THE CONCEPT OF EVOLUTION IN MICHAEL POLANYI'S PHILOSOPHY

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ABSTRACT

The concept of evolution plays a distinguished role in the philosophy of Michael Polanyi. According to him evolution can be understood only as a feat of emergence which determines the tacit roots of our cognition and personal knowledge. In contrast to Neo-Darwinian theory, he does not accept that the mechanism of natural selection is the principle of evolutionary development, and states that the principles of evolution and life are higher level stable open systems which determine the direction of the evolutionary development.

1. The Origin of the Tacit Roots of our Personal Knowledge

1.1 Explicit and Tacit Knowledge

Polanyi states that our cognition is directed by such "compelling *clues*" from the background which though we are not attending to – *subsidiary* awareness – still specify the object of our cognition – *focal* awareness; – therefore our cognition becomes necessarily *tacit* since we are aware of the clues only in a subsidiary way (e.g. Polanyi 1969c: 113).[1] So our cognition, in contrast to that of Laplace's demon who has complete and instantaneous knowledge, is relying on such compelling clues which "are not fully specifiable" (Polanyi 1997a: 255) and of which we are aware only subsidiarily.

This structure of our cognition is the same not only in the case of our simple perception but also in the case of complex processes of obtaining scientific knowledge[2] since "all {scientific} research starts by a process of collecting clues that intrigue the inquiring mind…" (Polanyi 1969c: 117)

[1] "Whenever we are focusing our attention on a particular object, we are relying for doing so on our awareness of many things to which we are not attending directly at the moment, but which are yet functioning as compelling clues for the way the object of our attention will appear to our senses."

[2] "The structure of scientific intuition is the same as that of perception" (Polanyi 1969c: 118).

Furthermore: "many of these clues cannot sense in themselves at all. The contraction of my eye muscles, for example, I cannot experience in itself" (Polanyi 1997a: 252). It means that the clues which make us possible to recognize new things involve such *skills* and *previous knowledge* (Polanyi 1969a: 134) which can*not* be determined in an explicit way. It follows from this that *there is no* explicit knowledge without clues and tacit knowledge. Tacit knowledge, however, *can exist* without explicit knowledge and we can already find this in animals[3] (Polanyi 1962: 71-77). "While tacit knowledge can be possessed by itself, explicit knowledge must rely on being tacitly understood and applied. Hence all knowledge is *either tacit* or *rooted in tacit knowledge*. A *wholly* explicit knowledge is unthinkable" (Polanyi 1969d: 144). This is our dual hierarchy of knowledge.

So in Polanyi's theory our knowledge, in contrast to that of Laplace's demon who has complete and entirely explicit knowledge, is relying on such skills and previous knowledge which "are not fully specifiable", and which can be defined – partly or fully – as tacit knowledge. Hence, on the basis of its explicit physical parts, an entity which has been recognized by our previous tacit knowledge can*not* be fully specified.

1.2 Emergence

Polanyi states that we can distinguish two different types of boundary conditions. One of them is the *test-tube type* which has *no* influence on the elementary processes taking place within; and the other, the *machine type* which has the function of *controlling* and *harnessing* the elementary physical and chemical processes for the sake of some kind of *purpose*[4] (Polanyi 1969b: 225-226).

The two types of boundary conditions are not in full contrast to each other: every machine type boundary condition is *also* a test-tube type boundary condition. For example, when a machine is going wrong its structure services as a test-tube type boundary condition making the lower level physical and chemical processes observable and understandable.

An excellent example of a test-tube type boundary condition is the structure of a rock or a crystal, since the structure of a crystal does *not* control or harness the

[3] Or more exactly, in all living beings, because "*knowing belongs to the class of achievements that are comprised by all forms of living*" (Polanyi 1962: 403).

