The General Law of Being. Article 2:
The Being of Differentiation and Its Arising Issues

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The Being of Differentiation and Its Arising Issues. *Journal of Big History*, VI(2); 47–64.
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This is Article 2 in a series about the General Law of Being, a science philosophy introduced by Chinese scholar Wang Dongyue twenty years ago and then expanded upon by Chen Ye, who linked it to other scientific and philosophical traditions, as well as to Big History. We encourage readers to review the first article in the previous issue of the *Journal of Big History* 6 (1). As addressed in Article 1, all entities in the universe – *beings* – are finite, interdependent, and interrelated.

A being is any entity, living or not, that can serve as a subject or an object. Their position is determined by both vertical and horizontal conditions. Vertically, all beings originated from the 'One,' a *primal singularity* generated in the Big Bang from which everything is derived.[1] Horizontally, the *realization of existence* is how a being's *interactive-quality* couples with another being's *interactable-quality*. This bi-directional relationship determines a subject-and-object's evolutionary position in the cosmos.

The emergence of new *forms of being* is an evolutionary process rooted in a superposition of specific historical stages. Each stage represents harmonious states of *structural-coupling*. Unlike traditional evolution that focuses on biological transition, the evolution we address includes all beings, from the Big Bang up to human society.

In our system, no matter how space and time are extended, the *holistic being* (beings as a whole) remains invariant, according to the Law of the Conservation of Energy. The *finite interval of derivative beings* refers to this holistic being, which contains all forms of beings that are in interdependent and derivative relationships.

In this article, we delve deeper into evolutionary progression to explore the generation of new beings and the mechanisms through which beings evolve to form distinct species. By examining the relationship between the *being of equivalence* and Charles Darwin's theory of natural selection, we find common principles – such as how the *being of differentiation* fit into both theories and unifies all beings.

Conservation Force and Variation Force

If there is a more explicit way than *material transformation* to describe how new forms of being are generated, what might it be? Let us consider reproduction, the process by which an entity fractures into new derivatives of the same class. Reproduction is a distinctive ability of a *living* being that allows it to continue from generation to generation[2] **This reproductive ability enables living beings to be stable in evolutionary history, just as for abiotic matter.** Without this stability, living beings would be like particles that cannot keep their form, such as beryllium-8 in hydrogen fusion. The living beings in this case refer to a species rather than an individual.

Single-cell organisms reproduce through the simple asexual mechanism of *binary fission* (for prokaryotes) and *mitosis* (for eukaryotes). In this process, a single cell divides into two identical daughter cells. However, the sexual reproduction of multicelled organisms is more complex since it involves the participation of two cells. In this system of *meiosis*, each parent cell splits their intertwined (diploid) chromosome of DNA, giving one strand each to their progeny cell. These two single strands join together to form a daughter cell or zygote.[3]

Although asexual and sexual reproduction manifest major differences in detail, their fundamental mechanism is similar – in both cases, there is cell division and the new cell is traced back to its parent cell(s).[4] A key difference lies in sexual reproduction's allocation of reproductive responsibilities to two distinct cellular forms (male and female), necessitating the fusion of separate cells to form a new cell. Through reproduction, we can see how the transgenerational *conservation force* enables living beings to be relatively stable.

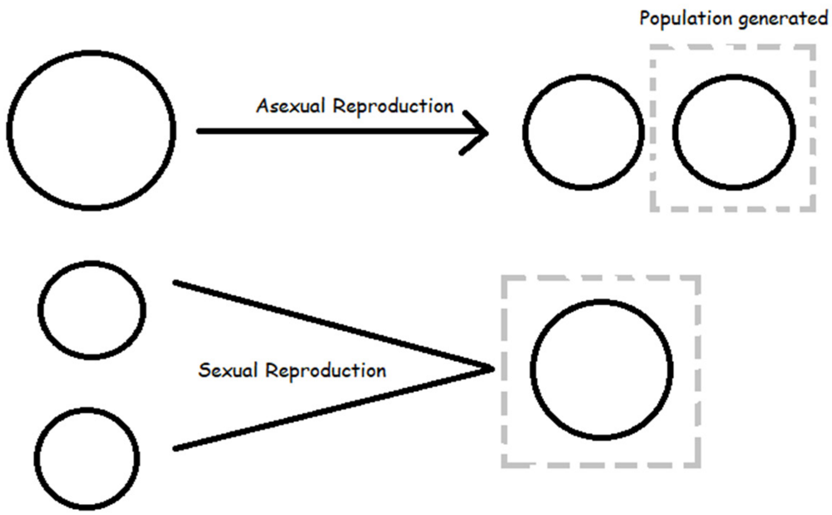


Diagram 1: Asexual Reproduction vs. Sexual Reproduction. Diagram by Ye Chen.

Another important aspect of reproduction is genetic variation, which is important to how a new *form-of-being* is generated. The main sources of genetic variation include mutation, genetic drift, non-random mating, and migration. Genetic variation is ultimately determined by *autologous mutation* (variation of interactive-qualities) in cooperation with natural selection (selection by interactable-qualities).[5]

Mutations are due to a permanent damage in the genome that may result from errors in DNA copying or from interactions with the environment.[6] Though most mutations are deleterious and get eliminated immediately, a few are retained when the species can better couple with its condition. This may lead to a single evolutionary lineage splitting into two or more genetically independent lineages.[7]

For example, a mutation may have allowed single-celled creatures to create complex forms, thus giving rise to multicellularity. In a study of choanoflagellates (single-celled organisms), researchers discovered that they often organize into groups to form a multi-celled colony to feed on certain foods. This suggests the expression of a successful genetic tendency enabling single cells to recognize each other and come together.[8]

Asexual reproduction involves only one parent and contributes little or no genetic variation, except when mutation occurs, since asexual reproduction involves only one parent. In contrast, sexual reproduction adds more variation, because the genetic material of different organisms is exchanged and recombined.[9] From this, we can see how this *variation force* has driven the evolution in which an enormous number of variant derivatives (species) have been propagated.

Natural Conservation of Non-Living Beings

Conservation is much easier for non-living entities than for living organisms, so non-living 'beings' occupy most of the universe. Their forms as dark matter and dark energy are the most pervasive, making up 96% of the total mass of the universe. Since dark matter and dark energy appeared in the early stages of the universe's expansion, they take on more elementary forms. The mission of the recently launched Euclid spacecraft (2023) is to better understand the nature of dark energy and dark matter.[10]

The older, more basic properties of non-living beings enable them to better conserve themselves. Although we do not see a strong 'willingness' to be conserved, as we do in living beings, **the immense proportions and age of non-living beings imply a more robust and powerful *natural conservation force* operating on them.**

Meanwhile, the other force – variation – also takes place in non-living beings and can lead to new forms of being. While mutation can change a DNA code and lead to rearrangement and re-coupling (re-combination) of cells in living beings, non-living elementary particles also interact, and their components (protons, electrons, neutrons) can be rearranged and recoupled. Thus, both a new species (living being) and a new type of particle (non-living being) are a result of variation. In either case, a mutation can be successfully retained.

Division-Coupling Process

The evolution of all beings takes place through the interplay of two opposite forces: conservation and variation. The force of variation must exceed that of conservation, otherwise the Big Bang could not have happened. All beings must go through the process of evolution, namely division (or divergence) and coupling: It is only through division that variation is possible and only through successful coupling that new forms are established.[11] All beings are products of this variation, including human beings.

