

MICHAEL POLANYI'S CONCEPT OF REALITY: FROM EPISTEMOLOGY TO ONTOLOGY AND FROM ONTOLOGY TO EPISTEMOLOGY¹

DANIEL PAKSI

Department of Philosophy and History of Science
Budapest University of Technology and Economics
daniel.paksi@filozofia.bme.hu

ABSTRACT

Michael Polanyi has a genuinely new concept of reality. On the basis of his theory of personal knowledge he denies the possibility of objective knowledge and approaches the question of reality from his theory of tacit knowing and knowledge. However, at the same time, he has another revolutionary concept, the theory of boundary conditions by which he can differentiate between conceptual and existential entities and can explain the emergent evolution of our tacit biological roots and cultural commitments, that is, the source of our tacit knowing and knowledge. So, although he starts from epistemology to arrive at a genuinely new concept of reality, at the same time, he explains the foundations of his epistemology by his genuinely new ontology.

Keywords: epistemology, ontology, British Emergentists, boundary conditions, personal knowledge.

1. Introduction: What is Real?

The question of reality is one of the most fundamental questions of philosophy. However, Michael Polanyi, originally, was not a philosopher but a physical chemist who turned to philosophy only in his middle age, and it can be the main reason why he started to investigate the question of reality from a new epistemological point of view. According to this epistemological point of view, what Polanyi takes to be real is what is judged as justified achievements of scientific research. This could be a good starting point to investigate Polanyi's concept of reality.² The philosopher Polanyi, however, has an elaborated ontology. He approaches the question of reality not only from an epistemological or a pragmatic aspect but he also provides a philosophical

¹ The research was supported by the grant TAMOP - 4.2.2.B-10/1-2010-0009, OTKA PD 83589, and OTKA K 84145.

² Or one could choose another modern thinker who, just like Polanyi, approaches the question from a genuinely new direction: for example Thomas Kuhn whose starting point is how scientific research functions or Charles Sanders Pierce, who states similar things about reality as Polanyi himself (see e.g. Mullins 1997).

theory of emergence. I believe that Polanyi's approach to philosophy and science can only be understood wholly if we take this viewpoint into consideration too. So, I will investigate Polanyi's theory of reality from the more traditional viewpoint of the contemporary literature on emergence, and try to find answers to what extent his theory of reality is original, what it means exactly to be real according to him.

Polanyi asserts about reality the following:

Real is that which is expected to reveal itself indeterminately in the future. Hence an explicit statement can bear on reality only by virtue of the tacit coefficient associated with it. This conception of reality and of the tacit knowing of reality underlies all my writings. (Polanyi 1964:10)

And:

...man has the power to establish real patterns in nature, the reality of which is manifested by the fact that their future implications extend indefinitely beyond the experience which they were originally known to control. (Polanyi 1962:37)

It is clear from these quotations that according to Polanyi there are such "real patterns" or comprehensive entities in nature which *have power* to control their "territory" and always can reveal themselves in genuinely new ways, that is, it is impossible to exactly predict their behavior. This is strongly connected to the fact that the power by which man can establish them is *tacit*. Laplace's demon who has complete physical knowledge but has not got the tacit power of man *can* exactly predict every property of every physical particle and *nothing* will be genuinely new for him. However, without tacit powers beyond these physical particles he is *not able* to recognize any comprehensive real pattern which could reveal itself in genuinely new ways. (Polanyi 1959:48–9) It means that the fact that a human being has tacit skills leads to the knowledge of any real thing and poses questions: cannot Laplace's demon with ideal complete knowledge see any real thing? Are the substantial physical entities not real? And are such comprehensive entities like a rock or a crystal which cannot reveal itself in genuinely new ways not real?

It is also clear from the quotations that a process of tacit knowing as we recognize a frog or a crystal precedes the acceptance of the reality of a comprehensive pattern. Strictly speaking the epistemology precedes the ontology. If it is true how something could be ontologically real? The phenomenon of a rock or a crystal is also the consequence of a process of tacit knowing and they still do not reveal themselves in genuinely new ways. A mind is more real than a rock or a cobblestone?

