Ontologija

A. WHITEHEAD'S METAPHYSICAL ONTOLOGY AND I. PRIGOGINE'S SCIENTIFIC ONTOLOGY: FROM A POINT OF VIEW OF A THEORETICAL CONCEPTION OF SCIENCE

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Whitehead's and Prigogine's philosophies of science are similar in this respect that they both are interested in ontology built in the light of modern science. This kind of ontological approach, especially Whitehead's metaphysical reasoning is usually regarded as speculative which should be avoided in philosophy of science. Ilya Prigogine and Isabelle Stengers appreciated, however, Whitehead's metaphysics as cosmology in that being the most ambitious attempt to elaborate a philosophy of nature that, although speculative, is not directed against science or towards separation of philosophy from the actual science. Although Whitehead criticized the classical science, he did not identify it with science in general and did not acknowledge the respective domains and tasks of science and philosophy as distinct of principle from each other. According to Prigogine and Stengers Whitehead's philosophy was somewhat the forerunner of Prigogine's non-classical science which gives a new content to the speculations of Whitehead. Chemistry was a starting point of Prigogine's non-classical physical theory. In the present paper Prigogine's conception of non-classical science is examined from the point of view of a theoretical conception of science elaborated in the context of philosophy of chemistry. Prigogine and Stengers, as well as Whitehead, have not really presented a theoretical conception of science. It is argued that the latter, however, offers a key for examining various issues in philosophy of science and understanding science in general, including Prigogine's non-classical science. Appreciating Prigogine's optimism concerning the chances of science that has liberated itself from the myth, the author still finds that this optimism can also be misleading as it can create a false impression that this new science does not deal with idealizations any more, that it is not a means of inquiry resulting from special requirements and aims, but will really understand the world "as it is" to the point that the problems of so called human world, including those of, e.g., ethics would be, in principle, scientifically understandable. In fact, however, if non-classical science manages rid itself from the myth of classical science, the only change will be that it does not equate the scientific picture of world and scientifically ***modelled*** *reality with the real world "as it is".*

Keywords: *non-classical science, philosophy of chemistry, Prigogine's scientific ontology, theoretical model of science, Whitehead's metaphysical ontology.*

Introduction

Whitehead's and Prigogine's philosophies of science are similar in this respect that they both are interested in ontology built in the light of modern science. This kind of ontological approach, especially Whitehead's metaphysical reasoning is usually regarded as speculative which should be avoided in philosophy of science (see, e. g., Losee 2001: 1). Ilya Prigogine and Isabelle Stengers have stressed, however, that "Whitehead's case as well as Bergson's convince us that only an opening, a widening of science can end the dichotomy between science and philosophy" (Prigogine and Stengers 1984: 96). According to them, Whitehead's *Process and Reality* was devoted to the central problem of Western ontology – the relation between being and becoming. Although speculative, it was an attempt to formulate a philosophy of nature avoiding basic contradiction between science and philosophy. Today, referring to Prigogine's theory of self-organization as a new paradigm in physical science, we can say that physics and metaphysics are coming together and "[t]he direction which microscopic theory of irreversibility takes gives a new content to the speculations of Whitehead ..." (Prigogine and Stengers 1984: 310).

Chemistry was a starting point of Prigogine's non-classical physical theory. The purpose of this paper is to examine Prigogine's conception of non-classical science from the point of view of a theoretical conception of science elaborated in the context of philosophy of chemistry. Prigogine and Stengers, as well as Whitehead, have not really presented a theoretical conception of science. Science is viewed by these authors as adequate knowledge of the real world, nothing being presupposed about the nature or character of scientificity. However, I would like to argue in favour of introducing a theoretical model of science as an idealised physics-like science called *φ-science* which can be used as a tool of investigation. The general approach in *φ-science* can be characterised as constructive-hypothetico-deductive and in *non-φ-science* as classifying-descriptive-historical. Modern chemistry is actually a combination of constructive-hypothetico-deductive inquiry (*φ-science*) and classifying-historico-descriptive inquiry or natural history (*non-φ-science*). Such a combination is also Prigogine's non-classical science. The birth of non-classical science clearly points out premises, actual aims and limits of science. This interpretation of non-classical science is different from Prigogine's view according to which non-classical science has liberated science from the myth of classical science and opened up new perspectives.[1]

