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SHORT COMMUNICATIONS

The Premises and Limits of Science: The Ideas of Rein Vihalemm[1]

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This short paper discusses how the philosophical understanding of science as *φ-science* (phi-science) by Rein Vihalemm reveals the limits of science (both the classical and non-classical) in describing the reality as grasped by laws, that is, in a predictive and logically explanatory way. Or, in other words, the limits begin from the phenomena of reality which are unpredictable, unstable, non-recurrent, accidental and so on. All these features Rein Vihalemm sees as the characteristics of the "given" natural objects, which can be seen through the social-historical practice, they are not the 'things in itself', but emerge through practice as the 'things for *us*'. This understanding is in accordance with Rein Vihalemm's 'practical realist philosophy of science' and, as it seems, also with Nicholas Maxwell's conception of 'aim-oriented rationality'. Both Vihalemm and Maxwell have stressed that there is *one* real world and potentially an infinite number of real 'world-versions' about this one real world. All these real 'world-versions' can be achieved only through the social-historical practice.

Rein Vihalemm (1995; 2001; 2008) has argued that *φ*-science as a theoretical object or an idealized model deriving from physics (since Galileo) is searching for objective laws formulated mathematically and confirmed experimentally and because of that it does not include the understanding of the natural-historical world *as it is*. Vihalemm (2008, pp. 189, 414) says that the aim of *φ*-science is not getting the true picture about some object in all its complexity and diversity, but discovering the laws: what, how, to what extent is subordinated to laws, what according to these laws is possible and what is impossible. Shortly, science is a

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theoretical object or an idealized model called φ-science and it may be discovered as a component in many different actual sciences, including even the social sciences. But in their nature, social sciences as well as humanities are not the same kind of theoretical object as φ-science is.

Rein Vihalemm himself explains φ-science as a theoretical object (or idealized model) and argues why this object is needed in his book written in Estonian (Vihalemm, 2008, pp. 414–416). He starts with stressing that φ-science as an idealized model allows checking the principal *premises* and *limits* of physics (starting from Galileo) and is used as a standard of science. That is, by this model we can check out whether it is possible or not to use an analogous way of cognition also in other disciplines, which compare themselves and/or which are compared with physics. Science understood as φ-science means a very specific way of seeing the world, namely modelling the world from the aspect of subordination to 'laws of nature', to objective laws. What cannot be described from the aspect of laws is not the matter of φ-science; φ-science, so to say, does not see this. Here another way of cognition (a classifying-historical-descriptive method) is needed. Vihalemm claims that the *premises* and *limits* of φ-science (factually of the exact—in ideal, mathematized—science) can be interpreted in terms of Immanuel Kant's Copernican Turn: φ-science (a constructive-hypothetical-deductive way of cognition) *presupposes* (and, as Vihalemm stresses, from this also its *limits* are coming) that an object must be adapted to (*a priori*) cognition, not the other way around (then we have a classifying-historical-descriptive way of cognition). Seeing the world through φ-science means seeing the phenomena in such real, objective conditions, in which these phenomena (the phenomena themselves!) behave as idealizations that are subordinated to exact 'laws of nature', to relations between the idealized objects which can be described mathematically. These conditions can be checked out experimentally. In this sense, φ-science determines itself what it researches from the world and how, for φ-science there are no phenomena independent of it. It means there are no "given" phenomena what to describe, but φ-science is characterized as a mathematical and experimental constructing of idealized and reproduced phenomena.

A 'law of nature' is usually formulated mathematically but can also be expressed in the symbols of logic. Let us see how Rein Vihalemm explains the logical formulation of a 'law of nature' (objective or scientific law) (Vihalemm, 2008, pp. 414–416). Traditionally from the point of logic the laws of nature are understood as a form of claim which can be expressed as follows:

$\forall x(P(x) \rightarrow Q(x))$, or shortly $\forall x F(x)$.

