From Symbiosis (*kyôsei*) to the Ontology of 'Arising Both from Oneself and from Another' (gûshô)[1]

Hiroshi ABE

What kind of questions should philosophers inquire into these days? In the first section, I will attempt to resolve this issue by analysing main problem of this paper.

1. Main Problem

Among the various ways of the being of existents, there is no doubt that a matter of tireless inquiry and the greatest interest since ancient times is the being of the one who makes the very inquiry, namely, that of human beings. However, it is quite obvious that this question regarding the being of human beings has taken a radical turn at present.

Questions regarding the being of human beings would previously take forms such as, 'What is man?'[2] or 'What is man's place in the nature of things [(*Sein*)]?'[3]. The purpose of these questions was to find a definition of the *essentia* of human beings, in order to obtain 'a unified idea of man'[4], which could integrate an enormous variety of information concerning the being of human beings in philosophy, theology, human science, etc. Moreover, according to Scheler, this purpose could be accomplished by determining the uniqueness of the being of human beings in which it differs from other ways of being (e.g. the principle of 'spirit' (*Geist*)) and by demarcating a location for the domain of the being of human beings in *Sein* (i.e. the entire system comprising all the existents that consists of different fields of being).

Needless to say, even approximately 80 years after Scheler's death, such a question continues to be of great importance. In fact, it can be further said that the question has much more relevance now than it did in his times, because in all the sciences, even in the field of philosophy itself, there currently exists an incredible level of specialization as compared to the situation 80 years ago.

---

[1] In Japanese, both *kyôsei* and gûshô are written using the same Chinese character (i.e. 共生).

[2] Max Scheler (tr. by Hans Meyerhoff), *Man's Place in Nature* (New York: The Noonday Press, 3/1969), p. 3.

[3] *Ibid*. (The information within brackets is mine).

[4] *Ibid*., p. 6.

Nevertheless, as mentioned above, this question has undergone a complete change at present, at the onset of the twenty-first century.

With global environmental issues becoming increasingly serious in recent times, the question regarding the being of human beings is compelled to undergo a transformation. What kind of transformation does this question experience as a result of these issues and why?

In his book *The Imperative of Responsibility*, Hans Jonas states the following: '*The presence of man in the world* had been a first and unquestionable given, from which all idea of obligation in human conduct started out. Now it has itself become an *object* of obligation: the obligation namely to ensure the very premise of all obligation'[5]. I would like to reply to the question under consideration by further elaborating upon this statement by Jonas.

Concerning the being of human beings, questions such as that by Scheler are, thus far, sufficient for our inquiry. Naturally, when we ask this traditional question, we presume the existence of an entire system comprising all the existents (Scheler's concept of *Sein*) and human beings — if we could not presuppose the *exsistentia* of all the existents including human beings as a given, it would be impossible for us to inquire into the traditional question. Nevertheless, the current situation of human beings is such that both the being of human beings and that of other existents can no longer be considered an indubitable foundation because of the increasing menace of global environmental issues. In the face of such a situation, it is very likely that the question pertaining to the being of human beings must inevitably change. For, if we wish to ask the above-mentioned traditional question today, it is crucial for us to engage ourselves, first and foremost, in inquiring into how the presupposition can be secured on the basis of which the inquiry concerning the traditional one itself is possible.

In this way, the question regarding the being of human beings has now changed from its traditional version to a modern one, for instance, *how the existence of both human beings and the entire system of all the existents can be secured*, which enables us to inquire into the former question itself. Along with this change, the original question's characteristics also undergo a transformation — the uniqueness of the being of human beings is no longer under consideration. Therefore, on what aspect of the being of human beings does this new question focus?

As everybody knows, every organism selectively draws matter and energy out of the environment for its own use, which it subsequently synthesizes or transforms for

---

[5] Hans Jonas (tr. by H. Jonas in collaboration with David Herr), *The Imperative of Responsibility — In Search of an Ethics for the Technological Age* (Chicago & London: The University of Chicago Press, 1984), p. 10.

the purpose of self-preservation, reproduction, etc. (anabolism). In return, it discharges useless matter and heat, which are the products of anabolic activity, into the environment (catabolism). These two activities (i.e. metabolism) of the organism depend on the cyclic flow of matter and energy in its own ecosystem, which is based on a metabolic system consisting of producer, consumer, and decomposer. Further, this cycle of matter in the ecosystem is itself dependent upon a larger system, such as the water cycle between the earth's surface and the atmosphere and that of mineral nutrients between the land and the sea. Thus, the cycle of matter on earth forms the ultimate basis of being for all animate beings, who exist only because they have been cast into this worldwide circulation in nature from the beginning.

We human beings, who live by means of both metabolism and Marx's 'social metabolism' (a series of activities such as the development of resources, production, consumption and abandonment), are not exempted from this fundamental condition of being. Whether or not we are conscious of it, our existence requires being cast into the above-mentioned cycle of nature. It is impossible for us to deny this fact, since we cannot even make a denial of it without being based on such thrownness of the being of human beings. Therefore, the present-day question concentrates on the facticity of the being of human beings, who have been passively involved in the global circulation of nature from the outset. The moot question, as we have already seen, now inquires into the means by which the existence of human beings can be secured.

Before proceeding further, it is necessary to ask again the above-mentioned question: What kind of question should philosophers inquire into today? My answer to this is as follows: contemporary philosophers should inquire into how the existence of both human beings and the entire system of existents can be secured, focusing on the fact that human beings have been cast into the cycle of nature. Thus, this paper aims at considering this new question pertaining to the being of human beings. In such a scenario, how should we begin this consideration?