In this context just outlined I wish to discuss three questions. (1) Does science need metaphysics? (2) Is some kind of ontological approach acceptable in philosophy of science, or is it correct to presuppose that science pursues knowledge about the world as it is and, in this connection, deals with the ontological questions meant as questions concerned with the nature of being or with a consideration of what kinds of entities really exist? (3) What has a theoretical conception of science elaborated in the context of philosophy of chemistry to offer to the elucidation of these two questions and of the answers provided by Prigogine and Stengers?

Science and Metaphysics

As to my knowledge, the question 'Does science need metaphysics?' has for a decade alrea-

[1] I have analysed Prigogine's new scientific understanding of the world in (Vihalemm 1995) and will also dwell on it in the last section of the present paper.

dy been in the centre of attention, e.g., for the English philosopher of science Nicholas Maxwell (see his monographs 1984, 1998, 2001, 2004b), who has also provided a clear answer with his radical conception. He also has a special web page (*http://www.nick-maxwell.demon.co.uk*) advocating the viewpoint on the necessity of a revolution in academic life in general. Maxwell thinks (see, e.g., his special paper on the web: 2004a) that a new conception of physics should be developed which makes metaphysical theses an integral part of physics (actually of science in general) and which, at the same time, makes it possible to assess such theses in terms of their empirical fruitfulness. He holds that physics actually makes metaphysical presuppositions concerning the physical comprehensibility of the universe and that rigour requires that these substantial, influential and problematic presuppositions be made explicit – so that they can be criticized and alternatives may be developed and assessed, with the aim of improving the assumptions. The current paper, however, does not strive towards taking a stand as to Maxwell's conception (unfortunately, Maxwell has scarcely studied Whitehead's works; I have noticed only a reference to (Whitehead 1967) in his (2001: 18)), I only wished to indicate to the fact that the issue "Science and Metaphysics" has been considered important recently as well and Maxwell's conception has provided a very detailed contemporary solution on the research of this issue.

The approach of Prigogine and Stengers seems to be quite different from that of Maxwell's (these authors have also not referred to each other's works). So, let's move on to some general remarks on the reception of Whitehead's philosophy, especially by Prigogine and Stengers, paying main attention to the aims and methods of Whitehead's speculative philosophy and its relation to science. As I already mentioned, Prigogine and Stengers appreciated Whitehead's findings, but emphasized that in non-classical science his speculations have a scientific content. So, as it seems, according to Prigogine and Stengers, metaphysics or speculative philosophy is acceptable in science as some kind of pre-scientific treatment of scientific issues. What really matters is scientific knowledge. Philosophy as metaphysics is either some kind of a preliminary discipline to scientific disciplines or not an autonomous discipline at all but rather an aspect or a component of science with the ability "to close some fundamental gaps in … [existing scientific] knowledge" (Prigogine and Stengers 1984: 98). Prigogine and Stengers appreciated Whitehead's metaphysics as cosmology in that being the most ambitious attempt to elaborate a philosophy of nature that – unlike, e.g., of the philosophies of Kant, Hegel and Bergson – is not directed against science or towards separation of philosophy from the actual science. Although Whitehead criticized the classical science, he did not identify it with science in general and did not acknowledge the respective domains and tasks of science and philosophy as distinct of principle from each other. Quite the contrary, having pointed out the basic inadequacies of the theoretical scheme developed by classical science, Whitehead's purpose was, as Prigogine and Stengers put it,

> to define the conceptual field within which the problem of human experience and physical processes could be dealt with consistently and to determine the conditions under which the problem could be solved. What had to be done was to formulate the principles necessary to characterize all forms of existence, from that of stones to that of man. It is precisely this universality that, in Whitehead's opinion, defines his enterprise as "philosophy". While each scientific theory selects and abstracts from the world's complexity a peculiar set of relations, philosop-

> hy cannot favor any particular region of human experience. Through conceptual experimentation it must construct a consistency that can accommodate all dimensions of experience, whether they belong to physics, physiology, psychology, biology, ethics, etc. (Prigogine and Stengers 1984: 94–95).

