

Intra-World Measurement and Intra-World Action

Michinori Kobayashi

(Japanese philosopher)

We perceive the world not externally but internally. Also, we act on the world not externally but internally. And it is these perception and action that make up the self-forming world. If so, we must transcend the world view of modern philosophy and modern science which regard separately the self and the world, subjectivity and objectivity, reconsidering the deep connection between existence, perception and action. From the standpoint of such intra-world perception and intra-world action, this thesis is an attempt to discard subjective and objective paradigm and to provide an epistemological basis for a world that forms itself from the interconnection of innumerable elements, that is, a complex system.

1. Uncertainty Principle

Uncertainty Principle and Complementarity Principles

According to Heisenberg's indeterminacy principle, no two physical quantities, such as the position and momentum of a particle, can be accurately measured at the same time. If you try to measure the position of a particle, that measurement will affect the momentum of the particle and the momentum cannot be determined. When attempting to measure the momentum of a particle, the measurement affects the position of the particle and the position cannot be determined. For measurement, particles such as light and electrons must be used, but when this happens, the particles to be observed interact with each other, and the position and momentum of the target particles become ambiguous. Because the state of the particle under measurement is disturbed by human measurement, it is no longer possible to categorically determine the state of an objective particle that is detached from measurement. In the case of classical mechanics, the states of particles, such as their position and momentum, were assumed to be objectively measurable independently of us (observers), but this classical certainty has been collapsed in the micro world of quantum mechanics.

Thus, in the microscopic world, we can never know exactly where the particles is but can only know the probability of existence. Any microscopic event can only be understood as probability. In

quantum mechanics, such probability are expressed mathematically as a wave function. Therefore, in quantum mechanics, particles are also treated as waves at the same time.

For a particle, waviness is a fundamental property. In fact, light can also be considered a particle, and at the same time a wave. In addition, electrons, which were thought to be particles, also cause interference and behave like waves, just as light does. Neutrons, atoms, and even giant molecules are said to exhibit wave-like properties. However, if the path of the particle can be observed by the experimental apparatus, the particle nature appears, the wave nature disappears, and the interference phenomenon is weakened. In the microscopic world, matter can be a particle or a wave, depending on how you look at it.

The nonlocality of the particles can also be attributed to this. Particles can only be described in terms of probability and can only be said to have a tendency to exist. The particles show a tendency to be in various places at the same time. So, particles are non-locally bound and do not exist in isolation.

In the microscopic world, matter is both a particle and a wave. When we observe it, it becomes a particle if we see it as a particle, and only appears to be a wave if we see it as a wave. The particle nature and the wave nature of matter are complementary and can never be observed at the same time, but only with both can we fully describe the state of matter. As is well known, Bohr named it the complementarity principle and established it, along with Heisenberg's indeterminacy principle, as the most important principle of quantum mechanics. According to Bohr, irreconcilable concepts are different aspects of the same world, and opposing concepts must be considered complementary to each other.

In quantum mechanics, the ultimate unit of physical existence does not have a specific position nor occupy a single state before it is observed. Before the measurement, the object is in a state where various states are simultaneously superimposed, and it is not possible to state definitively that the state of the object is like this. The object is in the superposition of various possible quantum states until it is grasped by some act of measurement. The quantum indeterminacy of this superposition is due to the fact that the observer cannot know the exact quantum state in the same way that we cannot know the future precisely.

However, as soon as the object is observed, this superposition is dispersed and the object takes only one state. Only then can a classical description be made possible. For example, microscopic entities such as electrons spread out as waves when they are unobserved. However, as soon as the wave contracted, electrons appear as particles. A quantum appears as a particle only through our measurements. Our act of measurement causes the waves to lose their character. The dice in the

bowl are in a state of superposition that is both an odd number and an even number. In the same way, it is in the hands of our observers that a particle is determined to be in a single state.

This problem, as is well known, is explained by the thought experiment of <Schrödinger's cat>. In one box, one cat, a jar of volatile venom, a hammer, a radioactive atom, and a radiation detector. The detector and the hammer are interlocked, and when it detects radiation, the hammer is swung over the jar, the jar breaks, and the box is filled with the venomous gas, and the cat dies. The probability that a radioactive nucleus will decay after one minute is 50/50, and it is a superposition of <decayed> and <not decayed>. Therefore, the cat's condition would be one of not knowing whether it is alive or dead, or rather a superimposition of the living and the dead. It is only when we, the observers, open the box and observe the cat that it is determined whether it is alive or dead.

This thought experiment parable was originally prepared to point out the strangeness of quantum mechanics, but there are many important epistemological issues involved here. However, in the quantum mechanical world, our act of measurement has an effect on phenomena. The effect of any measurement on the object being observed cannot be discounted. It is not possible to observe it without affecting the phenomenon itself. The observer is also necessary to define the nature of the object.