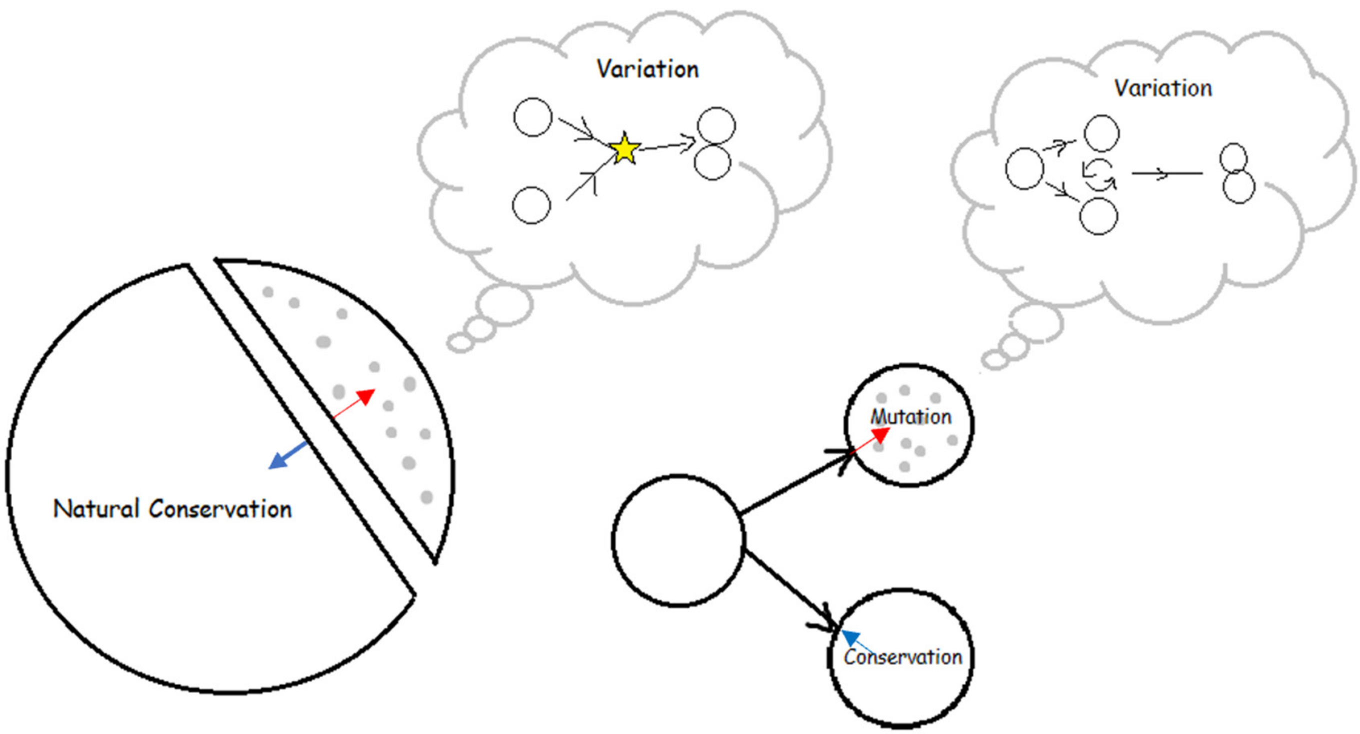


Diagram 2: A demonstration of the two forces at play on non-living and living beings. The left section shows the division-coupling process of non-living beings, while the right shows it for living beings. The blue arrows refer to the force of conservation, while the red arrow refers to the force of variations. Diagram by Ye Chen.

The term, *division-coupling*, therefore, can be used to describe any stage of evolution in the finite interval of beings. While the concept does pass over many detailed facets of existence, such as the diverse forms of reproduction and intricate composition of beings, it allows us to better comprehend existence, as the simplified concept helps us develop a unified rubric. This leaves us with the essential variables for a fundamental understanding of reality and allows us to generate a functional universal philosophy.[12]

We should not be surprised to find ourselves sharing properties with less-complex animals and plants as well as with chemical and physical substances, for we all belong to the *finite interval of beings* – the holistic unity of existence. In this interval, there are no environments, conditions, subjects and objects – there are only **beings interrelated with each other and derived from one another carrying on the conservation and variation that allows them to repeatedly diverge and couple into different forms.**

The Being of Equivalence

When we speak of the existence of a being, we mean that it is in a state of structural-coupling, in which its interactive-quality is coupling with a corresponding interactable-quality. This makes every being generally equivalent – as all of them meet this existence criterion. Dissatisfaction of this criterion indicates that a being is no longer in a state of adaptation. Losing an adaptive state does not mean that the being disappears in the finite interval of beings. Instead, it drifts to a different position in the interval, which also meets the existence criterion, but it loses its original form of existence.

So-called ‘inferior’ or ‘superior’ qualities (conditions) are an expression of humans’ intuitive feelings. They are of little value in our paradigm. Instead, we should consider what makes a quality possible and how a being came to exist. This examination needs to include **the vertical evolutionary history that made**

it possible and the horizontal interactable-qualities that support its existence.

One may argue that a human is superior to a bacterium because they can do things a microbe cannot. But this only reflects different *realms of existence*. If a human loses their reasoning ability, they lose their realm of existence. A human without reason would be unable to function in society unless someone cares for them, which adds an extra interactive-quality to a disabled person. Only when this interactive-quality fulfils the criterion prescribed by a human realm of existence can they exist in that form.

Therefore, from the perspective of existence / adaptation, all beings can be considered the same. Whatever the varieties of interactive-quality, it is all for realizing the existence of a specific form-of-being. In the 20th century, Ludwig von Bertalanffy adopted this concept in biology as *equifinality*: how all beings maintain themselves by different means to reach the same final state of adaptation.[13] Humberto Maturana and Francisco Varela similarly adopted this concept in biology: 'All these variations … are equally adapted. They can continue the lineage to which they belong in their particular environment.' The phenomenon of evolution, they argue, is only an organism's effort to continuously couple with the environment.[14]

Darwin's Natural Selection

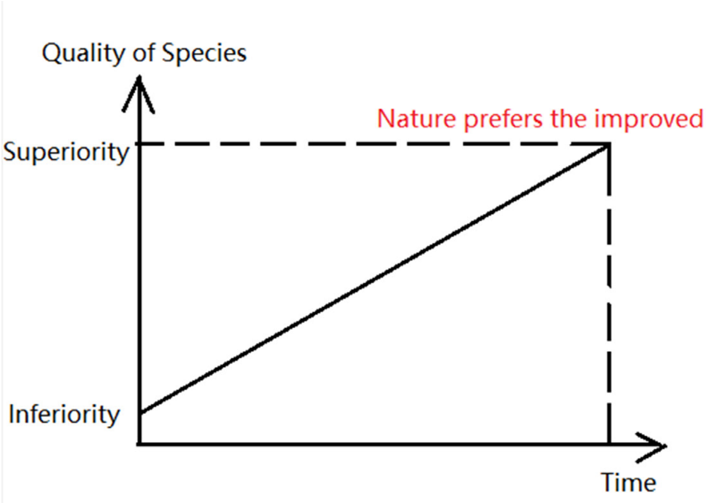
One of the theories of evolution that Darwin proposed in *On the Origin of Species* (1859) is natural selection. As he stated:

> The theory of natural selection is grounded on the belief that each new variety, and ultimately each new species, is produced and maintained by having some advantage over those with which it comes into competition; and the consequent extinction of less-favored forms almost inevitably follows.[15]

This conclusion was evidenced by observations of the survivability of different animals, competition taking place among animals struggling for existence, and the process of inferior animals being replaced by improved forms. His statement contains two paradoxes. On one hand, nature favours the adapted ones and kicks out the less adapted, which is consistent with our criterion of adaptability.