In his final years, Georg Picht devoted himself to discussing a similar question, whereby he instituted a science called 'human ecology' that deals with 'the conditions of human life on this planet'[6]. The present-day global ecological crisis caused by modern science motivated him to conceive of this new science. Faced with this difficult problem, he established a new standard of truth, which stressed that 'what is useful to life is 'fruitful''[7] and attempted to make 'a revision of the fundamental concepts and

---

[6] Georg Picht, 'Ist Humanökologie möglich? [Is Human-ecology Possible?]' in *Humanökologie und Frieden* [*Human-ecology and Peace*], ed. Constanze Eisenbart (Stuttgart: Klett-Cotta, 1979), p. 17.

[7] *Ibid*., p. 32.

[8] *Ibid*., p. 27.

methods which have carried the science up to now'[8]. Therefore, at the onset, human ecology raises the following question concerning science and the logos on which it is based:

> 'If humankind makes itself the object of its science, that is, if it will apply the universal model of ecology to itself and build a 'human ecology'.... Now, with its knowledge, it no longer stands beyond and outside the domain of the object which it investigates. It can no longer ignore the recognition that *the projections of logos — the projections performed through technology — upon the biosphere change and often destroy this and that the logos itself is, therefore, an ecological first-rate determinative*. This experience must lead to a revolution in the self-understanding of the science. Namely, we can now no longer avoid the question *whether the science itself, its theoretical model, its axioms and the attitude of humankind toward the nature which is sketched in them beforehand have a structure that is in harmony with the life conditions of humankind in this same nature or whether the word 'science' indicates a thought form which cannot be integrated into our ecosystem because of its structure'*[9].

The first purpose of human ecology is this critical consideration of both science and the nature of its *logos*. Its second purpose lies in 'the integration of human beings' 'logos' into the constitution of their ecosystem'[10], that is, the conception of a new logos that can unite with the structure of the human ecosystem, since 'human beings will only be able to survive in their ecosystem if they succeed in harmonizing their 'logos' with the fact that they are living things'[11].

Addressing these two purposes as our own tasks, which are, according to Picht himself, 'a reflection on the structure of the model of world which is presupposed when we build theories and on its relation to the structure of our biosphere'[12], we will endeavour to investigate the above question, namely, how can the existence of both human beings and the entire system of existents be secured?

Thus, in this paper, we will first focus upon biological and ecological research on symbiosis in order to clarify the *logos* on which it is based, along with critically considering the nature of this *logos* itself. Second, instead of this *logos*, we intend to

---

[9] *Ibid*., p. 21f. (italics mine).

[10] *Ibid*., p. 66.

[11] *Ibid*.

[12] *Ibid*., p. 30.

present the idea of an alternative *logos*, which corresponds with the real fact of symbiosis as 'the structure of our biosphere', and ontology, which is founded on this new concept of *logos* and which, therefore, can potentially secure the existence of both human beings and the entire system of existents (Picht writes: 'If human beings should contribute to their self-preservation, then they must acknowledge that an ecosystem lies in the balance of symbiosis, which permits no population to regard itself as the center of the whole system'[13]. This is why symbiosis is thematized in this paper as 'the structure of our biosphere').

However, for achieving the above aim, it would be necessary to survey the history of biological (and ecological) research on symbiosis from the second half of the nineteenth century to the present day, in order to determine its fundamental trend, and from the research, learn about various concrete cases of symbiotic phenomena occurring in nature. We will perform such a survey in section two.

2. Historical Development of the Study of Symbiosis and Various Aspects of Symbiotic Phenomena

Let us provide a brief outline of the study of symbiosis in biology and ecology before describing its historical development. The term *symbiosis* can be roughly defined in three ways. For future discussion, we will refer to these three definitions as (a) 'symbiosis' (as its literal meaning — living together), (b) 'mutualism in the narrow sense of the term' and (c) 'mutualism in the broad sense of the term'. Considering these definitions of the word, the history of symbiotic study can be understood as the process of change in the concept of symbiosis, to be more precise, the process of change from (a) to (b) to (c). What is implied by each of these three definitions? How and why has the change of definition occurred?

(a) It is said that the study of symbiosis in biology was triggered by the publication of *Die Erscheinung der Symbiose* (1879) by Anton DeBary, a German researcher of plant pathology. DeBary took into account examples of organisms of different species living together while maintaining close relationships with each other — physically and physiologically. (The best-known examples of this phenomenon are the relationships between the *Actinia* and the *Paguroidea* and between the *Leguminosae* and the *leguminous bacterium*). He coined the term *Symbiose* to refer to the relationship of organisms of different species living (*bios*) together (*sym*). The first definition of the term *symbiosis* (i.e. 'symbiosis') is 'the living together of two

---

[13] *Ibid*., p. 66.

organisms in close association'[14], in the above sense. It should be noted here that the required conditions for a symbiotic relationship, according to his definition, are as follows: (1) the 'close association' should be *invariant* and (2) the two species concerned should be 'living together', that is, the two species should be *physically close to each other*.

(b) It would not be difficult for careful observers, however, to recognize that the two conditions presented above are not always necessary for two species to maintain a close physiological or behavioural relationship. For instance, although the entomophilous flowers and the insects that visit them maintain a 'close association' and depend upon each other regarding issues of vital importance such as propagation for the former and the main source of food for the latter, literal constancy is not regularly observed in their interaction, nor is physical closeness in a strict sense found between their respective habitats, with the exception of those that have established a so-called runaway co-evolutional relationship only with particular species, as seen in that of the fig and the fig wasp. In that case, what could be the factor that contributes to generating these 'close associations' between organisms of different species? At this stage, the perspective of cost and benefit is incorporated in the consideration of interspecific relationships (in present-day biology, such cost and benefit, in terms of the fitness of individuals or increase in population, are to be evaluated from the viewpoint of gene fitness). Following this, the above-mentioned factor can be identified as the reciprocal relationship between species, and the meaning of the term *symbiosis* is transformed into that pertaining to 'an interaction between species that is beneficial to both'[15]. This becomes the second definition of the concept *symbiosis*, that is, mutualism in the narrow sense of the term, as presented in *Les Commensaux et les Parasites* (1875), written by Pierre van Beneden, a Belgian zoologist, four years before the publication of DeBary's book.