This formula can be read as follows: "For all x, if x is P, then x is Q" or "for all x, x has a quality (is subordinated to link) F, which in inductivistic-empiristic interpretation means: $F(a)\&F(b)\&F(c)\ldots$ (i.e. expresses an infinite conjunction: a is F (a has a quality F, is subordinated to link F) and b is F and c is F for all x). If $\forall xF(x)$ expresses the law, then x marks a variable only: the trueness of the corresponding claim does not depend on concrete values of this variable. The law does not tell us anything about the concrete objects, about the elements of the corresponding class, but relates the predicate F only, what is same for all the objects (for the whole 'infinite conjunction'). That is, the more exact logical form of the law is expressible in the second order predicate logic as follows: $\exists F \forall xF(x)$ (exists F such that for all x, x is F). Quality, link F does not depend on concrete values of x, on this concrete object, that takes the place of x. Putting it in the language of logic, the role of a scientist is in discovering the 'law of nature', in finding the predicate that from the contentional-actional point of view means constructing an idealized object. For example, as Vihalemm explains, the 'law of free fall' is factually constructing the idealization of 'freely falling body'. This has nothing to do with the "generalization" of individual happenings, but it is, so to say, constructing the general situation, giving the phenomenon a "clear shape". Whatever object, if it is in conditions of free fall, moves with homogeneously accelerating velocity $v = gt$ and goes through the length of a road $s = gt^2 / 2$ (g is acceleration of gravity and t is time).

According to Vihalemm, the general cultural premise of science is the forming of the scientific world picture, where the subject is not included in the world; the world is subject-free. Vihalemm sees that the way of cognition of φ-science is paradoxical: the objectivity is subjective—it is achieved by a specific activity of the subject. The way of cognition of φ-science and the technical world what is interacted with it, have the *limits*, what we can clearly see through the ecological crisis. The subject-free world begins to demonstrate its objective relation with the world that contains the subject. The ecological crisis makes it clear that the reality, the objective world is unit, man is not outside of it and the existence of this world does not depend on the existence of man, but the existence of man depends on whether the man adapts his/her activity with the objective unity of the world or not. I repeat, once again, that these were Rein Vihalemm's own explanations.

φ-Science investigates the purely quantitative aspects of nature, the aspects of nature that can be expressed mathematically, that can be measured, represented and reproduced experimentally. φ-Science does not see nature (*physis*) *as it is* (in all its complexity and diversity) but manipulates and formalizes the object

constructed by a scientist him/herself. But such characteristics of nature (*physis*), connected with humans and their everyday life and experience, like irreversibility, contingency, instability, irregularity, unobservable complexity, creative chaos, qualitative diversity, spatial and temporal nonuniformity, nonrecurrence, historicity, creativity, novelty, uniqueness, unpredictability, and others, with which the representatives of synergetics—theories of self-organization (the works of Ilya Prigogine, Manfred Eigen, Hermann Haken, Stuart Kauffman and others)—confronted, cannot be manipulated and therefore cannot be described by mathematical formalisms. (I have written many papers about the philosophy of synergetics and I have also had the honour to analyze the works of Ilya Prigogine together with Rein Vihalemm (Vihalemm & Näpinen, 1986; 1987).) The understanding of these natural characteristics does not proceed from mathematics, because it presupposes describing (in the natural language) the real world *as it is* (in all its diversity and complexity) and is based on *holistic* practice.

In Aristotle's times and even in the Middle Ages, human practice was holistic and because of that thinkers generally looked at the world as a whole (as a big living organism) to which also the humans belong. But in the 17th century, when the Galilean-Newtonian science arouses, the Aristotelian conception of cosmos was replaced by the conception of the universe as a mathematical structure. At the same time, a mechanical doctrine of causality was opposed to Aristotle's doctrine about four kinds of causes: material, formal, efficient, and final causes in their inseparable unity. Rein Vihalemm has repeatedly stressed the actuality of Aristotle's doctrine about four causes. He has said that theories in classical sciences are "dealing with the typical impact of the non-Aristotelian effective cause (instead of Aristotle's third cause) that realizes the external purpose, while Aristotle's natural final cause is ignored." (Vihalemm, 2001, p. 194) Vihalemm (1995) has also said that, in some sense, Ilya Prigogine (1917–2003) rehabilitated the Aristotelian cosmos (seeing the world as a big living organism to which also the humans belong). Already long ago, Rein Vihalemm and me explained that Prigogine's theories are in a full sense the non-classical exact science, because for the first time in the history of science they explicitly take into account the history of systems and their self-organization. The classical exact science (including quantum mechanics) is grounded on the idealization of reversibility of fundamental processes. However, what is missing in Prigogine's writings is that he, as Vihalemm has noticed, has never spoken about the *limits* of his own *scientific* theories. About non-classical science, to where Prigogine's theories belong, Rein Vihalemm summarizes:

> Non-classical science […] claims that there are objective limits to what can be predicted and checked, and these limits can be fixed by laws. The originality of non-classical science lies in the fact that it determined *the limits of both classical and non-classical science* and, thanks to this, opened up new perspectives for science. (Vihalemm, 1995, pp. 2659–2660; emphasis by the author)

Ilya Prigogine has stressed the new perspectives of science only (Vihalemm, 1995, p. 2539).

