared by much higher evolved creatures including humans.

Indeed, plants that have chosen a different path from those single-cell creatures in the course of evolution look as if they don't have any consciousness. But, even so, they seem to grow and live, perceiving surrounding conditions and even the existing of fellow plants. There are even carnivorous plants that eat insects such as monkey cups and *Dionaea*.

Because plants are autotrophic organism that can produce food by itself, they can adapt to environment only with hormone reactions which doesn't require nerves. That is why its main part stay underground and consciousness is not visibly expressed. However, the current consciousness is flowing toward plants. As is seen clearly in carnivorous plants, they are taking actions consciously. For example, *Dionaea* keep mental notes of the sensations when a fly touches a leaf and when it feels the same sensation next time, it closes the leaf immediately to capture flies.

Animals need to look around for food not like plants as they chose to live as heterotroph. As a result, they were always exposed to clashes and conflicts with outer world, which lead them to develop sharp consciousness. In order to be able to take quick and conscious action, animals, at each level of evolution, improved their nerve systems for sensing, precepting and responding, as well as their brains for recognizing, judging and choosing.

However, brains and nerve systems are not essential to have consciousness. Primitive single-cell creatures can take conscious action even though they don't have brains and nerves by utilizing chemical transformations of inner archoplasm and potential changes. Although plants haven't needed to take as much a conscious action as animals, but instead they developed mainly hormone systems so that they can make, though rather slow, similar move as animals. Whether it is nerves and brains, hormones or physicochemical responses, physical mechanism doesn't matter much for animals, actually. What is more important than anything else is

to be able to work consciously to conserve itself and its strain.

If this hypothesis is right, it means that the work of life which is described as consciousness or mind should be shared by all including humans, animals, plants and primitive creatures, and that even bacteria and viruses fundamentally have mind. Even aids virus which is an RNA type procaryote, once coming inside of a living organism, starts multiplying itself by taking over T4 lymph corpuscles and its DNA that control immune system of the organism, rewriting information of the DNA and having it reproduce endlessly the copy of aids virus with the new information. Looking at this train of actions makes us feel that the virus has been driven by firm motivations for self-preservation, making full use of its primitive sensing and judging abilities. We must admit that even viruses basically have consciousness built in.

The domain of life is almost the same as that of consciousness. Life and consciousness were born at the same time. If life is deeply rooted in substances, also the origin of consciousness should be something found in substances itself.

We humans can sense the existence of something that can be described as a consciousness which comes before being conscious, or the current of life itself, that is shared by animals, plants, primitive creatures and procaryote and even rooted in substances, in the moments of awakening and in the moments of sinking into sleep. Consciousness is not only the human's self-consciousness. It is actually only the tip of iceberg in the limitless sea of consciousness. The core of consciousness is rather found in the physical awareness that we have in sleep or instinctive responses. It maybe rather an unconsciousness in comparison with the consciousness that we use to reason, deduce and perceive. But it is in this unconscious world of life that we can sense the life shared among all living things. It makes us even sense the fundamental life that prevail across all substances and universe. Explicit work of consciousness or mind is a mere wobble on the surface of the sea of this fundamental life. True life can be sensed only at the deeper level of the sea.

A search for the origin of explicit consciousness of humans who perceive, deduce and judge will end up to animal's unique sense. And the origin of the animal's

sense will be found in the unconscious state of plants and primitive creatures, the origin of which is connected to the world of substance. What we call spirit, consciousness, and mind are not a separated existence from substances but they are found in the same place. Mind should be considered as something exists in the organizing, changing and creating processes by substances and life.

In this point, Gottfried Wilhelm Leibniz's saying sounds convincing that "naked monad" or substance has a representing ability of very subtle unconscious state and a faint representation. He says that the representing ability develops from this stage to a state of conscious representation with memory or life, and produces intelligent capable of reasonable thinking, and finally achieves selfhood based on apperception. (*6) Leibniz found a total unconsciousness in substances nevertheless he didn't regard it a death.

Mind and substance

Mind and substance are originally one thing, mediated by life. Mind and substance are actually the two aspects of the same process just like the front side and back side of a sheet of paper. The process is of a continuous development, growth and creation from simpleness to complication and from relaxation to tension. That is a flow of life. As substances become more sophisticated and more organized, it deepens its liveliness and its mind works more actively. On the contrary, the more active the mind become, the more complicated it becomes the way the mind, through reactions, structures, orders and organizes the substances. Mind and substances are opposite sides of the current of life and they are not separable in the world of life.

In the flow of life, things and mind, mind and things are one. In the flow of life, mind is working in things, and things are found working in mind. Our mind, too, express itself through the reactions of organs in our body and also those organs are made from highly sophisticated substances. On the contrary, substances acquire the mechanism of mind by sophisticating itself and expressed as organs. Mind is connected to substances through life. Substances is expressed as mind through life.

Universe is a generation and a change, and it also a flow. It is a process of continuous creation of itself. It comes as many galaxies, countless solar systems and numerous earths. But it is not in the state of death but active and living system that continuously produce itself. That is why the earth that is consisted of many substances produces life and mind. Creation of mind is a part of producing action of universe.

The force to form things that is inherent to space is found working in all stars, in all planet and in all substances. Therefore, there should be many other astral bodies that is producing life and mind than our earth. Space presents its ordering force in the form of substances and substances in the form of life, life in the form of mind. Furthermore, because the force is only one, the evolution of life that happens in other planet should be a similar one to the evolution on earth in terms of its expression, disregarding the aspect of materials.

Space is an endless generation and change. It expresses itself as substance and also as life and mind. Life on earth that contain inside substance and mind is a manifestation of ever working fundamental space.

Note

- 1 Monod, *Le Hasard et la Nécessité*, Alfred A.Knopf, 1970
- 2 Margulis, *Symbiosis in cell evolution* W.H.Freeman, 1981
- 3 Whitehead, *Science and the Modern World*, Pelican Books, 1938.pp.124-125.
- 4 Prigogine, Stengers, *La nouvelle alliance*, Gallimard, 1978
- 5 Schelling, *Erster Entwurf eines Systems der Naturphilosophie*, Werke Bd.2, Beck und Dldenbourg,1927.
- 6 Leibniz, *Monadologie* 18-30 66, *Hauptwerke*, Kröner, 1967. s.135-s.138. s.145.

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