According to Prigogine and Stengers Whitehead's philosophy was somewhat the forerunner of Prigogine's non-classical science. The authors of "Order out of Chaos" stressed, however, that classical science was "killed not by philosophical criticism or empiricist resignation but by the internal development of science itself" (Prigogine and Stengers 1984: 55).

Thus, Prigogine and Stengers are, first and foremost, science-believers. They perceive the so to say philosophical content in the science itself and consider the dialogue between science and philosophy possible. But it is not clear form their writings, there are only very few notes on how they – if at all – perceive the inclusion of metaphysics into science and to what extent science itself is philosophical. A most interesting, yet enigmatic description of the Stengers's conception of the relationship between science and philosophy has been provided by Bruno Latour in his foreword to Stengres's book *Power and Invention: Situating Science*:

> In countries where philosophy has been separated into epistemology on the one hand, and history of ideas on the other, it is very hard to locate a philosopher like Stengers who takes up the normative task of epistemology but who carries it out by using the tools of metaphysicians like Leibniz or Whitehead, who for generations have been taught (or not taught at all) as so many dead white males. For her, metaphysics is epistemology pursued by other means, a serious task that requires the collective wisdom of the whole history of science and thoughts and that cannot disdain any of rejected claims of past philosophy or underdog sciences. As will be clear in reading this volume, the effects of this writing strategy are very strange, especially when famous scientists – Galileo, Einstein, Poincaré, Planck – are read not as those who broke away from philosophy but as those who can be elevated to the level of great and controversial metaphysicians... (Latour 1997: xi).

Also, another issue not quite clear, there are again only few notes to be found, how Whitehead's speculative method has been comprehended and evaluated. Metaphysics has usually been criticized because of its speculative nature meant as empirically non-testable and therefore – as this is not logic or mathematics – considered if not arbitrary, then definitely not one belonging among knowledge. What then makes Whitehead's metaphysics appear acceptable?

Prigogine and Stengers characterize modern science first and foremost as the experimental dialogue with nature. They hold that experimental procedure can also become a tool for a theoretical analysis, then as a thought experiment. It is Whitehead's conceptual experimentation that is perceived as an analogue to scientific approach. Stengers writes, e. g., referring to her cooperation with Prigogine (Stengers 1997: 55):

> How is it that we have found inspiration from speculative philosophers when reflecting on the discovery by physics of its open character? The hypothesis that we would like to offer is the following: for these philosophers, it is likewise a matter of an *experimental* approach – not an experimentation on nature but on concepts and their articulations, an experimentation in the art of posing problems and of following the consequences with the most extreme rigor.
>
> Whitehead clearly expressed this conception of philosophical experimentation, with its own degree of freedom but also with its own constraints. Thus, he maintained that philosophy cannot have recourse to the strategy that underlies the experimental dialogue of science with natu-

> re – the strategy of choosing what is interesting and what can be neglected...
>
> [–] Whitehead ... [reserved] for philosophy the task of producing, through the play of quite abstract concepts, real experiences in their concrete richness.

Stengers considers it important to understand propositions in a world of events, as it appeared also from her keynote presentation at the 6th International Whitehead Conference (Salzburg University, July 3–6, 2006), dedicated to propositions as Whitehead's 6th category of existence. Quoting Latour (1997: xiii), Isabelle Stengers "lives in the world of events, not in a prison of words trying desperately to represent an absent faraway state of affairs. Propositions, to take up on of Whitehead's key words, are moving through and are not human interpretations of things-in-themselves that would be out there remaining different to our fate."

This metaphysical approach of Prigogine and Stengers based on the ideas of Whitehead is closely related to ontological approach.