[4] The test-tube in which we observe the different chemical processes has no significant effect on them; moreover it has the function of making these processes observable for us, it is purposeful only in this sense. In contrast to this, the structure of a machine has not got the function of making the elementary physical and chemical processes observable – these processes are interesting for us only in the case when the machine is going wrong – but utilize these elementary processes for the *purpose* of some kind of work. So, the machine controls and uses the elementary processes. In this regard, the role of a test tube type boundary condition is inessential but a machine type one is always *essential* and *purposeful*.

elementary physical-chemical processes of the crystal; moreover, the structure of a crystal is the *consequence* of the crystal's elementary processes in accordance with the lower level principles, in this case the physical-chemical laws (Polanyi 1997b: 286). In contrast with this, however, the structure of a machine, – that is, the higher level boundary condition controlling and harnessing the elementary processes – of course, is not the consequence of the elementary physical-chemical processes of the machine. "The structure of machines and the working of their structure are {...} shaped by man" (Polanyi 1969b: 225) – in accordance with some kind of human reason and with the higher level principles, in this case the principles of engineering.

Engineering includes the operational principles of machines and some knowledge of physics bearing on these principles. Physics and chemistry, on the other hand, include no knowledge of the operational principles of machines. Hence a complete physical and chemical topography of an object would not tell us whether it is a machine, and if so, how it works, and for what purpose. Physical and chemical investigations of a machine are meaningless, unless undertaken with a bearing on the previously established operational principles of the machine (Polanyi 1967: 39).

Because Polanyi wants to clearly differentiate between the principles of elementary and the principles of comprehensive entities in his approach the complete physical knowledge means *only* the knowledge of the properties of elementary particles and the knowledge of physical laws referring to them but *not* the knowledge of such properties of comprehensive entities (e.g. of a machine) which are physical *only* in the colloquial language. So it follows that even if we have complete physical knowledge about the whole world, as Laplace's demon has, we would *not* necessarily know anything about the principles of the working of machines because the principles of machines are *entirely outside* of the laws of physics. Moreover, in accordance with Polanyi, if we have only the complete physical knowledge of Laplace's demon then we *would not be able to recognize* any machine or tool (Polanyi 1959: 48-49).

Build upon these Polanyi states that "The complete knowledge of a machine as an object tells us nothing about it as a machine" (Polanyi 1962: 330). About the explicit physical parts of the object we could know everything but we would know nothing about the machine itself as machine type boundary condition. "Engineering and physics are two different sciences." (Polanyi 1967: 39) They are two fundamentally different sciences on two essentially different levels of the entities and on the basis of its explicit physical parts, an entity which has been recognized by our previous tacit knowledge can*not* be fully specified, that is, it is *emergent*.

There is another example of the machine type boundary conditions beyond machines, since living beings have the *same* purpose as the structure of a machine: to control and harness the elementary physical and chemical processes and to utilize their powers. They do it exactly in the same way as we have seen it in the case of machines in connection with engineering. "Thus the morphology of living things transcends the laws of physics and chemistry." (Polanyi 1969b: 227) The concrete purposes of biological beings are the growth (ontogeny) and the *reproduction*

(phylogeny) of the organism. So it follows that according to Polanyi *the living beings fall under the machine type boundary conditions* (Polanyi 1969b: 226-227).

This is an often quoted and often misunderstood Polanyian statement. It means that living beings and machines have the same higher level structure but does not mean that living beings are machines in any kind of sense. A difference between living beings and machines is that in the case of the former the structure is not shaped by man but by the DNA[5] – more exactly by the genes which are coded in the DNA – and, naturally, it is not the principles of engineering what stands behind this but the *principles* of *evolution* and of *life*.