The no-separability of the observer and the observed

We do not observe the world externally but observe it internally. Besides, we observe it through our body or instruments. Therefore, it cannot be that the act of measurement does not affect the observed fact. Measurement is an active conduct. Because we are the intra-world observers and actors, we disturb the world and also determine the world. The observer exist within the observed not observing the observed externally.

In the case of Schrödinger's cat also, the state of the observed is determined by an observing human being, yet that human being is not an entity floating in the air, completely detached from the observed. It is the self with physical body observing and acting in the world. So, the observers are deeply involved in the existence of the observed. In the quantum mechanical world, the observer cannot be an independent observer, but always participate in the way the world exist. We are not spectators, but we are the co-actors.

Quantum mechanics has brought “me” from the background of natural phenomena to the stage of measurement and action. It also revealed that measurement by the scientific method itself has an effect on nature itself, forcing a major change in the traditional view of natural science. The idea since Descartes and Newton that the observer stands outside the world and observes, and that this

establishes an objective perception without disturbing the world itself, is no longer valid.

This state of superimposition is constantly appearing in the everyday perceptual world. For example, even in Escher's polysemic figures, there are some that appear to be dancing angels and some that appear to be dancing demons. It is in a state of superimposition of the devil and the angel, so to speak. If we as observers observe them as angels, we see them as angels, and if we observe them as demons, we see them as demons. It could be said that this is an example of a constant convergence of states through measurement.

Originally, we can say that nature is in a state of superposition of various aspects, like Escher's polysemy figure. Nature, when observed in a certain way by us observers, has a definite state according to that measurement. The phenomenon of superposition is rather common in the natural world. The more we explore nature, the more diverse it will be. Since nature shows various faces according to the perceptivities of the perceiver, it must be said that an analogy such as Schrödinger's Cat is not only true in the microscopic world, but also in the macroscopic world.

The observed always includes the observer himself. The observed and its observer cannot be separated. The observer is an intra-world cognizer who is in the world and recognizes the world.

Ontology is deeply connected to epistemology. Physics should be a description of what we can say about nature, not just of nature itself. Physics is not a science of ontology, but of epistemology, the science of studying how we can know things. Thus, the classical idea that an objective material world exists is nothing but an illusion, and the goal of physics, which is to recognize an objective reality that exists as itself apart from the act of measurement, cannot be realized in principle. The nature we see is not objective nature itself, but nature as far as it is reflected in our method of inquiry. Science is also an intra-world measurement and an intra-world action.

Modern science has emphasized the importance of the observer behind the objective world, revealing the deep relationship between the observed phenomenon and the observer. The perceiver and the perceived are correlated. Modern science began with a subject-object dualism since Descartes, but this Cartesian disconnect is no longer viable. Existence and thought, objectivity and subjectivity are deeply intertwined. It is not possible to posit an entity that exists entirely independently of the subjectivity it recognizes.

Extension of the Uncertainty Principle

The indeterminacy principle, along with the relativity principle, was a revolutionary paradigm shift in the realm of physics, but in the realms of life, society and psychology, it is rather commonplace. In the measurement of organisms and ecosystems, experimental and clinical

psychology, socioeconomic phenomena, etc., the interference of observers on the research object itself always occurs.

For example, if one observes an ecosystem, it includes the humans themselves who observe the ecosystem. Therefore, the measurement disturbs the ecosystem itself, and the disturbed ecosystem itself has a reaction on the observers. Measurement of ecosystems is based on the assumption that the observing system is within the observed system itself, so humans cannot be bystanders to the ecosystem.

In the measurement of animals, pure and objective measurement of animals is not strictly possible because the observer influences the animal being observed. Also in the measurement of the human or animal brain, the act of measurement affects the brain response itself, so it is not possible to measure the brain response objectively, excluding the effects of measurement. Even in experimental psychology, it is impossible to observe a purely objective psychological state because the very act of conducting an experiment disturbs the psychological state of the subject. In clinical psychology also, the counselor cannot be an objective observer, because the client changes as the counselor intervenes, and the counselor himself/herself changes as the client changes. Also in cultural anthropological surveys, the fact that a researcher has entered the area disturbs the previous way of being of the uncivilized society, so in principle, the situation of a purely uncivilized society cannot be observed. Here, the cognitive subject and the cognitive object are always interacting with each other, so it is impossible to recognize a cognitive object that is separated from the cognitive subject.

A society generally harbors its own observers and actors within itself. Therefore, society changes depending on the observers and actors within itself. This is the reason why society's predictions of the future can be more self-fulfilling than predicted, or conversely, the self-destruction of prophecy can occur, resulting in the realization of the opposite of what was predicted. Describing society is itself an intra-social act, so it also changes the social structure. In the same way that deflationary psychology can cause more and more deflation in economic phenomena, people's perception of market conditions can actually affect the way market conditions are. Thus, here, even if an economist makes an economic decision that he or she thinks is right, depending on the circumstances in which it is thrown into play, it can lead to disastrous consequences against that decision.

Whether observing ecosystems or humanistic and social phenomena, the observer himself or herself is included in the system being observed, so that measurement itself becomes an intra-world measurement, an intra-world action, and changes the very system being observed. Here,

from the outset, the subjective and the objective are inseparable.