On the other hand, it suggests that species are always evolving to be *more adaptive*. This implication is reinforced by Darwin repeatedly calling endangered species 'less improved' or of 'inferior quality,' as well as being replaced by 'improved' or 'superior' species.[16] This is a misleading if we consider living conditions to be a *variable* factor.

Old species, with their old traits, may have adapted well to their living conditions for millennia, yet with a change of conditions, such as environmental resources, climate and other factors, they lose their advantage. More adapted species may occur at that time, but, when we say the words 'more adapted,' we actually mean more adapted to the changed condition, which is no longer the original condition.



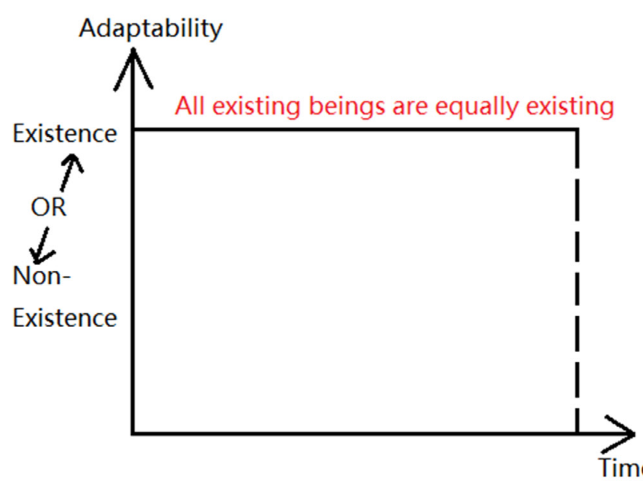


Diagram 3: The left coordinate demonstrates Darwin's natural selection, and the right Existence of Equivalence. Diagram by Ye Chen.

If we compare the adaptability of the old and new species to their respective conditions, it is the same – both can adapt to it. Based on this, the equivalence theory shifts the traditional evolutionary model that Darwin hypothesized, which can be illustrated as in Diagram 3.

Efforts to evaluate adaptability are incongruous. Suppose, for example, that a species develops new and more ‘advantageous’ traits in reproduction; it can then evolve into a new species that may outcompete the older species. In this case, the environmental conditions in which the older species thrived has changed (due to arrival of the new species), which causes the older species to ‘lose adaptation.’ Nonetheless, we cannot attribute a new species’ overall success to only a narrow range of factors, such as its new reproductive ability.

The new species will not be more adaptable to the new conditions than the old species had been to the earlier conditions … both were successful in their own environments. We cannot simply assess the mechanical value of a new productive trait, because such a change can affect the entire living system and may even lead to negative results. A hypothetical ‘advantageous factor’ does not exist independently, but instead it is interconnected with many other factors. Therefore, the survival of an ‘improved’ species (in Darwin’s words) is ambiguous, since it depends on complex, interactive circumstances, not single, simple factors.

However, what we can be certain of is that both species (before and after an added trait) were adaptable in their own formative environments. If we apply a common standard – whether an interactive quality matches up with overall conditions (interactable quality) within a given period, **natural selection can be redefined as ‘a selection between species whose interactive quality can couple with certain conditions and those species that cannot.’ Those who ‘win’ stay on this equivalency line, until interactive and interactable qualities of beings fail to couple.**

Lifespan of an Average Species and the Limitation of Darwin’s Natural Selection

Being of equivalent adaptability does not negate the fact that species evolve from having simple structures to more complicated structures that allow superior functions. However, are those beings with superior functions superior in their existence? If we expand our vision from Darwin’s occasional scenes of inter-species competition to a larger-scale evolutionary tree, we might even find clues suggesting the reverse.

Although the statistics for evolutionary life-forms can be quite inexact, due to a limited fossil record, they do imply a general relationship between lifespan and body plan. For example, invertebrates have existed much longer than vertebrates and account for 97 % of all species, while single-celled organisms have existed much longer than multi-cellular organisms. This tendency becomes clearer when we compare fundamentally-structured lifeforms with those that are more complicated.

Prokaryotes (such as blue-green algae) have existed for 3.5 billion years. Hydrozoans, a kind of cnidarian located at the basal stock of the metazoan line, have existed for more than 540 million years. Trilobites, one of the dominant groups of Arthropoda throughout most of its history, existed for about 269 million years. Megalodons, regarded as one of the largest and most powerful predators, existed for less than 20 million years. The once dominant terrestrial reptiles, dinosaurs, existed for less than 180 million years.[17]

Most dinosaurs perished during the Cretaceous-Paleogene (K-Pg) extinction[18] In contrast, lower-form, small species – such as diatoms, brachiopods, amphibians and most marine invertebrates – did not suffer such a degree of extinction. Although more complex life-forms have a longer individual lifespan than less-complex species, they tend to go extinct faster. Hydrozoans depended on fewer conditions than dinosaurs to survive, resulting in less of a possibility for them to go extinct.

More fundamental non-living beings – organic macromolecules, molecules, atoms and subatomic particles – can also be included in this evolutionary picture. Compared with living beings, their mass in the universe is much larger, which indicates their much stronger ability to exist than living beings.

This principle uncovers a limitation of Darwin’s natural selection. If there is any ‘inferior’ or ‘superior’ adaptability between beings, the criterion should not be whether one can defeat the other, as suggested by Darwin, but for how long they can conserve themselves in evolution – in other words, **for how long their interactive quality can stably couple with the interactable quality of changing conditions.**[19]

Taxonomy	**Lifespan, millions of years.**	**Kingdom / Phylum / Class**	**Body architecture.**
Cenozoic Mammals	1–2	Animalia/Chordata/Mammalia	Vertebrate; large brain and sensory integration, high metabolism and endothermy, flexible skeleton.
Mammals	1	Animalia / Chordata / Mammalia	As above.
Silurian graptolites	2	Animalia / Hemichordate / Pterobranchia	Chordate plan indicated by gill slits and restricted dorsal tubular nerve cord.
Marine animals	4–5	All kingdoms	All types of body plan, from unicellular to vertebrate.
Echinoderms	6	Animalia / Echinodermata	Mesodermal skeleton, few specialized sensory organs, water vascular system, simple digestive, radial nervous and reproductive systems.
Planktonic foraminifera	7	Protista / Foraminifera	Unicellular body plan in single-celled eukaryotes.
Marine invertebrates	5–10	Animalia / in several phyla, from sponges to mollusca	All body plan types, except vertebrate; 97% of animal species (May 1988).
Diatoms	8	Protista / Ochrophyta	Unicellular body plan, single-celled eukaryotes
Cenozoic bivalves	10	Animalia / Mollusca / Bivalves	Soft, unsegmented body; shell; muscle, simple nervous, open circulatory and digestive systems; sense organs for touch, smell, taste and equilibrium; occ. vision, usu. one or two kidneys.
Dinoflagellates	13	Protista / Myzozoa	Unicellular body plan; single-celled eukaryotes

Table 1: Comparison of the average lifespan between species in simple to complicated structures. Table organized by Ye Chen.

Differentiation Progress of Beings

Even though all beings, as long as they exist, are relatively stable and equally adaptive in the micro-scale, their overall lifespan shows the relative superiority / inferiority of their adaptability in the macro-scale.