Persons and problems are felt to be more profound, because we expect them yet to reveal themselves in unexpected ways in the future, while cobblestones evoke no such

expectation. This capacity of a thing to reveal itself in unexpected ways in the future I attribute to the fact that the thing observed is an aspect of a reality, possessing a significance that is not exhausted by our conception of any single aspect of it. To trust that a thing we know is real is, in this sense, to feel that it has the independence and power for manifesting itself in yet unthought of ways in the future. I shall say, accordingly, that minds and problems possess a deeper reality than cobblestones, although cobblestones are admittedly more real in the sense of being tangible. And since I regard the significance of a thing as more important than its tangibility, I shall say that minds and problems are more real than cobblestones. (Polanyi 1967:32–3)

What is the degree of reality? And what is the source of this faculty of real patterns that gives this degree? What is the connection between significance and tangibility? Where does the Polanyian ontology start? Is it consistent? In the followings I will try to answer these embarrassing questions.

2. Reality According to the Theory of Emergence

The theory of emergence occupies a middle position between two more radical positions: substance dualism and reductionism. Both of them have several kinds. For a substance dualist, e.g. Plato, Descartes, or the vitalists, the behavior of an apparent thing partly stems from another substance, e.g. the forms, the *res cogitans*, or the vital, and not only from the material substance. In contrast to this, for a reductionist, of course, all of the higher level phenomena of a thing stem *only* from the material substance and the governing laws. The emergentists are substance monist just like the reductionists but they also state that there are “heteropathic laws” (Mill 1843) or “special laws of nature” (Broad 1923) which are clearly separated from the “homeopathic” or basic laws of nature, and thus there are such emergent phenomena of matter which *cannot* be reduced to physical properties and the governing, basic laws, because they *partly stem* from these special laws. So the British Emergentists (John Stuart Mill, Samuel Alexander, Lloyd Morgan, C. D. Broad) state that there is only “one kind of stuff” (Broad 1925), but there are several kinds of higher level, emergent phenomena which cannot be reduced to this only kind of stuff. It follows that the British Emergentists are substance monist but property pluralists according to the contemporary terminology. However, they clearly state, that this emergent phenomena or properties are not merely epiphenomenal (Mill 1843; Alexander 1920) but they have their *own causal powers* just like the elementary physical particles do.

Formerly the ontology was connected to the notion of substance. There was no phenomenon with own causal power, every phenomenon stemmed from a kind of substance (and the governing laws). But the British Emergentists in their theory changed this conventional substance-based ontology and connected reality to the

emergent levels *too*. Thus, for them, that is real what has its *own causal power*. This is called by Jaegwon Kim “Alexander’s dictum”. (Kim 1992)

As we have seen in section 1 Polanyi’s “real patterns” or comprehensive entities have power to control their “territory”—and this is not restricted to the living body—and always reveal themselves in genuinely new ways, that is, their behavior can never be predicted entirely. In this aspect Polanyi’s ontology is similar to that of the British Emergentists. However, there are serious differences, since for Polanyi the higher level comprehensive entities—which are clearly not conventional properties—do *not* stem from some “special laws of nature”. For Polanyi there are *no* such objective laws. For him, as we have seen in section 1, the higher level comprehensive entities stem from the specific faculties of living beings, that is, the specific faculties of living beings underlie his ontology. So for him it is not the entire cosmos evolving in the direction of Deity or Mind started with matter (Alexander 1920) or at the chemical level (Morgan 1923; Broad 1925) *only life*—in the direction of more complex higher level biological and cultural entities started with the first primitive prokaryotes (see section 4); thus, contrary to the British Emergentists, his theory can be conciliated with the Darwinian theory of natural selection. Furthermore it is also clear that, in contrast to the British Emergentists, in the theory of Polanyi the substantial physical level has no such causal powers as the emergent entities have, naturally e.g. a down-quark does not reveal itself in genuinely new ways. So, according to Alexander’s dictum, either the substantial physical entities are not real only the higher level comprehensive entities, or there are at least *two different kinds* of causal power in the Polanyian universe (see section 6).

In what follows, I shall investigate Polanyi’s epistemology, because here lay the specific faculties of living beings.

3. Polanyi’s Theory of Tacit Knowing 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) 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. Furthermore: “many of these clues cannot be sensed 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 1969f:134) which *cannot* 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. (Polanyi 1962:71–7) “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 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 *cannot* be fully specified.