In contrast, the natural sciences generally assumed that the effects of measurement and experimentation on natural phenomena could be largely ignored. However, as the uncertainty principle drawn from quantum mechanics pointed out, this assumption of natural science violated the fallacy of simplification and abstraction. In the natural sciences, different phenomena often occur depending on the environment and conditions created by the observer. Measurements and experiments conducted by science are themselves disrupting natural phenomena and intervening in the behavior of nature itself. Science, too, is, in fact, an intra-world measurement and an intra-world act. As Heisenberg says, natural science itself is a part of the interaction between nature and us.

2. Intra-world measurement

Complex systems and Intra-world measurements

From the quantum mechanical world to human society, the uncertainty principle holds true, and what we observe and the observed interact with each other because they are, in reality, complex systems that are constantly shaping themselves through the dynamic interaction of many elements. The interaction of this multitude of elements includes the interaction between the observer and the observed.

A complex system is a system that originally contains an observer inside it, a system in which elements with the ability to observe each other interact to create a complex trajectory. So, in a complex system, we cannot know the dynamic aspect of the system only from external measurements that are completely detached from the system. Rather, in a complex system, if you want to observe it, you will inevitably have to enter the system, which means that measurement from the outside is not possible. In complex systems, the system must be described from the beginning, including the observer who describes the system. Here, the act of measurement and the object of measurement cannot be separated, and the result of measurement appears in correlation with the act of measurement. Every system, from the microscopic world of quantum mechanics to the social phenomena of human beings, is essentially such a complex system.

If we take chaotic systems as a representative of complex systems, here too, even the most microscopic disturbance caused by measurement disturbs the system, which in turn causes global structural changes. Because of the initial value sensitivity of chaotic systems, even if the disturbance caused by measurement is kept to a very small error, the result will be completely different. Therefore, the measurement problem exists not only in the quantum mechanical field but

also in the classical field.

However, in the case of chaotic systems, the state may converge to a certain level by observing chaos, and an ordered state may emerge. For example, installing surveillance cameras to prevent crimes, or creating disciplined classes through classroom measurement. Here, disordered phenomena are controlled or converged by the intrusion of the observer into the system being observed.

Considering such an example, it is necessary to break the traditional scientific framework that assumes that measurements and experiments do not interfere with phenomena, and to extend this framework. Human and social phenomena, as well as natural phenomena, are not closed systems in which the observer can be ignored, but open systems in which the observer himself can be included to any extent. Measurements and experiments in natural science are not out-of-world measurements that do not disturb nature, but intra-world measurements that disturb nature.

For example, in the case of Antarctic measurement, the ecosystem of Antarctica is being changed as observers bring in their equipment and live there. So, the objective ecosystem of Antarctica will not be strictly observable. Therefore, the measurements and experiments of natural science in Antarctica are also an intra-world action, which disturbs the world and participates in the self-formation of the world itself. Objective ecosystems cannot be observed in a strict sense. The modern scientific procedure of objective verification through experiments and measurements cannot be established as it is.

In the science of complex systems, the property that the behavior of a system is so sensitive to measurement that the structure itself can be changed is called description instability. Here, even a slight change in the way the system is described does not guarantee the identity of the system. The phenomenon that describing an object changes the structure of the object is always present in social phenomena such as human activities, but according to the study of chaos, it is found in nature in general, including matter and life. Therefore, in complex systems, we have no choice but to consider the method of measurement itself.

Conventional science has only looked at the world from the outside. There, it was assumed that measurement would not distort the nature or structure of the object. However, actual measurement, even if it is slight, distorts the nature and structure of the object. Therefore, out-of-world measurements cannot be made from the beginning. Any measurement is an intra-world measurement.

Internal measurement

In the study of complex systems, measurements in which the measured system itself is inside the measured system are called <internal measurements>. For example, all living things, from bacteria to humans, are internal observers. The organism itself is inside the world, observing, interpreting, and acting on the world it lives in. And their measurements and actions change the world again. This interpretation of the world and the behavior of the organism itself cannot be understood only by external measurement. Even if we go inside the body of a plant or animal, whether it is an organ, a muscle, an endocrine mechanism, an immune mechanism, a nerve mechanism, or a gene, life is based on internal measurement.

If we think of it that way, we can say that matter in general, whether molecules, atoms, or subatomic particles, is also observing other matter and the material world itself. In fact, the plasma phenomenon, in which a random flow of electrons cooperates and suddenly causes convection, is a phenomenon that can be said to be observed by matter. Measurements are being made everywhere in the material world. Each element of matter is also an internal observer. In order for each element to interact with each other in the material world, it is necessary to identify what the other is. This identification is internal measurement. Each element of matter accepts the other and the whole into itself, and works as well as being worked on. They can be seen as identifying with the other.