At the same time, an interesting fact has been pointed out regarding van Beneden's presentation of mutualism in the narrow sense of the term in his book. While discussing mutual phenomena in the natural world, van Beneden deliberately capitalized the word 'mutualists'. The reason behind this is thought to be that 'the capitalization of "Mutualists" is probably an indirect reference to the "Mutualité" societies organized by workers in France and Belgium to support each other

---

[14] Douglas H. Boucher, Sam James, and Kathleen H. Keeler, 'The Ecology of Mutualism' in *Annual Review of Ecology and Systematics* [= *Ann. Rev. Ecol. Syst.*] 13, 1982, p. 315.

[15] *Ibid*.

[16] *Ibid*., p. 317.

financially'[16]. Van Beneden played an active role in the 1830 revolution to win Belgian independence. It is supposed that this political experience in his youth made him sympathetic towards the labour movement. Therefore, the concept of mutualism in the narrow sense of the term, when it was first presented, was associated with socialism in a broad sense. This association was reinforced by *Mutual Aid: A Factor in Evolution* (1902), a representative book by Pyotr Alekseyevich Kropotkin, a famous Russian anarchist. As is generally known, Kropotkin attempted to illustrate in his book that Darwin's theory of evolution did not theoretically justify the necessity of the struggle for existence in nature; however, it scientifically proved the importance of mutual aid, that is, mutualism in the narrow sense of the term, which was exclusive of any competitive factors.

Despite this attempt by Kropotkin, 'mutualism has been avoided [among biologists and ecologists] during most of the twentieth century because of its association with left-wing politics (perhaps especially with Kropotkin)'[17]: It was not until the 1970s that mutualism was a subject for their consideration. However, this should not be understood merely as the consequence of the discrepancy between the freedom of the scientific stance from any dogma and a particular political ideology. In my opinion, the main factors leading to such a consequence should be noted as follows:

1. Dogma stating that it is competition that determines biological existence, such as that underlying Darwin's theory of natural selection concerning inter-individual relationships in a population, was also applied to the study of interspecific relationships in the biotic community (typical examples of this are the Lotka-Volterra model and 'the competitive exclusion principle' of G. F. Gause, which were both advocated in the 1920s and 1930s) and formed the basis of the above study (for instance, the theory of 'ecological niche', which used to occupy a central position in the field of biocenology, is based on the competitive exclusion principle).

2. Furthermore, due to the anarchist connotation mentioned above, symbiosis as mutualism in the narrow sense of the term was understood to exist in a paradoxical — and therefore incompatible — relationship with competition, which is the negative interaction between two species. The transition between mutualism and competition was considered to be impossible.

It is speculated that taking into account only these two factors, biological and ecological researchers were able to continue regarding mutualism as an exceptional phenomenon.

---

[17] *Ibid*., p. 318. (The information within brackets is mine).

(c) In contrast, a new trend of symbiotic study that first appeared in the field of ecology in either the 1970s or 1980s can be considered as having resulted from scepticism concerning the very factors mentioned above. According to the first factor, a synecological paradigm showing that the interspecific relation in the biotic community is established mainly through competition; these days, the counterargument for this is generally supported by means of a variety of experimental manipulations as follows: 'Ecologists have made significant advances in understanding community structure and function by focusing on negative interactions such as predation, competition, and physical disturbance…. However, *positive interactions, such as facilitation and mutualism, also play pivotal roles in organizing communities*, and incorporating positive interactions into ecological theory can fundamentally alter our understanding of the processes and mechanisms that shape communities'[18].

One interesting example providing evidence that 'mutualisms have large effects on community structure and function'[19] is the interaction between marine fishes such as salmonids and terrestrial trees lining the banks of rivers and streams.

> 'Juvenile salmonids spend up to two years feeding in freshwater streams and rivers before migrating to marine waters, where they mature and gain nearly all of their biomass, after which they return to their natal habitats to spawn and die. Trees subsidize production in these streams with the input of nutrients, leaf litter, and woody debris that supports higher populations of aquatic invertebrates, the main food source for juvenile salmon…. At the landscape scale, forested streams typically support up to three times more salmon than unforested streams…. Salmon, thus, benefit from living in streams surrounded by trees, but the benefit is not unidirectional. Spawning salmon migrations inject huge amounts of marine-derived nitrogen, carbon, and phosphorous into relatively nutrient-starved systems. … As a result, annual forest growth per unit area can be up to three times higher in forests adjacent to salmon spawning sites…. Furthermore, this subsidy of nutrients may alter the competitive balance among tree species'[20].

With respect to the second factor, the following scepticism is presented regarding one of its underlying assumptions — the impossibility of inter-transition between mutualism and competition (a similar skepticism is also presented regarding another

---

[18] Mark E. Hay et al., 'Mutualisms and Aquatic Community Structure: The Enemy of my Enemy is my friend' in *Annual Review of Ecology, Evolution, and Systematics* 35, 2004, p. 175f. (italics mine).

[19] *Ibid*., p. 176.