When we introduced asexual and sexual reproduction at the start of this article, we noted its common goal is the continuation of species. Asexual reproduction is carried out by a single cell, while its sexual form is between two entities – male and female. Reproduction is a form of the larger process of differentiation throughout evolution, from single-celled to multicellular organisms. Therefore, **evolution can be regarded as the differentiation by beings to adapt in their existence**.

The evolution of body architecture by organisms can be divided into five levels, as shown below.

A. The protoplasmic level of organization is observed in single-cell organisms. Within a plasma membrane, protozoa (for example) are differentiated into organelles that carry out specialized functions. Marking the beginning of specialization: **The evolution of protozoan groups heralds differentiation of more evolved locomotive, sensory and reproductive systems**.[20]

B. The cellular level of organization is transitional between single-celled and two-germ-layered organisms. Cells in this case are ordered in a general manner but have a higher level of morphological / physiological integration. Some of their cells are differentiated to take on the role of sensing, circulating, and plasticizing (body-shaping). In other words: **The 'adaptation task' is distributed to various cells, and each cell no longer functions on its own – it must cooperate with other cells.**[21]

C. The cell-tissue level of organization is an aggregation of similar cells to form better-defined patterns / layers as in tissues (but most other cells are scattered and not so organized). At this level, cells differentiate as they organize into diploid tissue layers, and subsequently, the adaptation task is further divided into more specialized parts controlled by different cell groups.[22]

D. The tissue-organ level of organization is when tissues aggregate into organs, which further increases an organism's complexity. The development of three germ-layers results in most cell-groups being sealed off from each other, causing them to lose direct contact with the external environment. This accelerates cellular differentiation and many of them transform into distinct tissues or organs. **Only in this way can nutrition be well distributed to each part of a body, ensuring the operation of functions to maintain existence**.[23]

E. The organ-system level of organization is a further differentiation, one that constitutes the most complex level of organization – organ systems. These perform all sorts of body functions, such as circulation, respiration, digestion, and others.[24] The complexity and variability of this organization gives rise to the diversification of animals from the simplest nemertean worms, molluscs, and arthropods to fish, reptiles, large-sized mammals, and humans.

Evolution is fundamentally a process of differentiation. The initial single-cell protozoan is a complete organism capable of performing all the basic functions of life. This is commensurate with the progressively specialized functions that emerge within species of escalating complexity. The escalating complexity of species is expressed through the increasing layers of cells (germ layers) that give rise to tissues, organs, and systems. Therefore, the diverse specialized functions and their supportive cell organizations can all be ultimately traced back to the corresponding primitive functions and organization of a single-cell organism.

Inevitably, animals must face the surface / volume ratio problem as their size gets larger. Since surface area (length^2) increases more slowly than volume (length^3), the surface area of larger animals may be inadequate for respiration and nutrition of cells deep within their bodies[25] This necessitates the growth of a nervous system to coordinate communication between cell layers as well as circulatory and respiratory systems for allowing sufficient oxygen and nutrients to pass through their bodies.

In this regard, a protozoan cell, with no germ layer, possesses the most advantageous ratio of surface / volume. Its vast ratio enables it to take in nutrition and interact with the environment, stimulating its metabolism and granting

Level A		Level B		Level C		Level D		Level E	
Cell Division	Functions	Cell Division	Functions	Cell Division	Functions	Cell Division	Functions	Cell Division	Functions
Only specialized organelles	All basic functions needed	Epidermis	Sense	Sensory cells	Tactile, optical	Sensory organs	Better tactile, optical	More sensory organs	Touch, smell, hearing, taste, balance, and vision
		Collar cells	Circulation	Gastro-vascular cavity	Feeding, digestion, excretion	Digestive system: mouth, pharynx, intestine	Digestion	Developed digestive system: liver, stomach, intestine, and other organs	Digestion
				Gland cells	Engulfing and digestion	Excretory system	Excretion and osmoregulation	Developed excretory system: kidneys and other organs	Excretion and osmoregulation
				Simple nerve cells	Links between sensory and muscular cells	Nervous system: neurons organized into sensory, motor, and association types	Sensorimotor association	Modified nervous system: brain and nerve chains	Sensorimotor association
				Muscular cells	Locomotion	Muscular system	Active locomotion	Strengthened muscular system: limbs / wings	Rich behaviour patterns
		Mesohyl	Skeleton	Mesoglea	Skeleton	Connective tissue	Give structure to other tissues and organs in the body.	Respiratory system: gills or lungs	Oxygen moves throughout the body; break-up of size limitation
								Circulatory system: heart, blood vessels and sinuses	Oxygen and nutrient delivery between cells; take-away of wastes
								More complicat-ed connective tissues	Structure given to other tissues and organs in the body.
		Amebocytes	Other functions needed	Interstitial cells	Reproduction and nerve cells	Well-organized reproductive system	Reproduction	Matured male or female organ	Reproduction

Table 2: A rough summary demonstrating the role differentiation progress accompanied by cell division from the lowest to the highest level of biological organization. Table produced by Ye Chen.

	Level A	Level B	Level C	Level D	Level E
Body architecture	Single cell	Aggregation of Cells	Two germ layers	Triploblastic	Triploblastic
Organization	N/A	Loose	Most cells scattered, some organized into tissues	Tissues aggregate into organs; more complexity	Organs work together and form systems
Required condition	Nutrition of any type	Nutrition from water currents	A variety of organisms	Small organisms e.g. protozoans and rotifers	Specific portfolio of nutrition
Response to stimuli	Simple reflexes, instincts	Local and independent	Various stimuli such as light and pressure	Better response to stimuli e.g. light, pressure	Acute sense for faster response
Reproduction	Asexual	Hermaphrodite; asexual/sexual	Sexes separated in some: asexual/sexual	Hermaphrodite; cross-fertilization	Sexes are separated; sexual; end of asexual
Energy take-in mode	Autotrophic	Little locomotion; change shape	Some locomotion and initiative to prey on cnidocytes	Active locomotion	Strong locomotion

Table 3: A demonstration of typical change in the interactive quality and interactable quality of beings with the gradual complexification in levels of organization. Table produced by Ye Chen.

them strong vitality.[26] It is not difficult for sponges either to overcome the surface / volume ratio problem with the second simplest body architecture. Since their cells are loosely organized, sponges can change their body shape to ensure a regular supply of local water currents.[27] However, after cells are organized into diploid-tissue layers at the cell-tissue level of organization, specialized functions must be developed to counter this surface / volume ratio problem.

The growth of an organism's composition must be supported by the absorption of more energy to ensure its functioning. This necessitates the transition of an organism from the life of an autotroph to that of a heterotroph, which means that a given environment alone can no longer satisfy the organism's existence. Organisms, at the cell-tissue level of organization, must turn their passive living state into one that is more active. To find food themselves, sensory cells must be differentiated to enable them to generate signals in response to various types of stimuli, such as light and pressure. Sensory cells differentiate into eyes in more complex organisms to satisfy more demanding food requirements.[28]

Likewise, the development of specialized functions, such as locomotive and digestive systems, express enrichment of an organism's 'interactive quality,' giving rise to expansion of the behavior patterns of organisms. Such progression is only to couple with the organism's increasing 'interactable qualities.' As a result, the process of differentiation also implies harmonious coupling between interactive and interactable qualities.

Principles Drawn from the Differentiation Process

Comparing the variables of the organisms from A to E in the above subsection, we can see the following evolutionary transformations at work:

(i) A radical increase in cell diversification and organism functions.
(ii) An organism's structure becomes more complex, and it tends to be more tightly and systematically organized.
(iii) The required conditions to support an organism are more and more demanding.