The philosophical understanding of science as *φ*-science makes an accent in the 'normal science' (in the sense of Thomas Kuhn) and reveals the limits of the exact science in describing the reality as grasped by laws, that is, in a predictive and logically explainatory way. Or, in other words, the limits begin from the phenomena of reality, which are unpredictable, unstable, non-recurrent, accidental and so on, that is, the limits begin from the characteristics of "given" (through the social-historical practice, see Vihalemm, 2011) natural objects.

Rein Vihalemm thinks that perhaps Nicholas Maxwell's 'aim-oriented rationalism' (associated with *the philosophy of wisdom*) can actually be also seen as a 'practical realist philosophy of science' (Vihalemm, 2011, p. 48). Vihalemm propagates a 'practical realist philosophy of science' and compares it with 'practical realism' (described by Sami Pihlström, see Vihalemm, 2011, pp. 48–50), with 'radical philosophical naturalism' (developed by Joseph Rouse, see Vihalemm, 2011, pp. 53–55), with 'critical scientific realism' (developed by Ilkka Niiniluoto, see Vihalemm, 2011, pp. 54–56), and with 'aim-oriented rationalism' (elaborated by Nicholas Maxwell, see Vihalemm, 2011, pp. 56–58). Rein Vihalemm (2011, pp. 51–52) stresses that the roots of practical realism can be found in the concept of practice of Karl Marx and claims that Marx' approach to practice has often been considered not in the context of the serious philosophy, but as the ideological basis of the failed political doctrine.

Vihalemm points out the differences of other conceptions from the practical realist philosophy of science. For example, the author sees the difference in understanding practice in the pragmatist philosophy in the following:

> The difference between understanding Marxist and pragmatist practice is mainly seen in the fact that the first emphasizes the social and historical character of human activity—even in case of an individual—, as conveyed by material and intellectual culture; pragmatism, however, usually concentrates on activity—even in case of social activity—from the viewpoint of individual. (Vihalemm, 2011, p. 52)

Differently from the Cartesian-Humean-Kantian line, Vihalemm emphasizes the following:

> According to practical realism […] there is *one* real world which is complex, inexhaustible, and can manifest itself in practice in a potentially infinite number of ways, i.e. in principle there can be an infinite number of real 'world-versions'. (Vihalemm, 2011, p. 58; emphasis by the author)

For this claim Vihalemm finds support in Nicholas Maxwell's conception about what the author says in *Abstract*: "Perhaps this conception can actually be also seen as a 'practical realist philosophy of science'?" (Vihalemm, 2011, p. 47) Both Maxwell and Vihalemm criticize the Cartesian-Humean-Kantian traditions. Rein Vihalemm explains that

> in reality, the objective world cannot be for knowledge an ungraspable 'thing-in-itself', but appears as a 'thing for us'. The notion 'thing-in-itself' is an empty abstraction where the inexhaustible objective world has been made indefinable by excluding any contact with the subject. (Vihalemm, 2011, p. 51)

The fact that φ-science (the exact science) sees only 'laws of nature', that is, physical or scientific laws, does not mean that there are no other aspects (qualitative and quantitative) in reality. Nicholas Maxwell is very right when he claims: "The very distinction between 'the physical universe' and 'the world of human experience' is, as it were, an artefact of our understanding rather than something that exists in reality" (Maxwell, 2007, p. 282). Already earlier Nicholas Maxwell (2001) dealt with "the human world/physical universe problem" which he saw "*the* fundamental problem of philosophy" (Maxwell, 2001, p. 18). There is only one real world (not two) and "[it] is only through the means of practice that the objective world can really exist for humans" (Vihalemm, 2011, p. 50).

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