[20] *Ibid*., p. 190f.

assumption, the antinomy of mutualism and competition, as is shown later): 'Mutualists in one ecological setting can be adversaries in another setting… conversely, interactions traditionally viewed as antagonistic can be mutualistic, depending on environmental and community settings'[21]. The reason for this is as follows:

> 'Most ecology textbooks devote much space to the classification of species interactions. Regarding the interactions of two species, if we symbolize as '+' the case in which the effect caused by one of the species increases the proliferation rate of population and fitness of individual in the other species, the opposite case as '-', and the case which is neither as '0', … then, according to this classification, each interaction corresponds to only one combination of symbols, for example, competition is (- -) and predation is (+ -). While such a classification based on a one-to-one correspondence is clear and straightforward, *it often ignores the variability of interactions by emphasizing their average consequences*. However, *because the consequence of interactions is determined by the balance between cost and benefit, it can be reversed when the cost and the benefit change according to the ecologic condition*…. What should be noted here is that a *classification based on average consequences is in danger of overestimating one aspect of the interspecific relationship and that, therefore, the greater the variability becomes, the more unreliable such a classification becomes*'[22].

In other words, 'interspecific relationships are not always invariant but can change dynamically according to changes in time or space'[23]. The classification of interspecific relationships is nothing more than an abstraction used by biologists. Due to such variability, an interspecific relationship is competitive when the benefit for the two species concerned is lower than the cost, while it becomes mutualistic when the former exceeds the latter[24]. Thus, the third definition of the term symbiosis emerges,

---

[21] *Ibid*., p. 176.

[22] Takayuki Ôgushi, 'Kotaigun kara shukankankei he [From Population to Interspecific Relationship]' in *Chikyûkyôseikei to wa nanika* [*What is Global Symbiotic System?*] ed. Masahiko Higashi and Takuya Abe (Tokyo: Heibonsha, 1992), p. 202. (italics mine).

[23] *Ibid*., p. 201.

[24] For instance, we can postulate a circumstance in which A, a predator, preys on two species, B and C. B and C are eventually involved in a relation wherein either one's increase in population results in an increase in that of A, the predator, which leads to a higher predation pressure, thus causing a decrease in the other's population. In this situation, the relation between B and C is competitive, because both of the species suffer a loss by being victims to the predation. This is, in turn, because their indirect interactions promote the propagation of the common predator. Such a relationship is referred to as 'apparent competition' by

that is to say, 'interspecific interactions in which the benefits exceed the costs for both participants'[25].

To understand this third definition, it should be noted that 'interspecific interactions in which the benefits exceed the costs for both participants' are 'the relationships in which the two species concerned use each other's existence for their respective benefit, not those in which each of the species gains the identical benefit or cost'[26]. Based on this explanation, agriculture, for example, can be perceived as mutualism because it involves 'a mutualistic interaction between humans and domesticated plants'[27], and similar relationships are also found in cultivation, stockbreeding, aquaculture, etc. Considering the various interspecific relationships of this type in nature, it could certainly be said that 'the earth is full of mutualistic relationships'[28]. This is why we describe the third definition as mutualism in the *broad* sense of the term.

As shown in the examples of 'apparent competition' and 'apparent mutualism'[29], the effects that one species can have on the other solely through an intermediary in the form of a third species (like A in the previous example) or a fourth or fifth plays an important role in the species interaction pertaining to mutualism in the broad sense of the term (as seen in the relationship between B and C in the previous example). The effects that 'require the presence of intermediary species in order to arise'[30] are named 'indirect effects' by ecologists. An indirect effect is different from a 'direct effect',

---

ecologists.

This apparent competition between B and C, however, changes into a mutualistic relationship as soon as A's 'switching' of the food preference occurs in such a way that it preferentially preys on only the species that has a larger population. This means that A preys only on B when B's population increases. Consequently the predation pressure for C decreases, which results in an increase in its proliferation rate. Thereafter, the switching occurs again, prompting A to prey exclusively on C, this time, while the reproductive rate of B increases. In this situation, therefore, B and C develop a mutual relationship through their alternate self-sacrifice for each other. This relationship is called 'apparent mutualism' in ecology.

[25] Hay et al., *op. cit*., p. 176.

[26] Hiroyuki Matsuda, *Kyôsei to wa nanika — sakushu to kyôsô wo koeta seibutsudôshi no daisan no kankei* [*What is Symbiosis? — the third relationship of organisms which is beyond exploitation and struggle*] (Tokyo: Gendaishokan, 1995), p. 23.

[27] *Ibid*., p. 57.

[28] Makoto Katô, 'Seibutsu no kyôsei kara mita shizen [Nature Viewed from Symbiosis of Organisms]' in *Kankyô toshiteno shizen, shakai, bunka* [*Nature, Society and Culture as Environment*] ed. Kôgaku Arifuku (Kyoto: Kyoto University Press, 1997), p. 61.

[29] Cf. fn. 24.

[30] J. Timothy Wootton, 'The Nature and Consequences of Indirect Effects in Ecological Communities' in *Ann. Rev. Ecol. Syst*. 25, 1994, p. 444.

which is 'a result of a physical interaction between two species'[31]: the former arises only in multi-species assemblages, while the latter 'would occur between a pair of species both in isolation and within multi-species communities of varying composition'[32].

After studying such indirect effects, present day ecologists have discovered definite evidence against the second assumption mentioned above, the antinomy of mutualism and competition. Natural communities demonstrate competitive interactions between two species that 'are still antagonistic from a pairwise perspective but become mutualistic when imbedded within the nexus of community interactions'[33].

A good example of such interactions is included in Michio Hori's research concerning scale-eating cichlids.

> 'Congeneric species of scale-eating cichlids may benefit each other even though they share the same prey. These predatory fishes consume the scales of other living fish using a species-specific approach and attack sequence. In two congeneric species, attack success was greater when in the presence of the congeneric, but not conspecific, scale eaters…. Presumably, prey fish were unable to be as vigilant against multiple attack strategies. Thus, two species using a similar resource (scales on a given fish) facilitated, rather than interfered with, each other's success'[34].

While tracing the process of change in the concept of *symbiosis*, we have briefly surveyed the history of symbiotic study in biology and ecology. It can be summarized as follows:

1) In nature, not only two species that are physically close to each other or whose physiological or behavioural relationships can be easily recognized but also two *apparently unrelated* species that are *far from each other*, such as trees in the forest and

---

[31] *Ibid*.