(iv) An increase in the interactive quality of an organism, as its response to stimuli becomes richer and faster.
(v). The reproductive task of more complex organisms is differentiated into two gender roles, which complicates the breeding procedure.
(vi). The organism's locomotive ability becomes stronger to align with increasing required conditions.

Evolution of non-living beings also follow the being of equivalence criteria and differentiation mechanism. For example, the single point of origin of existence – the Primal Singularity – differentiated into elementary particles that played different roles in constituting atoms. These atoms aggregated to play different roles in composing a molecule. 'Cooperation' between the particles preceding the genesis of living beings is not as complicated as the cooperation of cells functioning in an organism, which applies to principle (ii).

Evolution of the social domain also follows the differentiation mechanism, in which every individual plays a part in maintaining society's structure. The society itself is a product of differentiation.

The principles of differentiation indicate the *being of equivalence*: **For any level of a being, its properties** (interactive, reproductive, locomotive …) **are consistent and correspond to its realm of existence**. But that being said, the beings are not equivalent, considering their disparity in the overall lifespan of species. This is related to the increasingly intense differentiation of roles in an organism, as shown by (i) differentiation of functions, (ii) complexity of structure, and (iii) increase of required conditions. We will discuss the riskier existence state of higher-level entities, especially the complicated social domain, in a following article in this series.

To sum up, the progress of evolution / variation is a process of differentiation, by which one role is differentiated into additional roles, which then couple with each other to maintain their respective, on-going realms of existence. This provides us with a clearer view of the 'division-coupling' process.

Relationship between the Interactive Quality Layers

We now understand the relationship between the four layers of human beings' interactive quality: **Each layer is an enhancement of its lower layer, yet each layer is also a differentiation – a derivative**. Enhancement therefore

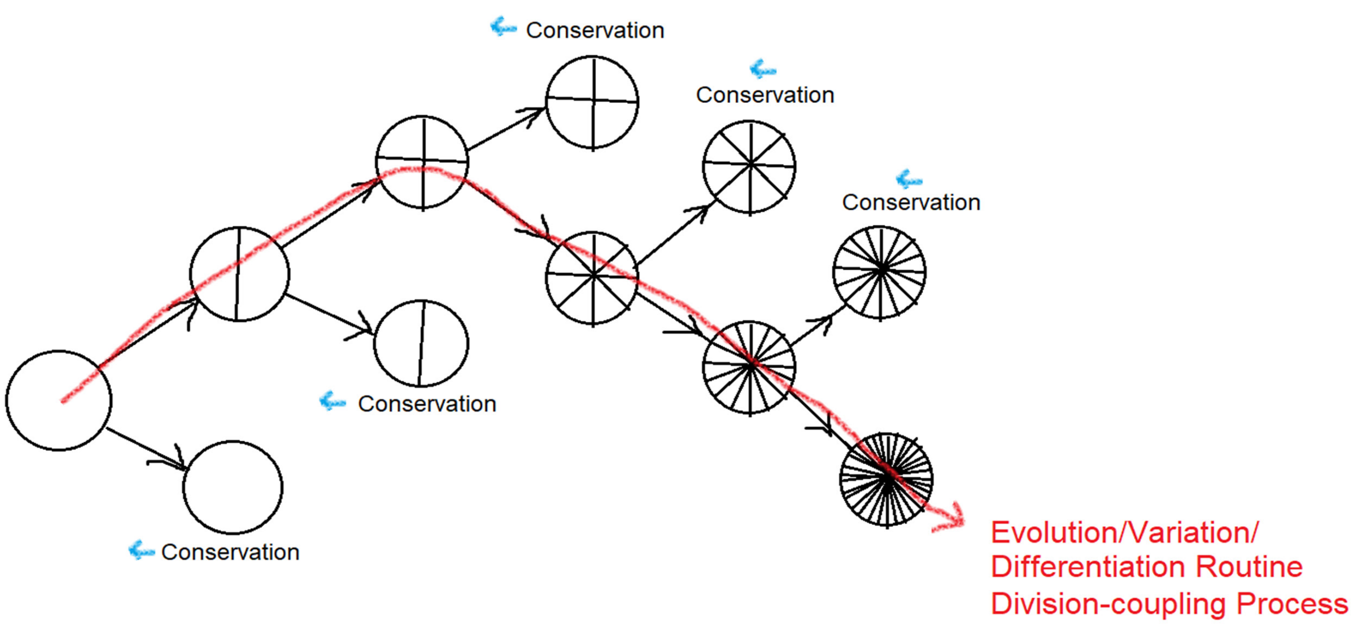


Diagram 4: Sketch illustrating the division-coupling process, showing how the role of existence is differentiated into more and more roles that couple with each other along their evolutionary pathway (shown as a red curve). The circle on the right with the most segments represents a being with the most complex structure and richest functions (interactive quality). The circles for 'conservation' reflect the force of conservation among all species. Diagram by Ye Chen.

means an enlargement of the interactive quality (compared with the lower layer), which enables a being to couple with more interactable qualities.

In diagram 5, layer D is derived from earlier differentiations of layers A–C. The quality acquired from that layer is thus an enhancement / enlargement of the lower-level interactive quality that belongs to the A–C layers. To make an analogy, a difference between layer A and layer D is like spreading glue on a single fingertip versus on an entire palm – one can stick more things with an entire palm.

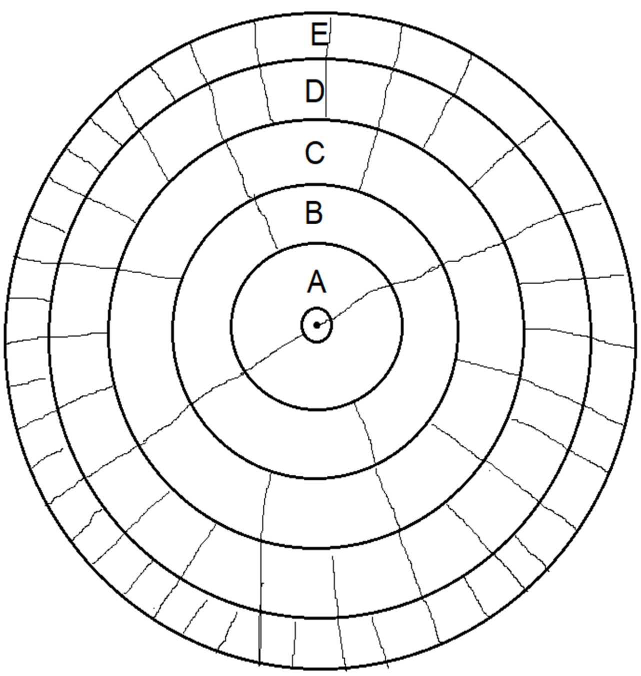


Diagram 5: A schemata of how a being evolves from levels A to E with more and more differentiated segments. The centre of the circle, a dot, with its simplest interactive quality (functions) and structure, symbolizes the being closest to the Primal Singularity, at the very beginning of the differentiation process, which is the least differentiated. All circulars around the centre are enlarged versions of it and surround the same centre. This reflects 1) Derivative relationships from the Primal Singularity through A to E., 2) Quality to maintain existence is differentiated and expanded level by level, 3) All differentiated functions (segments) of the circles aim to serve the same goal of existence (adaptation), which makes them equivalent. Thus, all circles are **in commensurate relationship**. Diagram by Ye Chen.