Philosophy of Science and Ontology

I am one of those philosophers of science who dislike the word "ontology" (in philosophy of science at least). Of course, there is no sense in arguing about the words. There are several works in philosophy of science as well, containing the word "ontology" in their title. These are mainly works discussing the existence of theoretical entities, referring to this as the question of the ontological status of these. The issue is also topical, e.g., in philosophy of chemistry, especially in connection with the problem of the autonomy of chemistry, which has usually been discussed in the context of the issue of reduction of chemistry to physics. Recently it has been pointed out that it is not enough to analyze this problem and defend the autonomy of chemistry on the basis of mere failure of epistemological reduction; the question of the ontological reduction should also be discussed. And in this connection the need for a metaphysical view of chemistry as an ontologically autonomous field is placed on the agenda. A more profound look into this question is yet another issue, but as to the arguments of the current paper I consider it necessary to explain my position with the following. I think that philosophy of science does not need some kind of metaphysical-ontological underpinning to convince us that there is no reason to believe that fundamental physical theories are the only ones telling us something about the real world and therefore have ontological priority over the others.

Thus, the issue of ontology in the current paper is, as it was mentioned in the introduction as well, basically a question whether it is correct to presuppose that science pursues knowledge about the world as it really is and consequently, philosophy of science should also, or perhaps even first of all, analyze ontological questions as those about the nature of being or about of what kinds of entities actually exist? In addition, the title of the current paper makes a difference between metaphysical ontology and scientific ontology, associating the first with Whitehead, who developed ontology as a discipline of metaphysics, and the second with Prigogine, who allegedly considered studying ontology as an assignment of science.

Whitehead, indeed, emphasized him being interested in metaphysics as an ontology placing him in the philosophical tradition which has been started by Aristotle. There is no need to give an overview of Whitehead's metaphysical ontology (see especially his 1985, also 1967 and the classical overview: Leclerc 1975).

However, I would try to provide a brief analysis on Prigogine's and Stengers's views on the aspect of philosophy of science. By the way, Bruno Latour claims, that when Isabelle Stengers in her "first period" during which she cooperated with Prigogine, was "the philosophical henchman of a highly controversial chemist" (I don't know, of course, why Latour considers Prigogine a highly controversial chemist), then in the "second period", i.e. in a series of articles and books written in her own name, she moves from philosophy of science to Whiteheadian philosophy proper (Latour 1997: x–xi).

But now, as I promised, I would try to provide Prigogine's and Stengers's viewpoints in the context of philosophy of science. The key question seems to be the question that should be the main issue in philosophy of science, namely: "What is science?" Prigogine and Stengers do not consider it necessary or even possible to come up with a theoretical conception or model of science. To them it seems to be only natural that science pursues knowledge about the world as it really is. When the classical issue of philosophy of science is to distinguish between science and non-science and good science and bad one, then according to Prigogine and Stengers the touchstone is, quoting Latour (1997: ix) again, "not in epistemology but in ontology, not in the word but in the world". The world itself modifies our definitions of science and offers "ontological touchstones" for scientificity.

Prigogine and Stengers consider it important "to look for the philosophic significance of the results of scientific activity" (1984: 88). They criticize classical science (as did also Whitehead, proceeding from metaphysics) on the basis of new scientific achievements, according to which the world is not what it looks like in classical science, or to put it the other way, classical science is ontologically erroneous. This ontological erroneousness is not limited to the view of the world of classical science only, it is also a question of receiving the description as if "from the outside" of the world, not by a scientist as a real human being who is also part of the world. Prigogine and Stengers wish to proceed from the real world with real scientists. They write (in the book *Order out of Chaos: Man's New Dialogue with Nature*) that classical science "is no longer our science. ... as scientists we are now beginning to find our way toward the complex processes forming the world with which we are most familiar, the natural world in which living creatures and their societies develop" (1984: 36). "Scientific understanding of the world around us is just beginning" (1984: 34). Or as Prigogine has written in the preface to his *From Being to Becoming: Time and Complexity in the Physical Sciences* (1980: xii–xiii): "… we are in a period of scientific revolution – one in which the very position and meaning of the scientific approach are undergoing reappraisal…"