On the basis of this, now it is clear that we recognize “real patterns” or comprehensive entities and their own causal powers at the higher levels in consequence of the tacit foundations of our hierarchy of knowledge. The question, however, is still open: how can we differentiate between such comprehensive entities which have their own causal powers e.g. a frog or a mind and which do not e.g. a rock or a crystal? Furthermore, in contrast to Laplace’s demon, why do we have tacit roots in our knowledge, by which we recognize these comprehensive entities and their own causal powers? The answers come from Polanyi’s other fundamental theory of boundary conditions.

4. Polanyi’s Theory of Boundary Conditions

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 it, only makes them observable for us; 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*. (Polanyi 1969b:225–6)

It is important to emphasize that the two types of boundary conditions are *not* contrary to each other: every machine type boundary condition is *also* a test-tube type boundary condition, since when a machine is going wrong its structure functions as a test-tube type boundary condition making observable and understandable the lower level physical and chemical processes.

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 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.

This does *not* mean, however, the breaking of the causal closure of the physical domain. Although the structure of a machine is not the consequence of the elementary physical processes of the machine but of such processes which are *contingent* upon these processes of the machine—“A boundary condition is always extraneous to the process which it delimits.” (Polanyi 1969b:227)—still at this level, that is, at the level of the elementary, physical parts of the machine, these contingent processes can also be *solely* understood as elementary *physical* processes which are absolutely in accordance with the laws of physics. That is another question if it is possible to talk about a machine as a comprehensive entity meaningfully—or at all—without the help of the higher level boundary conditions and their principles.

Because Polanyi wants to clearly differentiate between the principles of elementary and the principles of comprehensive entities 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 Laplace’s demon knows nothing about a machine despite his complete physical knowledge of the world if he has no knowledge of the principles of engineering.

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. The concrete purposes of biological beings are the *growth*—ontogeny—and the *reproduction*—phylogeny—of the organism. So it follows that *the living beings fall under the machine type boundary conditions*. (Polanyi 1969b:226–7)

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 DNA³—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*.

However, beyond machines and biological beings we can also find these machine type boundary conditions in the cultural life of humans.⁴ One of Polanyi’s favorite

³ 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:229–30)

⁴ As a matter of fact, the machine type boundary conditions of machines also come from the human culture, but the next example is much clearer and typical of the machine type boundary conditions of human culture.

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, thus, speech functions on the words as a machine type boundary condition and it has its own emergent principles.

Of course, the development of speech as a machine type boundary condition is not the consequence of the genes—although they naturally shape some biological structures necessary for speech—but of the cultural knowledge which was accumulated and handed down by generation to generation.

It follows and it is clear from this example that there are not 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 which can be *built on each other*. So the higher level machine type boundary conditions can restrict not only the elementary physical and chemical processes but any lower level ones.⁵

So there are not just two levels, but several of them, which are gradually built up on each other to create something genuinely new.

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.⁶ Onto this base, further and further machine type boundary conditions are gradually built till we arrive at the higher level human activities such as for example the process of obtaining scientific knowledge. And “the principles

⁵ Also in the case of our example of speech, there are several levels of machine type boundary conditions built on each other; “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 1967:35–6) 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)

⁶ Built upon that zero level, the fundamental levels of life are the following: 1. *compartment*; 2. *cell*; 3. *multicellular* organism; 4. organism with *nervous system*; 5. *culture/language*. (Polanyi 1962:387–9)

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 a *sequence of machine type boundary conditions*—perception, speech, obtaining scientific knowledge, etc.—*building on each other* are the consequences of the process of evolution and due to these faculties we have our own causal powers and “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.”⁷ (Polanyi 1969b:236)

5. The Existence of Real Comprehensive Entities: The Polanyian Ontology

Now it is clear that the apparent “real patterns” or comprehensive entities are *boundary conditions* which were recognized by the power of our tacit knowledge. However, there are two essentially different kinds of boundary conditions: the test-tube type and the machine type, and the first type include the second but not vice versa. Thus the machine type boundary conditions have the power to control the lower level processes and manifest themselves always in a genuinely new way but the test-tube type boundary conditions do not have. It follows that the test-tube type comprehensive entities (as a rock, a cobblestone or a crystal) have not got own causal powers, that is, they are not real in themselves, they have no significance *only tangibility*. They are only the consequences of *our specific structure of knowledge*.