The concept of derivation and differentiation emphasizes that although the primitive interactive quality is differentiated and thus enhanced, the central theme does not change – namely to maintain its state of existence. While a particle uses layer A to maintain its existence, animals must possess layer D to maintain their state of existence.

The act of 'knowing' is a result of structural-coupling between an interactive-quality and an interactable-quality. **The enrichment of a being's interactive-quality increases the contact points of its interactable-quality**, thus enabling humans (with a higher-level interactive-quality layer) to couple with more interactable-qualities than say prokaryotes (with a lower-level layer). This results in the phenomena of 'knowing more.'

Yet 'knowing more' does not mean getting closer to the 'truthfulness' of an object simply because of the common essence of higher and lower levels of interactive-quality. Higher-level of interactive-quality are only an enlargement of lower-levels and can be evolutionarily traced back to them. The difference between a protozoon and a human merely reflects their different realms of existence and states of structural-coupling.

Required Conditions for Progressive Beings

Besides the differentiated and enlarged functions (interactive qualities) needed to support the evolving nature of beings, the interactable qualities – under the principle of *horizontal interrelation* – are also vital to how a being functions. So, it is necessary for us to examine conditions in the progressive level of beings, so that we can understand how they reach their existence criterion.

The lowest level of being in the universe lies with elementary particles – quarks and leptons, which are currently considered to be the ultimate constituents of matter, and bosons, the force carriers of fundamental interaction.[29] Unable to be divided further, these particles possess the strongest structure that is not possible to disintegrate, which means that the required condition to support their existence is almost nil.

Through differentiation and coupling, these elementary particles construct simple, composite particles, such as protons, neutrons, and other hadrons. They possess the second strongest structures, with a relatively high binding energy of 280 MeV for bottom quarks. The temperature needed to separate quarks and gluons is about two trillion degrees Kelvin (the expected conditions for their particles to disintegrate).[30]

As these composite particles differentiate further into more complex forms, such as atomic nuclei (protons and neutrons), their structure again weakens, and it is possible to separate nuclei. The average binding energy of a nucleon (from the elements hydrogen to nickel) is about 6 MeV – almost fifty times less than that of simple, composite particles.[31]

The next step of differentiation generates atoms in the universe, which are composed of electrons, protons, and neutrons. Again, as the structure evolves to become more complex, it also becomes weaker and more vulnerable to disintegration. The energy required to remove an electron from an atom, namely ionization, is lower than that needed to split atomic nuclei … by several orders of magnitude – 12 keV for copper.[32]

As atoms further differentiate and form molecules, we now enter the world of chemistry. The energy that binds atoms together, known as its chemical bond, decreases again (compared to ionization), generally varying from 10eV to 0.03eV.[33] We then arrive at the level of organic chemistry – compounds based on carbon – signifying a next stage of evolution just prior to the advent of living beings.

We can therefore conclude: **As structures complexify and differentiate, the conditions required for a being to disintegrate becomes less**. In other words, a being disintegrates more easily. This also means that along the unidirectional evolutionary / differentiation route shown in Diagram 4, the required condition for a being to maintain its form is more and more demanding.[34]

When macromolecules evolve into living beings, this tendency continues. A being then shifts from an energy-releasing to an energy-consuming mode, in order to maintain its existence. Instead of paying attention to the condition required for non-living beings to disintegrate, we now focus on the condition for living beings to conserve.[35]

Level A organisms, like single protozoan cells, accept all types of nutrition and can gain energy simply from sunlight. This means that the organism relies on very few conditions, as its interactive quality / structure is so simple that ambient conditions are enough to sustain it. In comparison, more complex forms of animals demand more conditions (interactable qualities), with which they need to couple for their survival.

This trend is prescribed by phylogeny – without certain preconditions in its evolutionary pathway, a species cannot come into existence. For example, it was only possible for flatworms to appear when microorganisms had evolved to provide food for the flatworm ancestors' interactive quality / structure. **There must be right conditions for an organism to exist … and there must be right conditions for the right conditions to exist.**

The occurrence of increasing conditions makes a being's interactive quality / structure possible and determines on what the being must depend on to survive. This means that a being's interactive quality (such as sensing, digesting and hunting) couples with the conditions, while the conditions also ensure that the being can acquire sufficient life material, thus supporting the continuous operation of its interactive quality.

So, to support the functioning of a more differentiated being, conditions must be of a greater quantity and a more demanding quality. That is why higher animals depend on a much larger number of conditions to maintain their existence. Adaptive radiation, addressed by many evolutionists, evaluates species' ability to create new zones when facing a change in conditions.[36] This approach is effective when comparing species at similar levels on a relatively small scale, but it is less relevant on a larger scale, because the quantity of the conditions required by different levels of being are so disparate.

For example, an ancestral E level organism may be lucky enough to adapt to a variety of possible changes through speciation. But its vitality cannot be compared to organisms of A, B, C levels, because they *do not need* to challenge themselves to adapt *so frequently* as an E level organism, since the conditions they require are much less and hence more easily sustained.

This is easy to understand if we compare the condition complex between different levels of particles. Logically, **a random change has a greater probability to threaten a condition** on a level that molecules depend than at the level of atoms. Such change may either cause molecules to disintegrate into atoms (or other forms) or force a molecule to mutate in order to adapt to change in conditions. This explains why the level of molecules is more likely to mutate compared to the level of atoms, giving rise to the genetic variation on a molecular basis.

Based on the above, three issues aroused by the being of differentiation can be drawn:

(1). **The being of differentiation is accompanied by an increase in conditions**.[37]

(2). **The process of differentiation is also a process of structuration, which means more and more specialized roles are differentiated and can couple with each other to make more complex, yet *weaker* structures.**

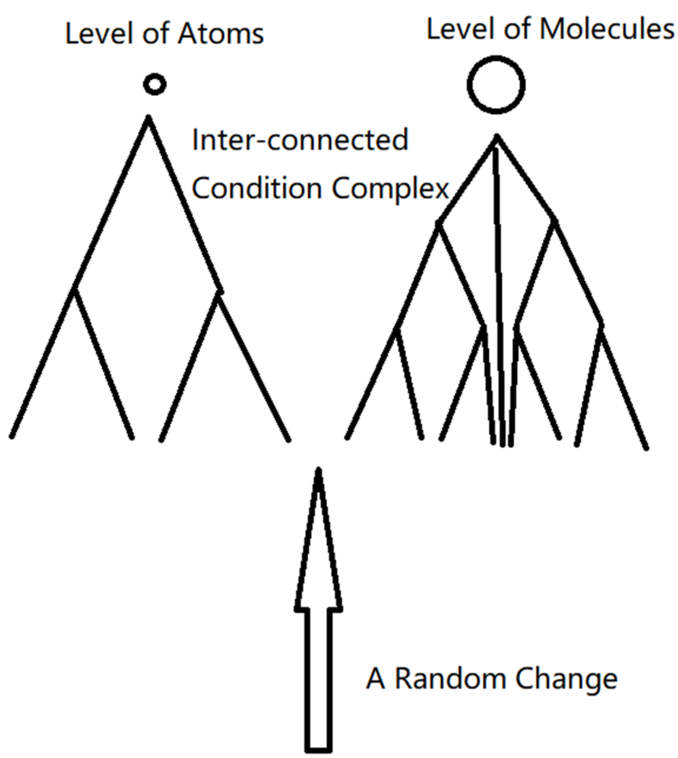


Diagram 6: An analogy of the conditions on which different levels of beings depend. The line segments represent superposition of interconnected conditions. When more conditions appear, some atoms differentiate into molecules, which means that the molecules must depend on more conditions than atoms to occur and maintain their existence. Diagram by Ye Chen.