[32] *Ibid*.

[33] Hay et al., op. cit., p. 185.

[34] *Ibid*., p. 189. Hori also reported other interesting observations: 'Mutualism also may occur among individuals within a species, as exemplified by frequency-dependent selection in the scale eater *Perissodus microlepis*. Individual *P. microlepis* have asymmetrical mouthparts and corresponding attack strategies: "right-handed" individuals have mouthparts oriented to the right and attack the left side of their prey; "left-handed" individuals have mouthparts oriented to the left and attack the right side of their prey. Deviations from an even ratio of morphs within a population resulted in lower attack success in the dominant morph…. These observations suggest that these two morphs act mutually to increase attack success by decreasing prey-fish alertness for attacks from one side or the other' (*ibid*.).

the salmon in the sea, can have indirect mutualistic relationships. As implied by this, 'all of the species in the global ecosystem are, after all, in direct and indirect mutualistic relationships'[35]. Furthermore, 'because matter circulates in the ecosystem, indirect effects reach throughout the earth through the inorganic environment'[36], all living things on earth (including human beings) are in such mutualistic relationships.

2) The mutualistic relationships stated above are not invariable and fixed, determined solely between the two species concerned. As suggested in the example regarding apparent competition and apparent mutualism, the mutualistic relationships can easily change *according to the context of the whole interspecific interactions of the two species, which are multiple because each can have mutual relationships with any other species*.

3) In addition, this interaction between the two species is not merely limited to a dichotomy such as 'either competition or mutualism' or 'either friend or foe'; it can principally *transcend such an 'either-or' relationship*, as is clearly shown in the above instance of scale-eating fish. In other words, it is a relationship that can be both competitive and mutualistic.

As elucidated thus far, indirect effects enable the occurrence of the above-mentioned interactions (from 1 to 3) between species. It can be said, therefore, that these very indirect effects are quite essential for the occurrence of symbiotic phenomena in nature.

This is well-demonstrated in the fact that the present research on symbiosis in ecology focuses on the indirect effects. In such a situation, how can indirect effects be explained at present? Can the *logos*, which underlies ecology and the real fact of symbiosis, and the indirect effects that are studied in ecology correspondent with each other? These questions will be examined in the next section.

3. The 'Logos' of Ecology

With regard to the first question, Masahiko Higashi, a Japanese ecologist, explains the method of research regarding indirect effects as follows:

'The term *indirect effect* generally refers to whatever "effect" that is transmitted

---

[35] Matsuda, *op. cit*., p. 125.

[36] *Ibid*.

from one to another through a mediator. …Recognized only through the logical chain which traces that of cause and effect, indirect effect is essentially invisible. …One of the clues to solve this problem is, paradoxically, found in the very characteristic of the indirect effect that "it is recognized only by tracing the chain of logic". In other words, it can be said that *an understanding of the indirect effect is essentially a theoretical problem and that indirect effects within a certain system can be defined and elucidated only by means of the theoretical model of the causal network*. …However, because each phenomenon requires its own formulation based on the corresponding type of theoretical model, it is necessary to use *a mathematical method* to investigate indirect effects in every different type of model'[37].

In the above citation, it is stated that in ecology, an inquiry regarding the indirect effect is a 'theoretical problem' that should be clarified 'mathematically', based on a 'theoretical model of the causal network'. However, would it be possible to estimate the indirect effects of interspecific interactions as they exist in nature by means of such a mathematical method? Would we not risk distorting a phenomenon in the natural world by imposing a *logos* upon it that is fundamentally different from that of the very phenomenon, even if we happened to succeed in explaining it by applying the theoretical model, for example, the hypothesis preformed through experimental manipulations? Such questions will acquire a greater degree of significance if we consider the history of human errors that have led to unexpectedly adverse effects. Such effects have resulted from our intervening with the ecosystem, while aiming at achieving certain desired effects based on simulations of theoretical models, as shown in *Silent Spring* by Rachel Carson. To quote from Picht once again, we 'can no longer ignore the recognition that the projections of logos — the projections performed through technology — upon the biosphere change and often destroy this, and that the logos itself is, therefore, an ecological first-rate determinative'.

After considering the above problem, we will critically examine two representative methods of research pertaining to indirect effects in current biomathematics.

First, we will consider a method using a matrix as follows: 'There is a popular and useful basic theory which enables us to evaluate indirect effects through the evaluation of direct effects. …Arrange all species having direct effects vertically and all of those that are affected horizontally, in order to draw a chart (matrix) of direct

---

[37] M. Higashi, 'Kansetsukôka — shukankankei no hukuzatsusa, jyûnansa wo umidasu kakureta sayô [Indirect Effects — Hidden Effects Producing Complexity and Flexibility of Interspecific Interactions]' in Higashi and Abe, *op. cit*., p. 223. (italics mine).

effects produced by respective pairs. From the inverse matrix of this, you can evaluate indirect effects'[38]. Naturally enough, however, this method of calculating indirect effects is based on the assumption that all direct effects existing in the interactions of every organism in the biotic community have been evaluated. In addition, if '*it is theoretically necessary to evaluate the direct effects of the interactions of the entire species on the earth* because all of the species in the community have indirect effects not only on one another but also on the whole earth'[39], it is 'virtually impossible'[40], as Matsuda himself states, to reveal the actual nature of indirect effects by means of this method.