So in Polanyi's theory both crystals and frogs are emergent entities. Nonetheless, there is a significant difference between them. It is true that according to our personal knowledge we recognize a comprehensive *individual entity* in every crystal about which we have concrete, *previous* knowledge compared to our physical knowledge of its parts and that this means that our previous tacit knowledge about the concrete, individual crystal and its structure is *emergent* relative to the explicit physical knowledge of its parts, since "there is, indeed, always a noticeable logical gap between a topography and a pattern derived from it, and to this extent no pattern is specifiable in terms of topography" (Polanyi 1962: 394). At the same time, in Polanyi's theory the comprehensive structure of the crystal, in contrast to that of a frog and a machine, can be deduced from the physical and chemical processes of its structure (Polanyi 1997b: 286).

> The first thing to observe here is that, strictly speaking, it is not the emerged higher form of being, but our knowledge of it, that is unspecifiable in terms of its lower level particulars. We cannot speak of emergence, therefore, except in conjunction with a corresponding progression from a lower level to a higher conceptual level (Polanyi 1962: 393-394).

The difference between the crystal and the frog, on the basis of Polanyi's concepts, can be put in the following way: in contrast to the comprehensive structure of the frog that of the crystal falls under *only* the test-tube type boundary conditions while the comprehensive structure of the frog at the same time falls under the machine type boundary conditions *as well*. Now it is clear from this that the concept of test-tube type boundary conditions expresses merely an – in an explicit way – indeterminable relationship between our previous knowledge of a tacitly recognized higher level comprehensive structure of an entity and our knowledge about its explicit physical parts.

[5] The structure of an organism is „a boundary condition harnessing the physical chemical substances within the organism in the service of physiological functions. Thus, in generating an organism, DNA initiates and controls the growth of a mechanism that will work as a boundary condition…" (Polanyi 1969b: 229-230) So a DNA itself is not a boundary condition, but something similar which can originate boundary conditions, and thus functions as a "primary boundary condition" (Küppers 1992).

> Yet since in the case of the crystal we can easily pass from the pattern to the topography and back again, the conception of such a pattern is in fact not destroyed by the knowledge of its topographic particulars. I would acknowledge, therefore, in this case two distinguishable conceptual levels but not two separate levels of existence (Polanyi 1962: 394).

So due to our previous tacit act of our personal knowledge we recognize a comprehensive individual entity both in the case of the crystal and the frog which cannot be determined on the basis of its explicit physical parts. Because of this, both the crystal and the frog are emergent entities in the *conceptual* sense. However, according to Polanyi, in the case of the frog and machine we do recognize not only a comprehensive individual entity but also a higher level entity with certain *purposes*. (Polanyi 1959: 47-48; 1962: 328-331; 1967: 35-36; 1969b: 226-227; 1997b: 286-291) Such purposes are *not* possessed by a rock, a crystal or any other non-living thing the structure of which falls under *only* the test tube-like boundary conditions. This is one of the fundamental *tacit* acts of our personal knowledge that in certain things we recognize frogs and machines which are determined not only by the laws of physics but *also* by higher level principles. They have such specific higher level structures which, as machine type boundary conditions, control and harness the lower level physical and chemical processes of the living beings for some kind of purpose. This means that, in contrast to the crystal in which *merely we* recognize a comprehensive individual entity, in the frog we recognize such a comprehensive entity which does not get its individuality from the act of our tacit recognizing *but from its own structure*. In contrast to the crystal, the structure of the frog is a machine type boundary condition which cannot be determined on the basis of its physical parts and cannot be deduced from the physical and chemical processes of its structure. So, in the case of the frog, due to the previous tacit act of our personal knowledge we recognize such a comprehensive individual which – because of its specific origin – has purposes, and such *specific structure* which cannot be deduced from its physical processes. Because of this, the frog – and other similar entities e.g. machines – is an emergent entity in the *existential* sense. Polanyi is interested in *this* kind of emergence and he always uses the term in this sense as I will do in the followings.