On the contrary, the internal observer is also an actor. Matter, as an internal observer, senses and acts upon others and the whole. Even the movement of matter cannot be captured by a mere mechanical law of causality. It is the limitation of modern science, which is based on out-of-world measurements, to view matter in such a mechanistic way. Not only humans and living things, but also atoms and molecules are sensing and acting. And these actions change the world itself. This is where experience is created. Internal measurement and internal action create new experiences from within.

Where experience is generated, information is generated, and where information is generated, there is new organizing. Measurement is identification, and identification produces action. And action generates experience, experience creates information, and information draws out work. And the work that is drawn out creates new measurements, experiences, and information. Thus, the world is constantly generating and developing toward a new creation.

For example, as organisms evolve, they make new measurements even from within the same environment. They find new meanings in the environment, organize matter and energy in new ways, and perform new tasks. The world is creatively remade by these intra-world actions of living

things. Moreover, this creative evolution occurs from the material stage.

All beings, from matter to man, are not only intra-world beings, but above all intra-world observers and intra-world actors. No one can remain outside the world. This world is a world in which we have a subject that recognizes itself. When we observe and act, we are not outside the world, but are thrown into the world to observe and act. Therefore, it transforms the world from the bottom up. Here, the outside is always incorporated into the inside, and there is no distinction between inside and outside.

Leibniz believed that each monad, as the individuality of an individual, represents the universe in a different way from its own perspective. In this sense, the universe contains an infinite number of monads that perceive themselves within it. The universe contains within itself the expressive action of itself. The representational actions of animals and humans are, so to speak, the self-expression of the universe. In the world of monadology, the universe contains its own observers within itself. The monad is an intra-world observer who observes the world from within. However, the limitation of Leibniz's monadology is that this intra-world observer is not treated as an intra-world actor.

Non-separation of subject-object

In order to understand the structure of intra-world measurement and intra-world action, it is necessary to break away from the modern Western worldview that considers humans to be outside of nature. In particular, the dualism since Descartes, which distinguishes between speculative and extensional entities and separates the subjective world from the objective world, must be overcome. The methods of modern philosophy, which were based on the subject-object dualism, cannot capture the living forms of matter, life, and society.

Based on this Cartesian dualism, modern natural science has attempted to find deterministic laws of nature by placing humans, who observe and act, outside of nature. The modern view of nature holds that the objective world, separate from the human being who observes and acts, is a world of purely material motion, determined by mathematical laws.

However, nature cannot be viewed as a deterministic machine that is detached from the subjectivity of perception. Since we are intra-world observers and intra-world actors who are perceiving and acting in nature, the principle of modern science of objectifying knowledge of nature by eliminating the subjectivity of perception and action is not valid. Originally, science itself is an intra-world perception and an intra-world action. In fact, scientists have been conducting measurements and experiments within the world through the means of measurement instruments and experimental devices. That is why, with the development of measurement and experimental

instruments, nature appeared in a different way, and science itself had to change its own paradigm in response.

Science is not something that is objectively there, but something that is historically generated and changed. Science itself is not outside the world, but within it. Science itself has changed our perception of nature through leaps in the development of tools and discoveries, that is, through changes in action. Rather than proving the separation of subject and object, it proves that we are observers in the world and actors in the world, and that our view of the world changes according to our measurements and actions. The subjectivity of perception and the objectivity of perception cannot be separated.

Without the observer, the phenomenon does not appear. There is always an observer in the phenomenon. There is a correlation between observer and the observed. It is not the case that the subject, which is separated from the object, recognizes the object, which is separated from the subject. The perception of a phenomenon is neither subjective nor objective, but a correlation between subject and object. The subject and the object are correlated to establish recognition, and there is no distinction between them. There is no distinction between subject and object. Rather, it should be said that the object recognizes the object, and the subject recognizes the subject.

Observers as participants

This world is, in a sense, a theater. Moreover, we, the audience, are the ones who can influence the play that is being performed. In any play, the audience is not just a bystander, and the actors' performance changes depending on the audience's reaction. In watching a play, there is an empathy between the actors and the audience through the body, and the excitement of watching a play through this empathy cannot be obtained only from photographs or images from the outside. In the same way, we are observers of the world from within, and what we see influences the world. What we observe influences the observed, the observed inspires the observer, and the observer and the observed object interact with each other in the play of the creation and change of the world. Just as the audience participates in the progress of the play, the observer participates in the self-formation of the world through the act of measurement. The observer is a co-actor in the play of the world. Measurements and experiments in science are themselves involved in the self-formation of the world as intra-world measurements and intra-world actions. This universe is a participatory universe.

The image of nature as a mechanical nature formulated by modern science was nothing but a fiction. Modern science's vision of the world was based on the hypothesis that there is an ego that views the world from outside the world, and that it has no influence on the world. It was like looking

at a photograph of a play being performed in a theater, so to speak, and it was only a false image of the actual play being performed. We don't actually see a play in a theater the way we see it in a photograph. Similarly, as intra-world observers, we cannot see the world from outside the world. Without seeing the world from within, without intra-world awareness, we cannot truly grasp the world.