The second method under examination is 'path analysis', which is 'a statistical approach that estimates the degree to which changing a causal variable will affect a dependent variable through both direct and indirect pathways'[41]. A detailed explanation of this method is given below:

'The path analysis approach is a method which allows us to understand direct and indirect effects quantitatively by distributing correlations among variables in the multivariate system, the causal relations of which have been clarified. …In this method, a model named 'path diagram' should be made before beginning analysis. In making the model, we connect one variable to another by drawing arrows (paths) which indicate causal relations or temporal successions. The magnitude of the direct effect of a path is expressed as a standardized partial regression coefficient of multiple regression, which is called 'path coefficient'. A path which leads from one variable to another variable through various arrows shows the indirect effect of the former on the latter and its magnitude is calculated by multiplying all of the path coefficients of the respective arrows'[42].

However, as long as the basic premise is that the causal relationships among variables, the objects of analysis, 'have been clarified', path analysis contains a problem which is similar to that of the first method: 'As the complexity of a causal model increases, sample sizes must also increase. This may limit the application of this

---

[38] Matsuda, *op. cit*., p. 127.

[39] *Ibid*. (italics mine).

[40] *Ibid*.

[41] Wootton, *op. cit*., p. 457f.

[42] Izumi Washitani, 'Shokubutsu no hanshoku to seibutsukan sôgosayô [Plant Propagation and Biotic Interactions]' in *Samazamana kyôsei — seibutsushukan no tayôna sôgoriyô* [*Various Symbiosis — Diversified Interspecific Interactions*] ed. T. Ohgushi (Tokyo: Heibonsha, 1992), p. 126f.

approach in complex systems'[43]. Moreover, a more serious problem of this method has been pointed out: 'Because path analysis is related to traditional linear regression techniques, which assume unidirectional causality, it is unclear whether it can adequately handle reciprocal effects'[44]. It is evident, therefore, that this approach is also inappropriate for understanding the reality of indirect effects among organisms.

Why are these mathematical analyses unable to show us the indirect effect as it occurs? It is because, in our opinion, both of these methods basically follow a procedure in which (1) initially, the indirect effect is reduced to the direct effects between two species, which are understood only as linear and unilateral effects between species — in other words, as those picked out of an entire context of linked interactions between all species in the community and (2) the indirect effect is reconstructed by summing up these direct effects. (This can be regarded as a method based on the 'four rules of logic' advocated by Descartes in his *Discourse on Method*).

In that case, why do ecologists adopt such methods? As indicated by Higashi's above-mentioned comment that an indirect effect is 'recognized only through the chain of logic which traces that of cause and effect', ecologists adopt such methods in an attempt to understand all kinds of interspecific relationships by solely considering *the model of the causality* of two species as a *linear and unidirectional interaction*. This view held by ecologists is based on the hidden premise that the cause exists independently of the effect. This is because, if the cause and the effect in the causality were not different from each other but were identical and continuous, the effect of the cause would plainly be the same as the cause itself; in other words, no differing effect would arise from the cause, and therefore, no causality would exist. If we define an autogenous occurrence as 'arising from oneself' and a heterogenous one as 'arising from another', then we can give another interpretation to the above-mentioned premise of ecologists — causality should be arising from another, not arising from oneself.

This, however, suggests that the above premise is located in the logical space dominated by binaries such as 'either arising from another (i.e. the existence of causality) or arising from oneself (i.e. the non-existence of causality)'. In accordance with Tokuryû Yamanouchi, a Japanese philosopher of the Kyoto school, we name this bivalence of 'either affirmation or negation' 'logos'. Subsequently, we can say that *the logos that underlies ecology is none other than 'logos' as a binary logic*.

Now that the *logos* of ecology has been clarified in this manner, we should consider the second question: does 'logos' correspond to the indirect effect?

We already have the answer to this question. Although 'logos' is equivalent to

---

[43] Wootton, *op. cit.*, p. 459.

[44] *Ibid.*

the above-mentioned causal relationship between the two species (i.e. the abstract direct effect that is separated from the linked interactions among all the species in the community for the purpose of adapting to the 'logos'), it does not correspond to the interrelationships among organisms in nature, which are controlled by indirect effects. This is because such relationships cannot be linear and one-way causal relationships — for example, the causalities of a case in which species A (which is the cause) has existed independently of species B (which is affected) before A has any effect on B.

Let us reformulate our discussion thus far. As shown in the above-mentioned ecological studies of symbiosis, when species Y has an effect on species Z, more precisely, when Y has an influence on every species in the community, and ultimately, on the earth through its effect on Z, Y is constantly affected either directly or indirectly by every other species, including Z. Otherwise, it would be impossible for Y to exist in nature. (This manner of existence also underlies the above-stated characteristic of thrownness of the being of human beings). If Y depends on Z to such a degree that Y cannot have any effect on Z until Z exists, the causal relationship between Y and Z can be regarded as an effect of Z on itself. In this sense, this causality can be said to be arising from oneself. Nevertheless, as long as Y and Z are different from each other, any effect of the former on the latter should be thought of as arising from another. In such a case, is the effect of Y on Z arising from oneself or arising from another?

If we attempt to answer this question by strictly adhering to reality, we have to say that the effect neither arises from oneself nor from another — or that it arises both from oneself and from another. This means that the above interaction of Y and Z, which is controlled by the indirect effect (i.e. relationship between the two species in nature), cannot be understood by means of a 'logos' based on binary logic.

In that case, what kind of *logos* can be appropriately applied to the indirect effect, the reality of symbiotic phenomena in nature, and new ontology founded on this alternative *logos*? We will answer this question in the subsequent concluding section.

4. The Logic of *Lemma* and the Ontology of 'Arising Both from Oneself and from Another' (*gûshô*)

First, we shall inquire into why 'logos' cannot correspond with indirect effects. If we recall the example of the effect of Y on Z or the above instance of scale-eating cichlids, this question can be easily answered: it is because 'logos' has only two values — 'x' and 'non-x' —, and therefore, it is impossible to acknowledge the existence of an intermediate between them (i.e. the law of the excluded middle). However, since indirect effects rule in nature, there can also be something which is 'both x and non-x' (e.g. to arise both from oneself and from another) or 'neither x nor non-x' (e.g. to arise neither from oneself nor from another).