Although both a frog and a machine is an emergent entity in the existential sense, there is a significant difference which draws a clear boundary between them as two different types of emergent entities: a frog – and any other living being – is not merely a purposeful being but, in contrast to a machine, it has a *centre*.[6] (Polanyi

[6] Polanyi regards living beings "as instances of morphological types and of operational principles subordinated to a centre of individuality" (Polanyi 1962: 383) and "the acknowledgment of such a centre is a logical novelty" (Polanyi 1962: 344). In the case of man he writes the followings: "For, as human beings, we must inevitably see the universe from a *centre* lying within ourselves and speak about it in terms of human language shaped by the exigencies of human intercourse. Any attempt rigorously to eliminate our human perspective from our picture of the world must lead to absurdity" (Polanyi 1962: 3; italics: D. P.).

1962: 344, 383, 401) It means that equally to us *the frog itself is also in a cognitive relationship with his environment* (Polanyi 1962: 345, 403), it can see the world from its own individual point of view, it has its own phylogeny and ontogeny, and that the purposefulness of the frog is original while that of the machine is derived.

1.3 Evolution

As we have seen in the previous subsection there are machine type boundary conditions in nature which control and harness the lower level, elementary – physical and chemical –processes. However, beyond machines and biological beings we can also find these machine type boundary conditions in the life of humans. One of Polanyi's favorite examples of cultural machine type boundary conditions is speech. Speech restricts the words at the lower level in the same way as the specific structure of living beings restricts the elementary physical and chemical processes, therefore, speech is functioning on the words as a machine type boundary condition and it has its own emergent principles. "Thus a boundary condition which harnesses the principles of a lower level in the service of a new, higher level, establishes a semantic relation between the two levels. The higher comprehends the workings of the lower and thus forms the meaning of the lower" (Polanyi 1969b: 236). Furthermore, there are no only two levels – for example, the level of physics and chemistry and the level of living beings, that is, the level of biology – but several such levels. More exactly, also in the case of our speech example, there are several levels of machine type boundary conditions:

> ...namely the production (1) of voice, (2) of words, (3) of sentences, (4) of style, and (5) of literary composition. Each of these levels is subject to its own laws, as prescribed (1) by phonetics, (2) by lexicography, (3) by grammar, (4) by stylistics, and (5) literary criticism. These levels form a hierarchy of comprehensive entities, for the principles of each level operate under the control of the next higher level (Polanyi 1967: 35-36).

And, of course, "the operation of a higher level cannot be accounted for by the laws governing its particulars forming the lower level", because all of these levels have their own different purposes – to pronounce a voice, form a word, compose a sentence, etc. –, as well as they have their own governing laws and principles (Polanyi 1967: 36).

So, as we see there are not just two levels, but several of them, which are gradually built up on each other, to create something essentially new – this is in our case the faculty of speech which is possessed only by humans:

> The theory of boundary conditions recognizes the higher levels of life as forming a hierarchy, each level of which relies for its workings on the principles of the levels below it, even while it itself is irreducible to these lower principles (Polanyi 1969b: 233).

> Each level relies for its operations on all the levels below it. Each reduces the scope of the one immediately below it by imposing on it a boundary that harnesses it to the service of the next higher level, and this control is transmitted stage by stage down to the basic inanimate level (Polanyi 1969b: 234).

Naturally, this bottom, inanimate level is the level of elementary physical and chemical processes. Built upon that, the fundamental levels of life are the following: 1. *compartment*; 2. *cell*; 3. *multicellular* organism; 4. organism with *nervous system*; 5. *culture*/language[7] (Polanyi 1962: 387-389). And "the principles additional to the domain of inanimate nature are the product of an evolution" (Polanyi, 1969b: 234).