Observers are in the theater of the world, and they are looking at the play of the world from their own perspectives. Since the image of the world seen by the observer is only an image of the world as far as it is captured from the observer's perspective, the world appears in different ways depending on the perspective of the observer. In fact, animals, as intra-world observers, have their own unique images of the world, cutting the world according to their own body image and behavioral style.

Modern science is also a slice of the world from one perspective, and its image of the world is only a slice of the world. The image of nature that a scientist observes with his or her own measurement equipment is only a view of the world as far as it can be seen from such equipment. Therefore, without addressing the method of measurement, it is impossible to clarify what nature is. This is because the world appears in a different way depending on the measurement device. There are always aspects of nature that are not known to us. The laws of nature are not necessarily the laws of nature itself, but only one law as seen from our perspective. The science created by modern man is just another interpretation of the world, a hypothetical perception.

This universe does not exist apart from the observer. Moreover, we observers, as subjects with bodies, throw ourselves onto the stage of this universe, act, and recognize while acting. Measurement is also an action. Recognition is not merely a representation of the external world, but is itself a physical act. Like a spectator who throws himself into a theater, we dive into the world and recognize it by being there. Our perceptions of time and space are also formed through our physical actions. Our perceptions are action-oriented and practical perceptions to any extent.

In this sense, our perception is similar to that of clinical psychology. In clinical psychology, the observer himself or herself comes into contact with the other person and interacts with him or her in order to gain understanding. Here, like the audience and actors in a theater, the viewer and the watched are correlated through physical actions. The cognition of natural science is also essentially this kind of action-oriented practical cognition. The measurements and experiments of natural science are also acts of trying to know nature by throwing in physical acts. Only by doing so can nature be thrown in front of us. Natural scientists do not act as if they are outside the world, as if they were looking at a photograph. Not only us, but also animals, plants, and even matter are actors in the world, observing the world and participating in the world's self-formation.

The logic of intra-world measurement

According to the anthropic principle of the universe, the universe was designed to produce intelligent life forms that would observe the universe within it. In fact, many physical constants, such as gravity, were inevitably adjusted to the values necessary for the universe to produce life and for it to evolve into human beings. The universe was created in order to produce intelligent life that recognizes itself. The creation of life that recognizes the universe was also the purpose of the universe. The same root of the self and the world can be found in the fact that the universe itself created the subject that recognizes the universe.

Perhaps the reason why the universe created those who recognize the universe itself was so that the universe could become aware of itself. Our attempt to recognize the world as an intra-world cognizer is also the world's self-awareness. We are living in the universe and the universe is living in us. Modern science, which is based on the principle of recognition outside the world, must be overcome, but the work of modern science has actually been living in self-awareness of the universe as recognition within the world.

From elementary particles to human beings, they are all observers within the world who observe the world within the world. The measurement of the world within the world is cognition. There is an observer in the world to be observed. If this is the case, then the self is in the world and reflects the world, and the self is also reflected in the reflected world. The whole is reflected in the part, and the part is also reflected in the whole. Thus, intra-world cognition falls into the problem of infinite backwardness and indeterminacy. It seems that the incompleteness theorem also holds for intra-world cognition.

Gödel's incompleteness theorem was that "when we have determined the rules of inference and the axioms, some meaningful assertions cannot be proved or their negation proved. From this, we can derive that "no axiomatic system can prove its own inconsistency by itself. Thus, it becomes impossible to determine whether a system represents the truth or not. This happens because a system is incorporated into itself, and is repeated infinitely. This naturally leads to infinite backsliding and the problem of indeterminacy.

Even in the case of intra-world perception, the universe includes the observer who observes it. Therefore, in addition to observing the universe, the observer must also observe that he or she is in the universe, and that he or she is observing the universe. Thus, this intra-world measurement will fall into infinite backwardness and will never be completed.

In the scenery seen in a photograph, the photographer himself/herself is not in the picture.

However, in the scene where the photograph is taken, the photographer himself/herself is present in the scene being photographed. Therefore, the photographer himself/herself must be in the landscape being photographed. If this is the case, then photographing the landscape within the landscape is also a problem that leads to infinite backwardness and indeterminacy, like a snake swallowing itself.

I perceive the world within the world. Within the world that I recognize, there is me. Then, I must recognize the world that I recognize within, and also recognize myself as I recognize it. Thus, the same thing follows, and this recognition is never complete. Just as when two mirrors are placed side by side and a candlelight is reflected in them, the candlelight is projected infinitely, so recognition within the world is always incomplete. This is because the self to be recognized is included in the world to be recognized.

In the world, there is me who is drawing a world map. In this case, the world map that I draw must also include me, who is drawing the world map, but this also leads to infinite backwardness and is not complete. In general, when there is a describer in the world to be described, it is inevitable that there will be instability of description. The describer describes the world from within, but that world is also embedded in the describer. The describer must describe the world embedded in him, and at the same time, the describer himself/herself within it.