(3). **Higher-level beings, which depend on increased numbers of conditions, mutate and diversify at a faster rate than lower-level beings**.[38]

These conclusions align with matter's distribution in the universe: **The total quantity of each form-of-being reflects its stability – its conservation ability, so the diversification of various levels of being reflect its evolutionary momentum.**

Coordination Between Sense and Reaction at Different Levels of Beings

The fourth issue derived from the being-of-differentiation is related to coordination between sense and reaction. The interactive qualities of the lowest level of beings (elementary particles) stay at the level of particle-particle interaction, where **the functions of 'sense' and 'reaction' are unified.** There is no division at the most basic level of being – sense and reaction occur simultaneously within a particle.

This situation is quite similar with the Big Bang, when the four fundamental forces were unified as one entity in the primal singularity. The coordination between sense and reaction of higher-level living beings, as usually studied by biologists, actually originated from this unified sense-reaction function of particles. Thus, particles' interactive functions can be viewed as most ancestral, a latent sense-reaction function.[39]

For A-level organisms, sense and reaction occur almost simultaneously, since unicellular organisms, with their perceptual layer of interactive quality, respond to a stimulus by simple reflex. This means that their response is virtually automatic and instantaneous.[40] In this process, though, sense and reaction are somewhat separated since sensing and reacting are distributed to different components in the cell.

This process suggests the seed of a cognitive act by which a being detects an interactable quality with which it couples. At this level, a being's interactive quality is quite limited and so the interactable qualities with which it can couple are limited. The law of identity (A=A) applies to this situation, as the being is not able to sense interactable qualities other than 'A.'[41] This is enough for that being, though, because 'A' has provided everything needed to maintain its existence at that level.

Since a being only needs to sense 'A' and react, at this level, evaluation needs not to be complex. It is only when a being can sense interactable qualities B–C–D–E does it need to identify and evaluate those qualities to which it must respond. The act of evaluation only starts at higher intuitive layers. At the perceptual layer, once an A-level organism senses 'A,' it has completed the simplest dependent process and satisfied the demand for maintaining its realm of existence.[42]

For 'B' to 'E' level organisms, sense and reaction are increasingly separated as they are distributed to specialized functions in an organism. The cognitive function / nervous system gets more complex as the form of movement / behaviour is enriched to enable a being to react to its cognition. **A being's interactive quality therefore rises from the perceptual to the intuitive layer to make distinctions and judgements, otherwise it cannot survive the larger number of conditions it encounters.**

As a higher-level being, an organism must be able to sense more interactable qualities (conditions), such as the scent of other animals or the sight of a predator. Among the interactable qualities A–B–C–D–E (and so forth), an organism needs to utilize the three laws of thought – A=A, A≠non-A, and A=B or A≠B – to make distinctions, decide to which it must respond, and coordinate how it should react.

The more conditions there are, the more difficult it is for a being to make judgments and coordinate its reaction to these interactable qualities. If a being makes a favourable decision and reacts to conditions, it accomplishes *a completion of the dependent process*, which also means a realization of the demand for its realm of existence.[43]

Although completion of the dependent process in higher-level organisms is equivalent to that of lower-level organisms, the distance between sense and reaction is larger for them and the process becomes more complex. A being's wrong judgement or reaction to conditions may put it in danger, leading to a *failure in completing the dependent process*.

So, for any given species: **The interactive quality must reach a certain standard that matches up with its realm of existence**. If that interactive quality is below this standard, interactive failures (sense-reaction errors) will occur too frequently for a species to thrive. This may lead to extinction, unless a beneficial mutation appears, one that modifies the interactive quality of the species.

The more numerous the interactable qualities, the harder it is for a being to handle them, just as it is also

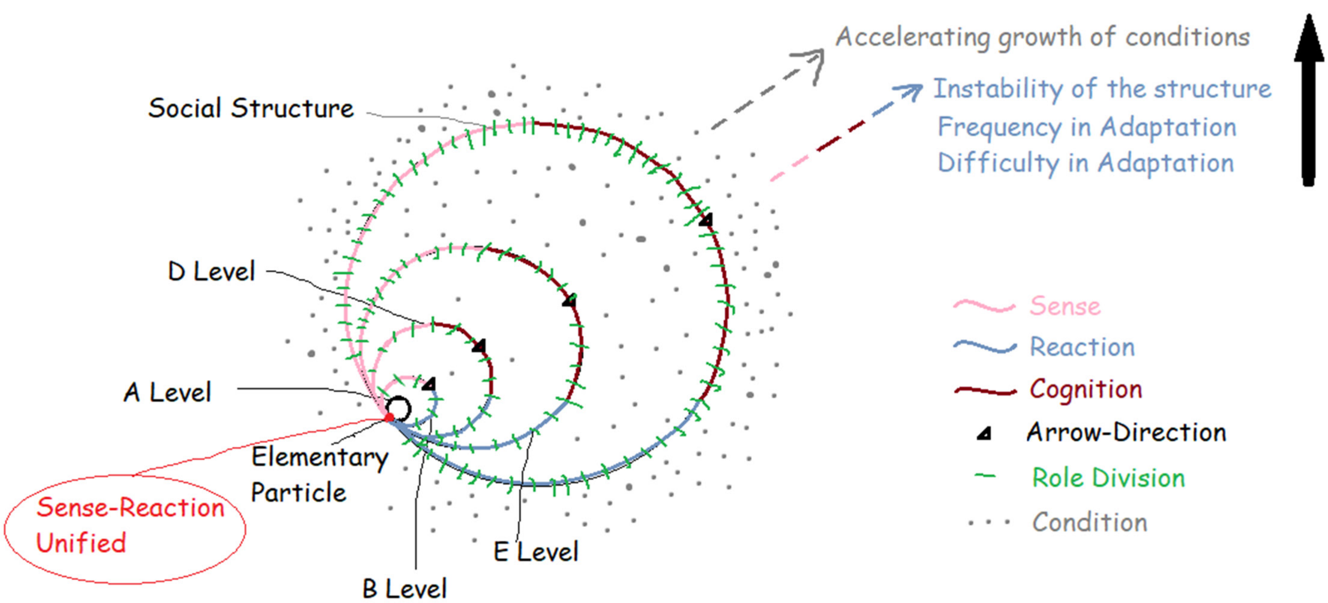


Diagram 7: A metaphor of the evolving sense-reaction process – from one red spot to bigger and bigger loops through which a being must go. A complete loop from the start (sense) to the end (reaction) means a completion of the dependent process and thus fulfilment of existence. More and more conditions (grey points) are generated when a being goes around the loop with its enhanced interactive quality, with more and more of its roles divided. Diagram by Ye Chen.

more difficult for it to complete the dependent process. Hence, more advanced interactive qualities are required. In this way, the original sense-reaction process expands to complex sense-cognition-reaction.[44]

For human beings, the distance between sense and reaction has been pushed even farther apart. We ponder on what has been acquired from our intuitive layer with more complicated forms of reasoning. **This is because our conditions are so diversified and complex that a more advanced 'information processing system' has evolved, which allows us to realize our own existence.**[45]

Therefore, human realization of the dependent process is complicated, flexible, and diversified. Compared to lower-level animals' uniform sense-cognition-reaction that copes with limited conditions, humans function with all four layers integrated together to handle a large magnitude of them.