If this is so, then the suitable *logos* for indirect effects would undoubtedly be

based — not on the law of the excluded middle which is the basis for the 'logos' — but, — neologically speaking —, on 'the law of the *included* middle'. In the following consideration of the characteristics of such a new *logos*, we can derive a clue from T. Yamanouchi's interpretation of Nāgārjuna's *Mūlamadhyamakakārikā* (*Treatise Concerning the Middle*, in Japanese,『中論』). In his study, Yamanouchi writes as follows:

> 'The law of contradiction forbids strictly both affirmation and negation from being valid at the same time. Therefore, [Western] *logos* declares not only that judgment should be either affirmative or negative but also that it cannot be otherwise, for example, the intermediate and the third. But Nāgārjuna's philosophy, in contrast, dares to posit 'the middle' and advocates the middle way [of logical thinking]. This is the reason why his main work is entitled 'Treatise Concerning the Middle' or 'Treatise Concerning the Intuition of the Middle'.... Obviously, the thought of 'the middle' is central to his position. It may be probably sage to acknowledge that this means *the reverse of the law of the excluded middle*'[45].

In such a context, how does such logic as can be found in 'the reverse of the law of the excluded middle' appear in this *Treatise Concerning the Middle?*

In general, the type of statement that consists of four phrases is called 'tetra-lemma' (in Japanese, 四句分別 or 四論). It is well-known that the *Treatise Concerning the Middle* contains a number of odes in the tetra-lemma form[46]. In essence, however, we can divide them all into two ideal types[47].

A: S is (1) neither P (2) nor non-P (3) nor 'both P and non-P' (4) nor 'neither P nor non-P'.

B: S is (1) either P (2) or non-P (3) or 'both P and non-P' (4) or 'neither P nor

---

[45] Tokuryû Yamanouchi, *Rogosu to renma* [*Logos and Lemma*] (Tokyo: Iwanami, 1974), p. 86. (The information within brackets and italics are mine).

[46] Among all the odes in *Treatise Concerning the Middle*, which are approximately 450 in number, over 80 have a tetra-lemma form (including those that are abridged and imperfect). Cf. Musashi Tachikawa, *Kû no kôzô — Chûron no ronri* [*The Structure of Sunyata — The Logic of Mūlamadhyamakakārikā*] (Tokyo: Daisanbunmeisha, 1986), p. 132.

[47] Cf. *ibid*., p. 131.

non-P'.

Thus, this typical example of Nāgārjuna's argument, in accordance with tetra-lemma, refers to 'the cases of (1) affirmation, (2) negation, (3) both affirmation and negation, and (4) neither affirmation nor negation'[48]. According to Yamanouchi, such an argument can be regarded as an expression of 'the logic which does not exclude but includes the middle, if we classify these [i.e. the third and fourth cases] into 'the middle''[49].

However, the following question arises at this point: what kind of reasoning justifies the reverse of the law of the excluded middle in Nāgārjuna's logic, which is composed of four lemmas — affirmation, negation, both affirmation and negation, and neither affirmation nor negation? Concerning this aspect, Yamanouchi explains: 'I transpose the third and fourth [lemmas], in order to take "neither affirmation nor negation" as the third lemma and "both affirmation and negation" as the fourth one. I think that "*neither affirmation nor negation" is at the core of the whole logic* [of Nāgārjuna]…. *It is" neither affirmation nor negation" that opens up the viewpoint of " the middle"*. Without grounding on this lemma, "both affirmation and negation" would be impossible'[50]. If this is so, how does the third lemma of 'neither affirmation nor negation' render the standpoint of 'the middle' possible?

Needless to say, a remarkable characteristic of 'neither affirmation nor negation' is that this lemma is not only a negation of affirmation but also a negation of negation. In fact, it is easy for us to understand what is implied by 'negation of affirmation', but what could 'negation of negation' possibly mean? Yamanouchi replies as follows:

> 'The answer to this question is that this negation [of negation] alone is meaningless and that it cannot be meaningful without its close relation to other lemmas. …Seemingly, it may be nothing but a duplication of negation. But in substance, it turns the second lemma toward the first one and combines them. … Because 'negation of negation', which is no simple negation, makes negation approach affirmation and relieves it from being hopeless denial. If there is

---

[48] Yamanouchi, *op. cit*., p. 71.

[49] *Ibid*., p. 70. (The information within brackets is mine). Naturally, in contrast to Yamanouchi's interpretation, there exists another version that states, 'fundamental laws of formal logic, such as that of contradiction and that of the excluded middle are obeyed in the tetra-lemma of *Mūlamadhyamakakārikā*' (Tachikawa, *op. cit*., p. 132.). However, it is not necessary for us to demonstrate which argument is correct. As stated above, the main intention of this paper is to conceptualize the *logos* in such a way as to transcend the dichotomy resulting from the law of the excluded middle. This is why our present consideration focuses on Yamanouchi's interpretation.

[50] Yamanouchi, *op. cit*., p. 71. (The information within brackets and italics are mine).

neither affirmation nor negation, what remains? Common sense appears to indicate that there is nothing but pure nihility. Nevertheless, or rather therefore, *there arises a world where both affirmation and negation are negated: it can be not only affirmation but also negation because it is neither. It is nothing but the world of the fourth lemma*'[51].

The crux of Yamanouchi's explanation is that 'negation of negation' means a denial of the very dichotomy inherent in 'either affirmation or negation' and that only the abandonment of bivalence in 'neither affirmation nor negation' makes 'both affirmation and negation' possible, which is none other than the standpoint of 'the middle', because it builds bridges between affirmation and negation and enables both of them to coexist.