So, Polanyi states that the various, higher level faculties of living beings as machine type boundary conditions (perception, speech, obtaining scientific knowledge, etc.) are the consequences of the process of evolution and thanks to these faculties of us, "as we ascend a hierarchy of boundaries, we reach to ever higher levels of meaning. Our understanding of the whole hierarchic edifice keeps deepening as we move upwards from stage to stage"[8] (Polanyi 1969b: 236). Naturally this has its own consequence to our higher level faculties, because those are not only independent achievements of evolution but also determined by it – as we can see that in the cases of the structure of our perception or of our obtaining scientific knowledge which can not be entirely independent from our personal biological and cultural nature on an absolutely explicit level of knowledge, and which thus cannot be entirely understood without an evolutionary approach.

2. Polanyi's Criticism of the Neo-Darwinian Theory

2.1 The Logical Structure of Boundary Conditions

"Darwinism has diverted attention for a century from the descent of man by investigating the *conditions* of evolution and overlooking its *action*. Evolution can be understood only as a feat of emergence" (Polanyi 1962: 390).

We have seen in the 1.2 subsection that for living beings the DNA is the source of the higher level boundary conditions harnessing the elementary processes. To do this job, the DNA has to function as a *code* determining the boundary conditions:

> ...whatever may be the origin of a DNA configuration, it can be function as a code only if its order is not due the forces of potential energy. It must be as physically indeterminate

[7] The first and the fifth were the 'major rebellions', the beginnings of biological and cultural stages of evolution.

[8] In Polanyi's other words: "We can recognize then a strictly defined progression, rising from the inanimate level to ever higher additional principles of life" (Polanyi 1969b: 234).

> as the sequence of words is on a printed page. As the arrangement of a printed page is extraneous to the chemistry of the printed page, so is the base sequence in a DNA molecule extraneous to the chemical forces at work in the DNA molecule. It is this physical indeterminacy of the sequence that produces the improbability of occurrence of any particular sequence and thereby enables it to have meaning (Polanyi 1969b: 229).

For if the chemistry of the printed page, more exactly the chemical laws which determine the chemical structure of the printed page – or the phonetics of the pronounced words – determines the order of the words that can be printed on that page – or can be said – then the words could *not* have independent meaning, we could *not* print different texts on the same page. In the same way, according to Polanyi, if the laws of chemistry determine the DNA configuration, that could not code independent information and could not be the source of the higher level boundary conditions harnessing the elementary processes, thus the living organisms could not have their specific, multileveled structure. However, the laws of chemistry left open the possibility both in the case of the printed page and in the case of the DNA that the same page (and ink) or the same DNA due to another, independent pattern or sequence can code entirely different information in different cases.

So, in Polanyi's theory higher level boundary conditions can restrict the lower level processes only if the correlation of the higher level boundary conditions and the lower level processes are random. Nonetheless: "Randomness alone can never produce a significant pattern, for it consists in the absence of any such pattern" (Polanyi 1962: 37). Otherwise, in accordance with meaning, the lower – more fundamental – level processes determine the structure of the higher level which, thus, could not function as a boundary condition. However, if the correlation of the two levels is random compared to each other, it means, on the one hand, that the higher level boundary conditions can harness the lower level processes – in our case, the elementary physical and chemical processes – and, on the other one, that in the two different levels *two essentially different principles are operating* which *can not descend from each other*. "Thus the logical structure of the hierarchy implies that a higher level can come into existence only through a process not manifest in the lower level, a process which thus qualifies as an emergence" (Polanyi 1967: 45).

It follows from this that *the higher level can never be the random consequence of the lower*, because then it ought to be random in itself too, in accordance with meaning, as a random consequence of a random process, but nevertheless it is, in itself, entirely *deterministic*. It *has to be* that, otherwise it could not have meaning, it could not be purposeful and it could not control and harness the lower level processes. In this approach the randomness is unambiguously *only a correlation* between levels. The lower or the higher levels can be regarded as random *exclusively in correlation with another level* – in this case with each other – but *not in themselves*. "By saying a factor is *random*, I do not refer to what the factor is in itself, but to the

relation it has with the main system." (Ashby, 1957: 259) So if their correlation is not random that means that the higher level entirely *depends* on the lower, thereby, there is no essential difference between them, and they are determined by *one* – lower level – principle.

