On the Unfitness of the Exact Science for the Understanding of Nature

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Abstract: *It is argued that the exact science – if we according to Rein Vihalemm define it as a theoretical object or an idealized model coming 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 nature. The exact science functions like a simple categorical syllogism and contains only explanation and prediction. The understanding of nature (as well as of society) can be only personalistic, i.e. it can be achieved through man's own individual experience and self-knowledge. In personalistic understanding man uses himself/herself as a model for the world and human(s) in it.*

Keywords: *exact science, φ-science, explanation, understanding*

Introduction

In this paper I want to argue that contrary to usual opinions among many scientists and science-based educators, developing and teaching logical, mathematical and scientific methods, the exact science does not deal with and must not deal with the understanding of the natural-historical world, because exact scientists themselves construct their objects of investigation, which are idealizations, not the reality itself. Idealized objects are real only in connection with a process of idealization, carried out by a scientist. The constructing of idealizations is a specific character of the exact science, not a drawback.

What is the exact science

By the words 'exact science' I shall mean mainly an idealized physics-like science, which since Galileo has existed as a component of many actual sciences, like physics, chemistry, molecular biology. The idealized physics-like science does not depend on natural characteristics of natural systems, but proceeds entirely from a mathematical projection. All the physical-mathematical sciences can be treated as the exact science. The non-exact sciences are all the other sciences from chemistry (partly) and biology (for the most part) to many social researches and to all the humanities. The exact science uses mostly the language of mathematics, but may partly use also the natural language. Mathematics in the exact science is primary and basic. The non-exact sciences use (mostly) the natural language, whereas the symbols are used only in a small part. All the non-exact sciences depend on their objects of research and because of that differ largely from each other. Only the non-exact sciences (which are the natural history type of sciences and the social-humanitarian investigations) are *forced* to strive for *understanding* their objects of investigation. The exact science strives for *modelling* (starting from possibilities of mathematics); the understanding does not belong to its goals. This is so because the exact science, according to Rein Vihalemm (2008), is a theoretical object, an idealized model got from mathematical physics (since Galileo) and is named by Vihalemm φ-science. Vihalemm (2008, pp. 189, 414) says that the aim of φ-science is not getting the true picture about some object in all its 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, the exact science is 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 the humanities are not such kind of theoretical object as the exact science is.

If we look at the history of the exact science from the philosophical point of view, we may realize that all the existing physical-mathematical theories – classical and quantum physics, nonlinear dynamics, chaos theory, and others – are based on the same two assumptions that contradict our (i.e. human individuals') everyday experience: first, time is as symmetrical as space; and second, geometry can represent, with certainty, the physical world. The exact science is based on mathematics and uses experiments, and nothing is wrong with this. Scientists strive for the exactness, the precision, and serve the special purposes: to model the physical objects by means of mathematics in a way that it were possible, firstly, to predict certain tendencies and to explain certain

quantitative aspects of systems and, secondly, to use nature for the needs of man. Science since Galileo, i.e. the 'physical-mathematical science' (φ-science, according to Vihalemm), replaced the Aristotelian qualitative cosmos with quantitative physical universe – with mathematical structure that may not grasp the whole world. It is indeed certain that science has led to useful technical and industrial achievements. But as the exact science is founded on the principle of identification, a discovered phenomenon is identified with a phenomenon already known. It makes it impossible to describe the emergence of novel appearances that we as human individuals can observe in our daily life and practice. As the historian and philosopher of science Thomas Kuhn has explained, the 'normal science' does not strive for discovering the new, but, in contrary, it attempts to place the world into the framework of thinking (a paradigm) already obtained.

The exact 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. 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 – the theories of self-organization (works of I. Prigogine, M. Eigen, H. Haken, S. Kauffman and others) – confronted, cannot be manipulated and therefore cannot be described by mathematical formalisms. The understanding of these 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 *personal* experience. The exact science (as φ-science) does not strive for and must not strive for such kind of description at all; it is searching for the laws to be formulated mathematically in a way that explanation and prognostication were possible.

Philosophical understanding of the exact science as φ-science reveals the limits of the exact science in describing the reality as grasped by laws, i.e. in a predictive and logically explaining way. Or, in other words, the limits begin from the phenomena of reality, which are unpredictable, unstable, non-recurrent, accidental and so on. To describe nature as it is, the *ceteris paribus* assertions must be abandoned and researchers must acknowledge the essential fact of *our* (i.e. human persons') being in nature (and finally in the whole cosmos) and realize that the exact science, as well as technology, is unnatural (see, for instance, Sismondo, 2004, Chapters 15 & 16), because scientists organize experimental and theoretical systems to fulfil their expectations (proceeding