According to Yamanouchi, Nāgārjuna's logic is the tetra-lemma to which the third lemma is central, which is 'not mere negation but lies at least in a complex connection between affirmation and negation and enables negation itself to evoke a new affirmation'[52]. In reference to this, we will use the term 'the logic of *lemma*', in Yamanouchi's words. Therefore, we can regard the *lemma* itself as a form of logos which is capable of corresponding to the indirect effect.

In such a situation, based on this logic of *lemma*, what should we consider 'the ontology of life' that corresponds to the reality of symbiosis? In conclusion, I would like to outline my own opinion pertaining to this problem.

In projecting such ontology (*logos* of being), our fundamental aim is not to elucidate the being of human beings and of living things within the framework of the existing principle of explanation but to see the structure (*logos*) of the reality of life on earth (including human beings) as it exists.

If we recognize that all natural organisms mutually depend on one another in

---

[51] *Ibid*., p. 190f. (The information within brackets and italics are mine).

[52] Ibid., p. 191. On the contrary, the above logic cannot be directly found in *Treatise Concerning the Middle*. 'Nāgārjuna's logic of *sunyata* primarily implies radical negation of the fourth lemma [i.e. "neither P nor non-P"]' (Akiyoshi Tanji, 'Gangyô no 'kishinron'-chûshaku no ichikôsatsu [A Study of Wonhyo's Commentary on *Discourse on the Awakening of Faith in the Mahayana* (『大乗起信論』)]' in *Indogaku-Bukkyôgaku-Kenkyû* [*Journal of Japanese Society for Indian and Buddhist Studies*] vol. 51 num. 1, 2002, p. 10.). In other words, Nāgārjuna himself gives no explicit explanation of how 'both affirmation and negation' in the third lemma is deduced from 'neither affirmation nor negation' of the fourth one. According to Tanji, the first person to express 'the logic of *sunyata*' (*ibid*.), which shows the ground of the transition from the latter to the former, is Wonhyo, a priest in the seventh century Silla Kingdom who was known as a representative of early Korean Buddhism. In his commentary on *Discourse on the Awakening of Faith in the Mahayana*, Wonhyo 'argues that absolute negation is absolute affirmation by interpreting "one soul [i.e. the soul of all sentient beings]" as the fourth lemma [i.e. "neither affirmation nor negation"] and "two aspects of the soul [i.e. 'the soul as suchness" and "the soul as birth-and-death"]" as "both suchness and birth-and-death", which corresponds to the third lemma, and then understanding that one soul and its two aspects are one and the same' (*ibid*., p. 10f. The information within brackets is mine).

direct or indirect relationships, presented above in the ecological research on symbiosis and in the example regarding the effect of Y on Z, then it would be impossible to find an organism in nature that could have arisen from itself. This is because it is impossible for A to exist in nature independently of B, in other words, to be as *substantia*. Without B,

A would not be as A itself. Correspondingly, does every living thing in nature exist in such a manner of arising from another as is seen in the above-mentioned linear and one-way causality? The answer would be in the negative — when A is dependent on B, it would be incorrect to think that B already exists as *substantia* before A, that is, without any relation to A, for it is only when B also is reliant upon A that B exists as itself.

In short, the being of life in nature is neither arising from oneself nor from another. In other words, A and B do not exist in a way similar to *substantia*; therefore, the mutual relationship between both does not correspond with the relationship between *substantiae* either. Hence, as long as we accept the ontology of *substantia*, we can provide no other expression to describe the being of living things apart from '[arising] from a non-cause'[53] in Nāgārjuna's words.

In contrast, Nāgārjuna raises the following query: 'Whatever existent that is established through contingence, how can that, if it is not yet established, be contingent?'[54] As mentioned by Nāgārjuna, without the substantial being of each organism, the above-stated mutual relationships in nature would not be possible. If A did not exist before B, it would be impossible for B to exist as *dependent* on A and vice versa. That is to say, as its own condition of possibility, the mutual dependence of A and B necessarily requires the substantial being of the two. Seen from this perspective, the interaction between A and B is such that one is as *substantia* (in other words, one has arisen from itself), and then, by depending upon this fact (that is, by the fact of having arisen from another), the other also exists. Given this condition, it is necessary to regard the being of living things as arising both from oneself and from another.

Even if, as mentioned above, the interaction between A and B in nature is based upon the being of the two, which implies arising both from oneself and from another, it is obvious that this kind of being of A and B prevents their mutual dependence from being realized. This is because their mutual dependence is made possible by their existence as arising from a non-cause. Thus, we can conclude that *the being of every organism in nature is arising both from oneself and from another, even though or rather*

---

[53] Nāgārjuna, (tr. by David J. Kalupahana), *The Philosophy of the Middle Way — Mūlamadhyamakakārikā* (Albany: State University of New York Press, 1986), p. 105. (The information within brackets is mine).

[54] *Ibid*., p. 202.

just because it is arising from a non-cause, and that the ontology of life corresponding with the reality of symbiosis is, therefore, none other than that of arising both from oneself and from another — which aims to elucidate the structure (*logos*) of being, namely, that of arising both from oneself and from another combined with arising from a non-cause.

Without doubt, in order to arrive at the concrete content of this new ontology, it is important for us to learn a great deal from not only the latest ecological research pertaining to different symbiotic phenomena in nature but also the latest theoretical analysis of biomathematics (e.g. the theory of a complex adaptive system[55]), which attempts to explain the mechanism of symbiotic phenomena as it occurs. From such a study, we could formulate a perfect answer to the question regarding the being of human beings, or how the existence of both human beings and the entire system of existents can be secured.

---

[55] Cf. Simon A. Levin, *Fragile Dominion: Complexity and the Commons* (Cambridge, Mass: Perseus Books, 1999).