This multifarious situation is seen in the many 'realities' described by psychologist George Kelly.[46] When studying this magnitude of conditions, peoples' way of organizing, defining and demarcating their experiences are diverse. The ever-changing views of so many objects explain the many models we implement to describe the world.

Conclusion on the Fourth Issue

We could perceive that sense and reaction are two sides of the same dependent process, but, along with the process of differentiation, **an increase in the number of conditions also confuses the process**, which gives rise to a nervous system that allows more cognitive patterns to coordinate the process. Nonetheless, however distant and complex this new system is from sense to reaction, they share the same goal of existence – a completion of the same dependent process.[47]

Meanwhile, as the gap between sense and reaction gets broader, **it also becomes more and more difficult to complete the dependent process and realize the state of existence, due to the accelerating growth of conditions (mass information) that one must deal with to make judgements favourable for existence.** This constitutes the fourth issue aroused by the being of differentiation.

However, is it possible for us, the highest-level of being, to reach a state of equilibrium where our interactive quality can overcome all conditions with which we face?

Preview of the Next Article

In my next article, I will answer this question by focusing on the evolution of society –how society is formed, balancing social structure, growing structuration and function, and the hardships of complexities human society needs to survive. Then readers will be guided to reflect on the phenomena that we have addressed – variations, differentiations and increasing conditions, then to contemplate the underlying mechanism that gives rise to them – the ultimate cause of evolution …

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Endnotes

1 While the concept of an originating source – the One – is derived from classical Chinese and Greek philosophy (Laozi and Parmenides of Elea), we can more accurately express it in scientific cosmology as the 'Primal Singularity.'

2 Maturana and Varela 1987: 61–69.

3 Smith and Szathmáry 1995: 149.

4 Maturana and Varela 1987: 65–66, 80–81.

5 Hickman and others 2002: 31.

6 Betram 2000.

7 Kimura 1983.

8 It drives a mutation in the single-celled organism, which changes the way certain proteins function – that is, proteins can link to other proteins. Pennisi 2018. Anderson and others 2016.

9 Scoville 2021.

10 Oks 2021. For example, the Sun makes up more than 99.86% of the total mass of our solar system, and, according to statistics from the Wilkinson Microwave Anisotropy Probe, the universe is made of 4% of regular baryonic matter, 23% dark matter, and 73% dark energy.

11 Wang 1998: 77. In Wang's theory, division does not simply mean something is fractured into two in a horizontal and static sense, rather they are derived from one in a vertical and evolutionary sense.

12 While more and more details appear in scientific research, this information is largely secondary to our goal of understanding the unified force driving existence. Properties can also be called information, as they both refer to what we know of objects, which is a product of our interactive quality coupling with the interactable quality of the objects. While the notion of 'information' became prevalent with the arrival of the Information Age, 'properties' were more commonly used in an earlier low-information time. Fundamentally they signify the same thing.

13 Jackson 2019: 30–31.

14 Maturana and Varela 1987: 107, 115

15 Darwin 1859: 343.

16 Darwin 1859.

17 Schopf and Packer 1987. Park and others 2012. Boessenecker and others 2019. Holtz 2007.

18 Overall, the K-Pg extinction killed most tetrapods over 25 kilograms. Muench 2000: 20.

19 Wang 1998: 285.

20 Protozoa locomotor organelles enable it to move, handle food, reproduce, excrete, and conduct osmoregulation; simple endoskeleton and exoskeleton are provided in some; true sexual reproduction with zygote formation is found in others; the response of protozoa to stimuli such as light or the presence of food represent the simplest reflexes and instincts; all those functions are important for higher animals. Hickman and others 2002: 52, 86–87.

21 Sponges, the simplest multicellular animal that adopts this level is merely an aggregation of cells that are coarsely assembled into two thin layers – 1) an opening epidermis layer bearing myriads of tiny pores and 2) an interior layer containing flagellated collar cells and a system of canals. In the middle of the two layers, a gelatinous protein matrix, mesohyl, is located. This functions as an endoskeleton that prevents the canals from collapsing. Sponges possess unspecialized cells called amebocytes that can differentiate into any of the other types of more specialized cells to carry out necessary functions, such as reproduction and digestion. Hickman and others 2002: 107.

22 Cnidaria have two well-defined germ layers – 1) the epidermis of the ectoderm (external layer) includes muscle, nerve, sensory, gland, stinging and interstitial cells; 2) the gastrodermis from the endoderm (stomach layer) contains gland, nutritive-muscular, interstitial, and stinging cells. Like the sponge, there is a gelatinous matrix (mesoglea) between the two layers, which functions as hydrostatic skeleton. The gastrovascular cavity is surrounded by two layers for digestion, with a single opening at the end serving as both mouth and anus. Hickman and others 2002: 53, 121-122.

23 A typical example of this is the flatworms, a phylum derived from a radial ancestor, probably the cnidaria. Flatworms' gelatinous mesoglea is replaced by a cellular mesoderm in the form of muscle fibers and mesenchyme (connective tissue). This adds an extra middle layer to the prior two germ-layers of cnidarians, which makes them triploblastic. Their muscular system is more developed since the added mesoderm makes more elaborate organs possible. To complement their active locomotion, a nervous system is formed, consisting of a pair

of anterior ganglia with longitudinal nerve cords. The neurons are organized into sensory, motor, and association types – an important step forward from cnidarian nerve cells. Sensory organs are advanced to cooperate with active locomotion, such as ocelli (light-sensitive eyespots). Hickman and others 2002: 52–53, 140–142, 152. Wang 2002: 43.

24 Hickman and others 2002: 53.

25 Hickman and others 2002: 52.

26 Wang 2002: 43.

27 Ruppert 2004: 83.

28 Hickman and others 2002: 122.

29 Braibant and others 2011: 1–3

30 Karliner and Rosner 2017. Gupta and others 2011. In this discussion of binding energy, it is important to point out that it is variable, according to the specific matter and energy under discussion.

31 Kraine 1988: 67.

32 Lang and Smith 2003. Wang 1998: 71.

33 Margulis and others 2021.

34 Wang 1998: 80, 85.

35 For non-living beings, we often use descriptions such as ‘stability’, ‘separation’, and ‘fusion’; while for living beings, we use ‘conservation’, ‘extinction’ and ‘evolution’. But ultimately, these descriptions signify the same situations from the perspective of being’s evolution: either a being stays in a certain form, disintegrates, or differentiates into being with a more complicated structure.

36 Hickman and others 2002: 29–30.

37 Wang 1998: 70.

38 Wang 1998: 21.

39 Wang 1998: 185.

40 Purves and others 2004.

41 ‘A=A’ is the act of demarcation, the most fundamental epistemological process existing in even the simplest beings. In Spencer Brown’s perspective, “a universe comes into being when a space is severed or taken apart. The skin of a living organism cuts of an outside from inside.” (Brown, 1972, p. v) “A=A” implies the concept of severance as A is an object that is extracted from a chaotic background, through which the being’s dependent process and realm of identity is realized. If a being has a condition to depend on, ‘A=A’ functions in it in a way that it distinguishes itself from the condition, it lives on.

42 Wang 1998: 174.

43 The dependent process refers to the process in which the being tries to acquire various sorts of dependent conditions taking advantage of its interactive quality. It runs through the entire lifespan of the species, rather than one or multiple instances.

44 Wang 1998: 129–130.

45 Wang 1998: 157, 176.

46 Midgley 2000: 26.

47 Wang 1998: 167.