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 1962:393–4)

In the first place, since every machine type boundary condition is also a test-tube type boundary condition, in the case of the machine type boundary conditions the situation is the *same*. At the same time, we recognize that they have their own causal powers that they control and harness the lower level processes, that is, they *have significance* and they are *real* in themselves. As a matter of fact, this latter one is the first step, since we recognize only later that there is a vast difference between these two kinds of things. Frogs, persons have their own causal powers—as opposed rocks and crystals—because they are such comprehensive entities the structure of which is formed by a hierarchy of machine type boundary conditions controlling and

⁷ In another way Polanyi put this: “We can recognize then a strictly defined progression, rising from the inanimate level to ever higher additional principles of life.” (Polanyi 1969b:234)

harnessing the lower level processes. This differentiation comes from our secondary philosophical and scientific investigations on the basis of which, according to Polanyi, we can establish the difference between these two kinds of comprehensive entities in the following way: the test-tube type entities are only conceptual because their structure is the consequence of the elementary processes taking place within but the machine type entities are existential because their hierarchical structure is after all the achievement of an *emergent evolutionary development*. This is the source of their significance, reality and ontological status.

So, at first glance, the Polanyian ontology is formulated within his epistemology. His theory of tacit knowing and knowledge describes the process how we get to know higher level comprehensive entities, and his theory of machine type boundary conditions inside this describes the process how we can differentiate between real and only conceptual comprehensive entities. However, the picture is not so simple, because only the first is entirely the consequence of our knowing activity (section 3), the second is *not*. The second is our understanding of the evolutionary developmental process of *real* comprehensive entities (section 4). Thus the first is only an epistemological question, but the second is an *ontological*.

The Polanyian epistemology, as we have seen in section 3, is based on that recognition that our knowing is determined by necessarily tacit clues. So we recognize real comprehensive entities and their own causal powers at the higher levels because of the tacit foundations of our hierarchy of knowledge. But where do these tacit foundations of our knowledge as e.g. the contraction of the eye muscles or the faculty of speech come from? The answer, of course, is that these tacit foundations stem from the emergent evolutionary development. So, from *this* point of view, the Polanyian ontology *precedes* the Polanyian epistemology, that is, the Polanyian epistemology is formulated *within* his ontology. The explanation of why Laplace's demon cannot see any comprehensive entity is that his faculty of knowing is not the achievement of the evolutionary development thus he cannot grasp the tacit clues by which we recognize them.

If this is true, and the Polanyian epistemology stems from his ontology whereas the Polanyian ontology stems from his epistemology, why does it still seem that the epistemology is the first? I think there are two main reasons for this. Firstly, Polanyi generally starts with the epistemology, partly because this is the former from the '40s while theory of boundary conditions was formulated only at the '60s. Secondly the Polanyian epistemology is closer to a traditional epistemology than his ontology to a traditional ontology, because his ontology is not only a traditional metaphysical or a simple pragmatic theory on reality but a comprehensive evolutionary theory which describes the developmental process of real higher level entities and their faculty of knowing from the deepest tacit roots to the higher level explicit knowledge, that is, the Polanyian ontology after all is a kind of *comprehensive evolutionary epistemology*.

6. Conclusion: Personal Knowledge and Reality

For Polanyi the personal “transcends the disjunction between subjective and objective.” (Polanyi 1962:300) So since we have *only* personal knowledge⁸ and it is not objective, *it is not possible for us to have objective knowledge* about reality, that is, it is not possible for us to have a traditional ontology. Thus the reality itself is necessarily *hidden* to us and only manifests itself in some aspects. “An empirical statement is true to the extent to which it reveals an aspect of reality, a reality largely hidden to us, and *existing therefore independently of our knowing it.*” (Polanyi 1962:311) Of course, it is also true in the case of a Laplace’s demon who does *not* know the higher level aspects of the hidden reality. Moreover, in principle it is possible to conceive of such an intelligent being who grabs the hidden reality via a still deeper (e.g. superphysical) knowledge—this is exactly the reason why Polanyi does *not* think that the physical knowledge is primary, and he starts with the acceptance of the reality of apparent comprehensive entities.