Paradoxes involving self-referentiality, such as "the Cretans said that the Cretans are liars," cannot escape incompleteness and undecidability. The discourse of mathematics and science cannot escape such a contradiction either, since they originally consist of formal systems that contain self-referentiality. As long as science has this paradox of self-referentiality, science will not necessarily determine the truth. The paradox of self-reference shakes the rationality of science to its very core. In fact, modern science is just one way of looking at the world, built on a particular hypothesis. Even today's science captures only one aspect of nature. Ninety-nine point nine percent of nature is non-deterministic, unpredictable, unprovable, and unverifiable. Nature is not necessarily rational, nor is it predetermined.

However, even if our intra-world perception is incomplete because of its self-referentiality, and the world perception of science is not complete, this does not necessarily indicate the limitation of science. On the contrary, it should be considered as something that drives the generation and development of science. Actual nature is not rational, determinate, or perfect. It is precisely because of this that nature generates and develops. The perception of science is just cutting out the rational, definitive, provable, and non-contradictory parts from it. Therefore, science always runs into contradictions near its limits, and in an attempt to break through the contradictions, it

discovers the next new aspect of nature. It also changes its own paradigm and creates new perceptions one after another. The paradox of intra-world cognition from self-referentiality is indispensable for the generation and development of science.

With self-reference, the deterministic logic of stillness is broken down and the non-deterministic logic of motion emerges. For generative development, the paradox of self-reference is necessary. The paradox of self-reference is, rather, a fundamental condition for self-formation to occur. The infinite backwardness of self-reference, on the contrary, evokes infinite forwardness. The fundamental incompleteness and groundlessness of a system leads to its destabilization, which in turn contributes to the formation of a new system. The paradox of self-reference arises when we try to grasp the logic of motion from the logic of stillness, and generation from existence.

Self-measurement has always been at work in the universe, which has been constantly evolving and constantly creating new things. When the universe itself recognizes itself, it moves forward one step. By having the observer in the universe play the role of self-recognition, the observer participates in the creation of the universe. Self-recognition always involves contradiction and infinite backwardness, but we should not be afraid of this infinite backwardness.

3. Intra-World Action Measurements and Experiments

We are intra-world observers and intra-world actors. Measurement is an action. Observing within the world is an act, and that act disturbs the world. The act is to break the symmetry. Therefore, measurement can also lead phenomena in a certain direction. Even if the method of measurement or the order of measurement is different, strictly speaking, the result of the observed phenomenon will be different. In order to accurately grasp the phenomena being observed, we must also consider the actions of the observer that are included in the phenomena. Also, measurement is a technology, and the appearance of the world changes with its development. New measurement devices and instruments expose new aspects of the world and create new perceptions of the world. In fact, with the introduction of various measurement tools, scientists have been able to obtain a newer picture of the universe.

Furthermore, the world can be changed by the act of experiment performed by scientists. The act of experiment in the natural sciences is to cut into nature with a certain hypothesis, and to throw the act out into the world. A scientific experiment is never conducted outside of nature, but within nature, forcing nature, so to speak, to confess its secrets. Of course, like a forced confession, the image is not as it should be. At the very least, it will be a forcibly cut and abstracted image of

nature.

In fact, trying to see something in a scientific measurement or experiment means, on the contrary, creating an invisible part. If you try to see the finer details, your field of vision will become narrower and you will not be able to see the whole. Scientific measurement and experimentation is a way of cutting out a part of nature.

Thus, the natural sciences manipulate nature through measurement and experimentation. The measurements and experiments of science are themselves in the interaction between the observer and the observed, disturbing the phenomena. In modern science, observers and experimenters are outside of nature, and their descriptions are also made from a perspective outside of the world. However, the hypothesis of modern science that scientists and nature are independent of each other does not hold true in practice. Scientists alone cannot act as if they are transcendent bystanders outside the world. The object of measurement cannot be separated from the subject of measurement. In this respect, natural science is similar to experimental psychology or field research in anthropology, where the act of measurement disturbs the phenomenon.

Human society is a complex system in which the observer participates from the beginning. Therefore, measurements and experiments in the society are themselves part of the self-formation of the society. In the economy run by humans, the agents that make up the economy are themselves intra-world observers and intra-world actors, and their measurements and actions shape the economy itself. What they observe and do shapes the economy itself. Here, what they observe in the economic activity itself guides the economic activity in a certain direction.

We do not merely perceive objective objects from the outside. We perceive while we act in the world, we act while we perceive, and we participate in reality. From this point of view, the non-determinism of the world also comes into play. Recognition is action, and action is formation. The world changes through action.

The Intra-World body.

Moreover, we place our bodies directly in the middle of the world and act through them. Well, today's natural science requires huge measurement equipment for both macroscopic and microscopic measurements of nature, and our bodies are rather swallowed up in the huge measurement equipment. But even so, it is certain that our bodies and our actions are in the background of these huge measurement devices. The measurement device is an extension of the body, even if it is huge.