2.2 The Deficiencies of the Neo-Darwinian Theory of Evolution

In the 19th century, evolutionary theories, as well as other contemporary theories of nature, culture and science, were influenced by the notion of progress (e.g. Hegel, A. Comte, H. Spencer). Thus evolution meant a *teleological process of progress*, during which the highest evolved man necessarily developed from the primitive germ plasm of the beginnings. This picture was significantly influenced by the phenomenon of *ontogeny* where if the necessary conditions are given an adult human necessarily develops from the initial zygote because of her DNA in which such general regularities work which unambiguously control and determine the stages, the process, and the end of the development.

The fundamental and important difference between these two ways of development is that in the case of the theories of progress, the development is determined by an absolute, external principle – set by God, nature, rationality or something else – while in the case of ontogeny by a non-absolute, internal one, set by evolution.

In contrast to the early evolutionists, Darwin himself pursued research *only* on those material mechanisms by which he could explain the appearance of new species[9] existence of which – at least one of them – he originally supposed.[10] In his work in accordance with the contemporary Newtonian paradigm – and in contrast with the theories of progress – he did not presume any teleological principle in evolution as the early evolutionists did. And because of this he avoided the use of the contemporary concept of evolution – and substantiated a new one.

However, from Polanyi's viewpoint, with this Darwin did not only displace an old, out-of-date teleological (absolute and external) principle, but unfortunately he threw out all higher level principles from the explanation of evolution.

Darwin based his mechanism of natural selection on the Malthusian demographical mathematical model, where the reproduction follows a geometrical series while the development of means of production is just linear thus the latter process restricts the population-growth. In connection with the descent of species it means that the

[9] *The Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (Darwin 1872)

[10] "There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved" (Darwin 1872: 429).

environmental resources *restrict* the increase of species – several newborn individuals will die well before their maturity – thereby if there is difference between the individuals, so there is *variability*, and if there are no sufficient environmental resources, so there is a *restricting factor* – a kind of boundary condition; call it selectional restriction – then the mechanism of natural selection begins to work and with the extinction of individuals who are different in contrast to the survivors the given species begin *to change*.

This is the logical structure of natural selection. It follows that *since both of the preconditions of the process are contingent* – the different features of individuals are the consequence of a random process and the conditions of environment and its changing are occasional – so, in the long run, *natural selection itself will also be a contingent, changing process from which no development follows*[11] (Darwin 1872).

Then, the followers of the Neo-Darwinian theory (e.g. T. Dobzhanshy, J. Huxley, E. Mayr, etc.) which theory became the ruling evolutionary theory of the 20th century took over both the mechanism of natural selection and the concept of evolution. In this new theory of evolution, the mechanism of natural selection is combined with the theory of genetics. This means, on the one hand, that they connected the formation of different individuals with the process of replication thereby they explained the occurrence of variability[12], and, on the other one, that they reduced the subject of evolutionary process to the genome[13] (Dobzhanshy 1937; Huxley 1942; Mayr 1942). However, the logical structure of the process has remained the *same*: the mechanism of natural selection is determined by the two contingent factors of variability and of restricting insufficiency, thus, *the Neo-Darwinian evolutionary theory has remained also a contingent changing process from which naturally no development follows* (Depew 1995; Mayr 1991; 2001).

So, the Darwinian notion of evolution means:

1. That the variants are the consequences of a *random physical* chemical process – mutation.
2. That the selectional restriction is the consequence of the insufficient *material* resources of the *occasional* environment.
3. The natural selection is the consequence of these two fundamental factors, and since both of them are determined by *random physical* processes, thus, the natural selection is only a *random physical* process too.