So one cannot have objective⁹ knowledge about reality itself but, as we have seen:

Man has the power to establish real patterns in nature, the reality of which is manifested by the fact that their future implications extend indefinitely beyond the experience which they were originally known to control. (Polanyi 1962:37)

This means that a comprehensive entity is real if it corresponds to the hidden reality in some aspect in itself and it is not only our idea (like the crystal or a fancy being). So a real comprehensive entity *is not under our control* and can manifest itself as an aspect of the hidden reality *in genuinely new ways*. Thus those recognized comprehensive entities are real the structure of which is a machine type boundary condition because they always manifest themselves for us in absolutely new ways. These are entities of higher, emergent levels and as such are real in themselves. Because Polanyi does not assume other substance over and above the physical one, real entities *are built entirely from physical substance*. Thus the physical domain has to be also *real*. Since it can exist outside of higher level, emergent structures—that is, in inanimate comprehensive entities—it is real *in itself*. At the same time, a crystal or a cobblestone never manifests itself in new ways¹⁰ so they are merely real in the

⁸ “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)

⁹ As a matter of fact, that Polanyi uses this word, however, not in the received sense, but to refer to the common aspects of our personal knowledge which transcends simple subjectivity.

¹⁰ As a matter of fact, that it is true only for a certain cobblestone or crystal, this is the existential side of the question. However, in the conceptual sense the certain classes of cobblestones and crystals as test-tube type boundary conditions are inexhaustible regard to their future

sense that they are *identical* with the lower level entities of the fundamental physical level—that is they as higher, emergent levels are not real in themselves and this is exactly the reason, I believe, why Polanyi states that “minds {...} are more real than cobblestones.” (Polanyi 1967:33)

Nevertheless, from the point of view of the theories of emergence the physical substance is also real, because it has another kind of causal power. More exactly, the elementary physical level has ordinary *effective* causal powers and the emergent, real comprehensive entities have a *new* kind of causal power. These new kind of causal power can be understood on the base of Aristotle’s formal and teleological causations. (Emmeche et. al. 2000)¹¹ However, understanding emergent causation as Aristotelian formal and teleological causations is significantly *different* from the understanding proposed by the British Emergentists which interprets it simply as effective. (McLaughlin 1992) Thus in the theory of Polanyi the problem of overdetermination—that a higher level entity is the sufficient consequence of its parts and, at the same time, is the consequence of another higher level entity’s causation (see e.g. Kim 1998; 1999)—does not emerge because the different kinds of causation rather *complete* and not compete with each other, and *both* of them are necessary for the satisfactory explanation of real comprehensive entities. Conceptual comprehensive entities, however, have no genuinely new causal powers thus they *can be explained* at the elementary physical level by *only* effective causes. According to this Polanyi clearly states that “...the operation of the mind will never be found to interfere with the principles of physiology, nor with the even lower principles of physics and chemistry on which they rely.” (Polanyi 1969b:221) This complementary relation between physical and emergent levels is possible in his theory because for him there is no objective knowledge, the physical reality is *not* the complete objective reality but only a complete *explicit aspect* of the hidden reality and beyond it *there is room* for another kind of aspect of reality such as human arts for example.

So, as we have seen, the hierarchy of machine type boundary conditions gradually built upon each other as emergent levels is the consequence of the evolutionary process. This hierarchy is an immanent part of our knowledge about the higher levels and *about ourselves* because, of course, we are *also* the achievement of evolution and it has its own consequences for our knowledge.

Biology then comes to include the accrediting of our own intellectual powers and the confirmation of our commitments within the framework of our calling. It acknowledges, in particular, our capacity for continually discovering new interpretations of experience which reveal a deeper understanding of reality, and takes us eventually to the point

manifestation since technically it can be conceived infinite number of different particular cobblestone and crystal.

¹¹ Other authors also take Aristotelian causal notions as an inspiration to think of causal processes in the case of biological beings and other complex systems, as e.g. Salthe (1985); Rosen (1991); El-Hani and Queiroz (2005).

where the whole panorama of science unfolds for a second time within a biology of man immersed in thought. (Polanyi, 1962: 373-374)

Due to this, our cognition has tacit structure, we are not entirely rational beings but fallible ones with common tacit roots and with a specific personal perspective—this is our *necessary centre of individuality*. (Polanyi 1962:344, 383, 401) And, of course, these tacit achievements come from not an explicit rational process but from a tacit one, in accordance with meaning, *the emergent evolution itself is an explicitly unformalizable tacit development*. More exactly, as we have seen, it is a process of development of higher level machine type boundary conditions which control and harness the lower level processes—e.g. the mosquito-caching activity of a frog, the skill of bicycle-riding, the specific structure of an eye, the cultural activity of obtaining scientific knowledge, or a specific cultural commitment of our life. For Polanyi there is no other substance over and above the physical which, however, is not primary regarding reality. That is, we are composed out of physical matter and—with regard to our essence—higher level boundary conditions *by the possession of which we can control and harness the lower level domains*. *So our reality consists in no thing more but in matter and this hierarchy of personal knowledge*.