from the possibilities of the exact science) and exclude the *chaotic* behaviour of nature. The exact (mathematical, in ideal) scientific knowledge is indeed powerful, but only in ideal and artificial conditions; it does not reflect the natural objects and natural processes. Now, when during several decades already humankind has had to grapple with ecological and other crucial problems, needed to be overcome as quickly as possible for the survival of humankind, researchers in their theoretical and practical activities cannot ignore the "given" (through the social-historical practice; independently of the methods of the exact science) objects that manifest their natural qualities in natural environments and in natural conditions. The natural characteristics of the "given" objects become evident by other than the exact scientific type of explorations. It means that the exact scientific approach (φ-science) has its limits and is not fit to understand nature (*physis*) to which also the humans belong. What is needed for the long-term flourishing of humankind is the synthesis of the understanding of nature (that is not based on mathematical and experimental construction of idealized objects) and the wisdom that touches the human's aims, human values and ways of living (worthy of a human being) in the natural-historical world. (About wisdom I have shortly written in Näpinen, 2004, pp. 156–157.) All of us (including representatives of the exact science) must acknowledge the fundamental indeterminacy of the whole history of nature and human society.

The exact science as an idealized model (φ-science) deals with prognostication and explanation, but not with understanding. Explanation and prognostication is founded upon mathematically formulated 'laws of nature' (which are objective and scientific) (see Vihalemm, 2008, pp. 414–416) and upon arbitrarily fixed 'initial conditions' measured as exactly as possible. The exact science functions according to a simple categorical syllogism. The understanding of nature is compatible with, but irreducible to physical-mathematical explanation or prediction.

What is the understanding of nature?

There is nothing wrong with creating useful working mathematical models, but the true understanding of nature demands something different: the scientific 'how'-question (search for laws) is not sufficient for this. Instead, Aristotle's four-component 'why'-question is needed here. Only through Aristotle's philosophical 'why'-question we can see the world as a whole to which also the humans belong. Remember that Aristotle's 'why'-question consists of four

questions: “What is it made of?”, “What is it?”, “What was the source of change to it?”, “What is it for?”. Only after understanding nature scientists may try to model some of its aspects. It means that the understanding of natural-historical process must precede its modelling. We must regard man as a creation of nature and as belonging to the whole cosmos. The cosmos might be comprehensible in a quasi-Aristotelian way, as being required to fulfil an ultimate cosmic goal. A scientific worldview gives evidence only to conscious human goals. Here it is mistakenly thought that only humans can realize their goals if they know the so-called laws of nature formulated mathematically. However, all the self-organizing systems have their own goals and these goals do not depend on humans’ consciousness. Evolutionally non-conscious goals preceded conscious goals. The classical exact science (what is based on idealizing the *reversibility* of fundamental objective processes) does not demand the understanding of natural-historical processes, but the non-classical exact science (the theories of self-organization) is possible only after the natural-historical processes are somehow understood.

But what is the understanding? Let us try to answer this question. (About understanding of the world in relation to the scientific paradigm of self-organization I have already written in some works, see, for instance, Näpinen, 2001; 2002; 2004; 2007.)

The exact science is based on thinking about ordered relations, but not on understanding of reality, which contains *chaotic* relations. The exact science is constructing idealized objects and includes only deductive and inductive thinking. The theories of the exact science are called ‘hypothetical-constructive-deductive’. The hypothetical part of the exact science is inductive logic. An exact scientific method cannot get knowledge of the whole, because this knowledge cannot be deduced from facts about the parts. The exact science can get solutions of some mental riddles. The solutions are the result of using logical, mathematical and scientific (searching for laws) methods. The theories of the exact science can help to manipulate and control the physical environment, but controlling is not understanding.

Understanding, however, is more than thinking in the framework of ordered relations. Understanding cannot be fully objective; it is mainly and primarily subjective. Robert Priddy (who researched and taught philosophy and sociology at the University of Oslo in 1968–1984, until retired) in his online book (Priddy, 1999a) originally entitled *Beyond Science* and also named *The Philosophy of Understanding* opposes science and metascientific understanding.

Let us find out some main points/ideas of Priddy's book. Priddy begins with a statement that "[m]odern education, with its predominantly [...] scientific leanings, mostly undervalues the practical, interpersonal, moral and intercultural dimensions of understanding". Priddy is in agreement with Martin Heidegger's statement that "[a]ll understanding has a subjective basis" and things lack meaning for humans if they cannot be related to humans' lives in some kind of purposive way. He emphasizes that understanding embraces a much greater sphere than inductive and deductive thinking; understanding lies "in identifying and relating all kinds of means and ends, actions and […] consequences". (Priddy, 1999a, Chapter 1, p. 4 of 13) Priddy strictly says that the quality and depth of a person's understanding of the inner and outer world and other persons is more important than the extent of factual knowledge. In the physical sciences there is no understanding of people as persons and subjects. The meaning and purpose of man and society scientists consider as meaningless. But this is not so in phenomenology where understanding cannot avoid the great questions of life, as Priddy (1999a, Chapter 4) says.