[11] „In some cases variations or individual differences of a favourable nature may never have arisen for natural selection to act on and accumulate. In no case, probably, has time sufficed for the utmost possible amount of development. In some few cases there has been what we must call retrogression of organisation. But the main cause lies in the fact that under very simple conditions of life a high organisation would be of no service – possibly would be of actual disservice, as being of a more delicate nature, and more liable to be put out of order and injured" (Darwin 1872: 99-100).

[12] So, the source of the variation became a lower level random physical chemical process called mutation.

[13] Or to the genes, as Dawkins, for example (Dawkins 1976).

4. And there is no other fundamental process or principle in evolution only the mechanism of natural selection.

However, according to Polanyi, living beings which are the products of evolution have *independent*, fundamentally different ordering principles in contrast to the laws of physics and chemistry (1.2 subsection). And, an independent ordering principle can *not* be the consequence of random processes (2.1 subsection).

Therefore, with the theory of natural selection Darwinism studies "the *conditions* of evolution and overlooking its *action*"; and this is why Polanyi does not accept that the mechanism of natural selection is the principle of evolutionary development.

3. The Principles of Evolution and Life

So, Polanyi regards living beings "as instances of morphological types and of operational principles subordinated to a centre of individuality" and he states that "no types, no operational principles and no individualities can ever be defined in terms of physics and chemistry. From which it follows that the rise of new forms of life – as instances of *new* types and of *new* operational principles centred on *new* individualities – is likewise undefinable in terms of physics and chemistry" (Polanyi 1962: 383). On the basis of these he throws doubt on the ruling Neo-Darwinian theory of evolution. "I deny that any entirely accidental advantages can ever add up to the evolution of a new set of operational principles, as it is not in their nature to do so" (Polanyi 1962: 385).

We have seen earlier in this paper what the main concepts of Polanyi are. Maybe the most important concept is that all machines and living beings are such emergent multilevel things which according to their machine type structures have *functions* and *purposes* (Polanyi 1959: 47-48; 1962: 328-331; 1967: 35-36; 1969b: 226-227; 1997b: 286-291). In connection with this Polanyi words clearly his position: "All physiology is teleological" (Polanyi 1962: 360) and that is "logically inherent in the conception of jointly functioning organs" (Polanyi, 1962: 361). Of course, it is evident what the source of the purposefulness of machines is: human reasons. But what are the sources of purposefulness of living beings as us? After all, there is no other answer merely that they are the principles of life and of evolution actions of which have led to the existence of living beings. But how it is possible, how can be these principles the source of all different purposefulness in our life? Before we try to find some kind of answer to this question, finally, we have to ask another one: what are the principles of life and of evolution, according to Polanyi, and how do they work?

"The *ordering principle* which *originated* life is the *potentiality* of a stable open system…" (Polanyi 1962: 383-384)

So, this is one of them, the principle of life. Although Polanyi does not name the other one, the principle of evolution, it is clear that is not the same – but supposedly something similar (Polanyi 1962: 384). How we have to understand this? Polanyi

can not help us particularly in the following because in this aspect his theory is not too elaborated, however, we have a possibility to talk about stable open systems in *two* fundamentally different ways. On the one hand, we can do that as does cybernetics, in which case the stable open system[14] will be a definitely stable self-regulating one[15] which is a centre of individual[16] with boundary conditions harnessing the lower level processes in Polanyi's words. This centre can be the initial subject of evolution, the germ plasm[17] of the beginnings.[18] And, on the other one, we can do that, as the system theories do, and in this case the stable open system will be the evolutionary system of the whole Earth restricting the lower level processes.

How do these principles work? In the case of the first principle, the DNA is the regulating mechanism of the organism, according to the meaning of the code which has been 'programmed' by the evolutionary process. The DNA determines the individual's multilevel structure which harnesses – organizational restriction – the lower level elementary processes for the purpose of the living being. But, of course, during the evolutionary development, further boundary conditions are added to the organism's structure, whereupon new regulating mechanisms form such as the nervous system or the second 'major rebellion', that of the culture.