BIBLIOGRAPHY

- Alexander, Samuel. 1920. *Space Time and Deity*. London: MacMillan and Co.
- Broad, Charlie Dunbar. 1923. *Scientific Thought*. New York: Humanities Press.
- Broad, Charlie Dunbar. 1925. *The Mind and its Place in Nature*. New York: Routledge.
- El-Hani, Charbel N. and J. Queiroz. 2005. Downward Determination. *Abstracta 1:2*. 162-192.
- Emmeche, Claus és S. Køppe, F. Stjernfelt. 2000. Levels, Emergence, and Three Versions of Downward Causation. In: *Downward Causation. Minds, Bodies and Matter*, szerk. P. B. Andersen, C. Emmeche, N. O. Finnemann és P. Voetmann Christiansen. 13-34. Århus: Aarhus University Press.
- Kim, Jaegwon 1992. „Downward Causation” in Emergentism and Nonreductive Physicalism. In: *Emergence or reduction? Essays on the Prospects of Nonreductive Physicalism*, szerk. Ansgar Beckermann, Hans Flohr és Jaegwon Kim. 119-138. Berlin: de Gruyter.
- Kim, Jaegwon. 1998. *Mind in a Physical World: An Essay on the Mind-Body Problem and Mental Causation*. Cambridge, MA: MIT Press.
- Kim, Jaegwon. 1999. Making Sense of Emergence. *Philosophical Studies 95*. 3-36.
- McLaughlin, Brian P. 1992. The Rise and Fall of British Emergentism. In: *Emergence or Reduction? Essays on the Prospects of Nonreductive Physicalism*, eds. Ansgar Beckermann, Hans Flohr, and Jaegwon Kim. 49-93. Berlin, New York: Walter de Gruyter.
- Mill, John Stuart. 1843. *System of Logic*. London: Longmans, Green, Reader, and Dyer.
- Morgan, C. Lloyd. 1923. *Emergent Evolution*. London: Williams and Norgate.
- Mullins, Phil. 1997. Polanyi's Participative Realism. *Polanyiana*. Vol. 6, No. 2.
- Polanyi, Michael. 1959. *The Study of Man*. London: Routledge and Kegan Paul.

- Polanyi, Michael. 1962. *Personal Knowledge*. London: Routledge and Kegan Paul.
- Polanyi, Michael. 1964. *Science, Faith and Society*. Chicago: University of Chicago Press.
- Polanyi, Michael. 1967. *The Tacit Dimension*. London: Routledge and Kegan Paul.
- Polanyi, Michael. 1969b. Life's Irreducible Structure. In: Michael Polanyi: *Knowing and Being: Essays*, ed. Marjorie Grene. 225-239. New Brunswick, London: Transaction Publishers.
- Polanyi, Michael. 1969c. The Unaccountable Element in Science. In: Michael Polanyi: *Knowing and Being: Essays*, ed. Marjorie Grene. 105-120. New Brunswick, London: Transaction Publishers.
- Polanyi, Michael. 1969d. The Logic of Tacit Inference. In: Michael Polanyi: *Knowing and Being: Essays*, ed. Marjorie Grene. 138-158. New Brunswick, London: Transaction Publishers.
- Polanyi, Michael. 1969f. Knowing and Being. In: Michael Polanyi: *Knowing and Being: Essays*, ed. Marjorie Grene. 123-137. New Brunswick, London: Transaction Publishers.
- Polanyi, Michael. 1997a. Creative Imagination. In: Michael Polanyi: *Society, Economics, Philosophy. Selected Papers*, ed. R. T. Allen, 249-265. New Brunswick, London: Transaction Publishers.
- Polanyi, Michael. 1997b. Life Transcends Physics and Chemistry. In: Michael Polanyi: *Society, Economics, Philosophy. Selected Papers*, ed. R. T. Allen, 283-297. New Brunswick, London: Transaction Publishers.
- Rosen, Robert. 1991. *Life Itself*. New York: Columbia University Press.
- Salthe, Stanley N. 1985. *Evolving Hierarchical Systems: Their Structure and Representation*. Cambridge, MA: MIT Press.