The perception of the world comes from acting through the body and relating to the world. And that body is also in the world. And the world is also in the body. The body and the world are connected by action. In fact, animals act with their bodies in the world, cut out the environment, and know the world. This knowledge is not objective scientific knowledge, but it is the knowledge necessary to live in the world. Animals reflect the world within themselves in their own way, through their bodies in the world.

The knowledge of the world is acquired by the subject working through the body in the world. Moreover, this subject who encounters the world is also created by the world itself. The subject is not a cognitive subject that looks at the world from outside the world, but an acting subject that appears on the stage of the world by itself and acts with its own body. The world is recognized by this acting subject.

The idea since Descartes that cognitive subjectivity is outside the world and the idea of Kant that assumes transcendental subjectivity that transcends the world are both wrong. Husserl, it should be said, remained largely in the position of the modern transcendental subjectivity from Descartes to Kant. Husserl put our natural attitude and the natural world in parentheses, reduced the world to transcendental subjectivity, sought clarity in it as Descartes did, and tried to derive the orientation of consciousness from it ⁽²⁾. This is similar to the way Descartes and Kant sought the root of consciousness in cogito and synesthesia. It must be said that the subject-object equation still remained, and that the subject who acts and perceives through the body in the world was not fully understood, at least not by Husserl in his later years.

Recognition is action, and action is recognition. To recognize while acting is the original recognition. We live in the vortex; we know in the vortex. We act in the vortex and recognize in the vortex. The sun-like eye sees the reflected light of the sun by acting in the light of the sun. The scientist, too, knows nature by cutting into it through the act of experimentation, by throwing himself into it. The scientist is never disconnected from the object. We see things through our actions.

As intra-world observers and intra-world actors in this universe, we are participating in the self-forming drama with our bodies. Therefore, how we move will affect this play. Here, what we see and what is seen are inseparably connected and interact with each other.

On the other hand, in the case of movies and photographs, the viewer and what is viewed are separated, and the viewer is not represented as if he or she is physically participating in the world, thus failing to convey a vivid and real image of the matter. In the same way, modern natural scientists have described the world as if they were observers outside the world, when they are

actually inside it. Because of the disconnect between the viewer and what is viewed here, the essence of the world has been missed at a crucial point.

In the measurements and experiments conducted by scientists, the world appears and emerges when the act of measurement and experiment is thrown out into the world. The act of measurement and experiment in science is to acquire the generation of this experience. It is not an out-of-the-world measurement or an out-of-the-world action, but an in-the-world measurement and an in-the-world action that is itself involved in the self-formation of the world. Human beings, animals, plants, and matter remain participants who are actively involved in the creation of the world.

Alteration of the environment

On the contrary, organisms have the ability to not only perceive the world, but more than that, they have the ability to modify it. Organisms have not only adapted to their environment, but have also actively created it.

For example, since there was no oxygen in the primordial atmosphere, only anaerobic bacteria could survive. However, the emergence of photosynthetic prokaryotes such as cyanobacteria led to the filling of the primordial ocean and primordial atmosphere with free oxygen. As a result, aerobic organisms were born to utilize the oxygen. Lichens, a group of algae and fungi, have also turned rocks into soil, allowing plants and animals to move onto land. The oceans, atmosphere, and surface of the earth have been drastically altered by living organisms.

The ability of animals to alter the environment is also great. Corals have created coral reefs and drastically changed the topography of the earth, and earthworms have eaten and scraped up the soil, resulting in a major transformation of the soil. Nest building by white ants, birds and beavers shows that animals have the ability to proactively remake their environment and create a comfortable environment for themselves. Animal behavior is not simply a movement based on mechanical causality, nor is it simply an action that is attached to the environment. Animals have the ability to create their own environment through their own actions.

Thus, through the work of living things, the barren earth has evolved into a fertile earth. The earth's environment itself has been greatly remodeled by living things. Living things remake the world they live in through their actions. Moreover, the world itself has created things with the ability to remake itself. The world not only creates things within itself that recognize the world itself, but also creates things within itself that remodel the world itself. What is made by the world makes the world. The world in which we live is such a self-aware and self-producing world. In other words, it is a world of complex systems.

Humans, too, have modified nature by extending the work of their limbs to create tools and machines. Man is a creator before he is a thinker. In order to be free from the constraints of the environment, humans have also used technology to drastically modify the environment. Well, animals also have a great ability to modify nature by extending the function of their limbs. However, human technology using tools and machines has greatly increased their ability to modify the environment.

And today, this human-developed technology, combined with science, has led to the creation of huge machines and the large-scale development and rearrangement of nature. As a result, the scope of human life has been greatly expanded and the amount of human activity has increased dramatically. The impact of this technological activity on the natural environment, including the oceans, soil, and atmosphere, is immeasurable. Just as cyanobacteria have remodeled the earth by creating a layer of oxygen on a planet that had no oxygen, humans are now transforming the earth's surface at least as drastically as never before. Since the work of science and technology itself is directly in the middle of the global ecosystem, this dramatic increase in human technological power, or the ability to alter the environment, will dramatically alter the global ecosystem.