In the case of the second one, the natural selection is the regulating mechanism[19] of the system according to the state of that.[20] The prevailing state of the system restricts – system restriction – the lower level processes. In this interpretation the logical structure of the evolutionary process has been changed. As we have seen it in the 3.2 subsection the process of natural selection is determined by two contingent factors, the random mutations – variability – and the occasional environment – selectional restriction –, thus, there is no any higher level principle which could control the lower level random processes into a determined direction. The determining

[14] It is important to note that these open, stable, self-regulating systems are such "systems that are open to energy but closed to information and control" (Ashby 1957: 4).

[15] Such self-regulating system of cybernetics is, according to W. R. Ashby's example, the incubator which thanks to some simple feedback processes is able to sift the external disorders out and to maintain the desired temperature. We can understand the living beings in the same way which can maintain via similar simple feedback mechanisms, for example, the desired pH of the blood or other important biological parameters (Ashby 1957: 236-237).

[16] This is not necessarily an individual organism in the everyday sense but can be in higher level an anthill or a cultural organism.

[17] „The evolutionary process takes place in the germ plasm, but it manifests itself in the novel organism which the germ plasm potentially embodies" (Polanyi 1962: 400).

[18] The birth of which can not be explained by the theory of evolution as we have seen that in the 2.2 subsection in Darwin's words but it is presupposed.

[19] This role of the natural selection as a „condition" is accepted by Polanyi, he only does not accept that is the „action" and ordering principle of evolution. „R. A. Ficher's observation of the way in which natural selection makes the improbable probable is but a particular application of this theorem" (Polanyi 1962: 384).

[20] There is a splendid example for this: Vilmos Csanyi's *General Theory of Evolution* (Csanyi 1982) Because among other things he based his theory on Polanyi's theory of boundary conditions (Csanyi 1988: 19-22).

selectional restriction is *occasional*. However, in contrast to this, the system restriction are *always determined* by the prevailing state of the stable open system which is the ordering principle of evolution, thus, the lower level random processes – the mutations – *will go into a determined direction*.

Two final remarks are necessary on this point.

First, which is also an answer to our question above about the purposefulness of our life. Within a required interval, when the environmental factor is not occasional but mostly constant, the natural selection in itself is necessarily teleological (Ayala 1998: 32-43), thus, for example, "the complicated anatomy of the eye like the exact functioning of the kidney are the result of a nonrandom process – natural selection" (Ayala 1998: 35). It *must* be teleological, otherwise, as we have seen that based on Polanyi's argumentation, it could *not* be the explanation of any purposeful thing.[21] But "the over-all process of evolution cannot be said to be teleological in the sense of proceeding towards certain specified goals" (Ayala 1998: 42). [22] The over-all process of evolution can be teleological only if we understand the mechanism of natural selection from the view of the *whole* evolutionary system in which we dwell and according to Polanyi this is the only way to explain the development and purposefulness of life – and of us – and not only that of certain things like the complicated anatomy of the eye.

Second, this teleology follows from the principle of evolution which is a stable open system. Thus this principle is *not* an absolute, external, substantially different, independent one as it is in the case of theories of the early evolutionist and of the theories of progress but a non-absolute, internal, dependent one which is at the beginnings, before the development of any emergent biological being *only a specific, conceptually emergent order in an entirely physical universe,* that is, in Polanyi's concept of evolution and life there is no place for any vitalist phenomenon, his approach to the topic is rather a *system theoretical* one.*

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[21] Darwin himself already emphasizes over and over again this teleological feature of natural selection when, in connection with his several examples, he talks about how different species, organs and ecological systems change in a specific, directed way according to the given environmental relations (e.g. Darwin 1872: 64; 165; 349-350; 401).

[22] We have seen it in the 3.2 subsection that in this sense in contrast to the earlier evolutionists neither Darwin thinks the evolutionary process teleological.

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