Priddy (1999a, Chapter 5) does not forget to mention also the principles of hermeneutics, first of all the primacy of the text and the author's intention. Priddy (1999a, Chapter 1, p. 2 of 13) claims that all attempts to understand nature, other people and even the cosmos are based on some goal-oriented activity. (Priddy has added here the following footnote: "The first and foremost presentation of this was by Martin Heidegger in *Being and Time* (trans., New York, 1962), to whom the present exposition is obviously indebted." [Priddy, 1999a, Chapter 1, p. 13 of 13]). Priddy (1999a, Chapter 1, p. 2 of 13) explains that "Heidegger implied that there can be no meaning in anything independently of us and our purposes or 'projects'". But "all that has meaning or purpose for us may well arise in and through the human mind, but this does not prove that there is no meaning or purpose in created nature" (Priddy, 1999a, Chapter 1, p. 3 of 13). The mind is itself a part of nature and finally of the cosmos. The cosmos is the greatest whole what we can imagine. All the diverse operations and resources of the mind – thought, memory, interpretation, intuition, etc. – make up human understanding. Understanding is holistic (i.e., according to Priddy, understanding never excludes non-cognitive elements: personal identification, ethicality, respect for others, and so on) and because of that it cannot be deduced from facts about the parts. Creative intuition is needed here. Priddy emphasizes that human understanding is the individual person's achievement. It demands long personal experience and self-knowledge. Only a person's understanding involves self-knowledge whereas a collective human knowledge does not involve it. Understanding embraces practicality, insight, evaluation and many

other abilities. Developing only logical, mathematical and scientific (searching for laws) methods does not give a proper understanding. Understanding must not be detached from *individual* participational and practical activity. In order to understand things and relations between them mind must be a questioning mind. Primarily and basically a person must take under question his own imaginations. Mind can never grasp all the aspects of reality, because reality is infinite and inexhaustible. According to Priddy, reality, being, the cosmos is the ultimate whole: one final or absolute whole. The concrete content of the conception of this ultimate whole, as Priddy writes, depends upon many circumstances of culture, personal experience and self-knowledge.

It is obvious that Priddy defends some kind of personalistic understanding (what author himself calls 'metascientific') and opposes it to scientific methods as searching exact laws and prediction. In his second 13-chapter online book, *Science Limited*, Priddy (1999b, Chapter 10) himself admits that the uniqueness of historically-situated human actions demands wider, 'softer' observational methods in social and human science.

Rein Vihalemm (2008, pp. 418–419) also promotes personalistic understanding. He strictly referees Chapter Five from Nicholas Maxwell's book *The Human World in the Physical Universe: Consciousness, Free Will, and Evolution*. Let us see what Maxwell himself has written. About personalistic understanding that Maxwell (2001, p. 104) has also called 'person-to-person understanding', author says: "Personalistic explanations seek to depict the phenomenon to be explained as *something that one might oneself have experienced, done, thought, felt*" (Maxwell, 2001, p. 103; author's emphasis). If many scientists characterize personalistic understanding negatively as a "folk psychology", then Maxwell writes:

> *Physical understanding is (a) objective, (b) impersonal, (c) factual, (d) rational, (e) predictive, (f) testable, and (g) scientific […] Personalistic understanding, by contrast, may be held to be (a) subjective, (b) personal, (c) emotional and evaluative (and thus nonfactual), (d) intuitive (and thus nonrational), (e) nonpredictive, and (f) untestable. (Maxwell, 2001, p. 109)*

If the representatives of standard empiricism claim that personalistic understanding is an intellectual disaster, then Maxwell believes that in cooperative activities personalistic understanding is more fundamental than physical explanation. Personalistic understanding may be characterized as wisdom, because wisdom can realize what is of value in life, for oneself and others. Scientific (physical) and technological knowledge is not enough for a good and wise life. Maxwell,

like Priddy, has also mentioned the tradition of hermeneutics and even used the term 'empathic understanding' as a synonym for the term 'personalistic understanding'. As Rein Vihalemm (2008, pp. 418–419), following Maxwell, says, in personalistic understanding man uses himself/herself as a model for understanding the other and others in (co)acting in the real world.

Conclusion

In this paper I have differentiated understanding from scientific explanation and prognostication. I have said that nature (*physis*) to which also the humans belong can be understood personalistically and only some *aspects* of nature can be explained or predicted scientifically. I have briefly characterized personalistic understanding by the medium of Robert Priddy's and Nicholas Maxwell's writings. Priddy does not use the term 'personalistic understanding', but uses the terms 'person's understanding', 'interpersonal understanding', 'holistic understanding', 'metascientific understanding', and others. Maxwell uses directly the term 'personalistic understanding', which is a synonym for the term 'person-to-person understanding'. Evaluating and developing personalistic understanding (especially by Maxwell) seems very promising. I think that personalistic understanding has not been and is not forbidden to anybody, including representatives of the exact science. The exact science makes it possible to manipulate and control (to some extent) the real world; personalistic understanding can help us to understand each other in cooperative activities in the real world.

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