On the contrary, humanity today is even trying to change the direction of life evolution. For example, with today's advanced genetic engineering technology, it is not impossible to create new life, or even to recreate a species that once perished. If we leave no value judgments to this issue, this genetic engineering technology itself is an act thrown into the history of life evolution. It must be said that humanity has reached a stage where it can even influence the direction of life evolution. Certainly, this is an act that disrupts the course of life evolution, but in this way, humanity is trying to play a role in the flow of life evolution. What kind of life this action will lead to in the future has not been determined in any way.

Of course, human technology, which has the ability to alter nature to a great extent, also disturbs nature, because it is conducted within nature, not outside of it. Therefore, we do not know what will happen to nature afterwards.

Turning our attention to space, today's human beings, with the development of science and technology, have embarked on space exploration, flying space rockets and spaceships to observe outer space. Certainly, this is an almost infinitesimal act from the perspective of this vast and limitless universe, but it is still an act that disturbs the universe. The structure of the universe is being changed, even if only slightly, by the technological acts of humans. As the chaos theory proves, it is not certain that such a small error will not go around and change the direction of the universe after tens of billions of years.

The world is being remade by the intra-worldly act of technology. Technology itself is an act that is actively involved in the self-formation of the world. Moreover, if the world itself produces organisms with such technological capabilities, then the world itself has the power to remake itself. It is true that the burden on the natural environment is increasing due to the self-expansion of the huge scientific and technological civilization that modern man has built. However, such activities may be part of the process of the universe's inexorable movement to form itself. The technological activities that humans are attempting are themselves a part of the self-formation of the universe, and may be a trajectory of the universe's self-awareness. Just as human beings are aware of themselves by creating things, the universe is also aware of itself by forming itself, isn't it?

Action and formation.

We act in the world and shape the world. Our actions change the world. From the point of view of the huge flow of the universe, which is like a big river, we do only a drop of work at the tip of a capillary, but we cannot say that it does not affect the huge flow of the universe at all. No matter how small, action does work. And work causes changes in the structure of the universe. Even if I pick up a little thing, I have done my work and changed the structure of the universe. Even the tiniest organism, swimming or crawling, is changing the universe in a big way. By acting in the world, we are participating in its creation.

Moreover, action is a choice. Choice creates a symmetry break, which in turn creates another symmetry break. Thus, the world has an irreversible history and forms an indelible history. Therefore, the events of this world are essentially one-time events and cannot be repeated. Modern science has attempted to discover the laws of nature from the possibility of repetition, but the reproducibility of this scientific phenomenon must also be questioned. The creation of the universe, the formation of planets, and the evolution of life are things that cannot be experimented with, nor can they be reproduced. The world is an irreversible drama, and not everything can be reproduced.

This also raises the issue of the non-determinism of the world. Actions have the freedom to break the laws. Therefore, the world does not always work according to the laws. If the world is a creative world that is always forming itself anew, there is a possibility that new natural laws will be born in the world that are completely unexpected. Natural laws can also evolve. If even natural laws can evolve, then we must say that this world is not predictable.

This self-forming movement of the world, which includes the element of action, cannot be solved by classical physics, which tries to describe the world deterministically based on the

separation of subject and object. On the contrary, even modern physics, which reads the non-separation of subject and object and opens the door to a non-deterministic world, will have difficulty in solving it. Quantum mechanics was certainly a step forward in that it included the observer and his/her actions in its description, but it did not describe the point where the world forms itself anew through its intra-world actions. Therein lies the limitation of modern natural science.

If a scientific theory is to be complete, it must include in its description the actions of the scientists themselves who are conducting the scientific inquiry. But if we try to include the actions of the actors themselves in the description, the system will be incomplete. Since we are part of this world, our intra-worldly actions will determine the future direction of the world, and the world will be open. The world is infinitely open. An open world cannot be described in a closed form.

The actors who move the world are within that world. Moreover, the world itself continues to produce such actors. In such a world, the self changes when the world changes, and the world also changes when the self changes. This is because the action of the self extends to the entire world through the interconnection of infinite events. Here, the self envelops the world while being enveloped by it, and incorporates the world while being incorporated into it.

The waves on the ocean move the boat. At the same time, when the boat moves, the waves also move. I walk because there is a path. But when I walk, a path is created. When the world moves, we move. But when we move, the world moves. We are such intra-world actors.

When spring arrives, flowers bloom, and when flowers bloom, spring arrives.

<Annotation>

1 Das Naturbild der heutigen Physik, Werner Heizenberg, Rowohlt,1955,

2 Husserl, Cartesianische Meditationen, Husserliana BdI, Martinus Nijhoff, 1973, Meditation II.III.

(Source: Michinori Kobayashi, The Philosophy of Life Collection, 5, Minerva Shobo, 2016, Kyoto.

Chapter 2 of "Continuation of Philosophy of Complex Systems" in the collection)