In my opinion this ontological approach of Prigogine and Stengers is somewhat misleading from the viewpoint of philosophy of science, as the notion of science is left non-specified. The authors do emphasize that classical physics cannot be identified with science in general and that the classical comprehension of science has expanded, but the topic is still a certain new physical science, but what exactly it is or how is it related to science in general – that is left non-specified in the light of philosophy of science. Hereby I do not seek to dispute the presentation of philosophic significance of Prigogine's non-classical science by Prigogine and Stengers, only to point out a few questions important from the viewpoint of philosophy of science that the

authors have neglected due to their ontological approach.[2]

To be brief, discussing science we cannot presume we can actually consider ontology as knowledge of real world or, in other words, proceed from the principle that the real world itself defines the essence of science. It has to be borne in mind that philosophy of science attempts to specify, to sophisticate the notion of science. It is not obvious that everything which is called science or *Wissenschaft* in German (say, from physics to the humanities) or has been in history called science, should be regarded as science as a special kind of knowledge and research. And on the other hand, it is also not obvious that **only** science in a specified narrow sense of the term (say, *exact science* or *physics-like science*) can tell us something about the real world, i.e. be ontologically acceptable. Physics, even classical physics has been taken as the epitome of science for a long time. However, in philosophy of science as well as in science studies in general, or in such a special branch of philosophy of science as philosophy of chemistry, it is not popular anymore to proceed from the notion of science based on the classical physics. Philosophers and researchers of science have begun to especially stress that all sciences need not be similar to physics. They have argued for a pluralistic understanding of science. It seems that no definite notion of science is available.

I think, however, that elaborating a definite notion of science is indeed impossible, if we set ourselves the aim of taking into account the peculiarities of all the fields of research that are known under the name of science or *Wissenschaft* in German. It is not a good idea to set such an aim. I have made a proposal to introduce a theoretical model of science as an idealized physics-like science called φ-science, and I think that this may be a good idea as that theoretical model offers a key for examining various issues in philosophy of science, including philosophy of chemistry, and understanding science in general, including Prigogine's non-classical science.

φ-Science, Chemistry and Prigogine's Non-classical Science

Very shortly, my idea is the following. It is true, of course, that science in general cannot be identified with physics, and therefore, e.g., chemical laws and theories are not identical with physical ones. But, on the other hand, it is also true that physics has obtained the status of the standard of science. The question is why? What gives to physics, to its laws and theories the status of the embodiment of scientificity in general?

It is obvious that physics is not regarded as science simply because it is physics, and physical laws and theories are not regarded as scientific simply because they are physical. However, on the basis of physics one may present a certain theoretical model of science. This theoretical model should be elaborated as an idealization substantiated by the historical practice of physics (as the paradigm of science). It should be stressed that the model in question cannot be *identified* with physics. Physics ser-

[2] An earlier version of this paper was presented at the 6th International Whitehead Conference held in Salzburg (from 3rd to 6th July). I emphasized in that presentation that Prigogine's and Stengers's interesting approach should actually not be considered as philosophy of science. By the way, Professor Stengers was also among the audience and did not raise any serious counterarguments. As she commented, she has never defined herself as a philosopher of science, only as a philosopher. She acknowledged that she had begun learning how to become a philosopher together with learning how to coexist with, and be interested by, Prigogine and his co-workers. Science has not been for Stengers (as well as for Prigogine) an object for philosophical reflection or definition.

ves only as a theoretical starting-point for the construction of a theoretical model covering *any* science. In elaborating such a model, chemistry is important as well.

It is essential that one acknowledges the premises and limits for knowledge and research in a field that has the status of a perfect exact science, like physics. Scientific cognition is paradoxical in the sense that theoretical knowledge presupposes empirical knowledge, but the latter, in turn, presupposes the former. This paradox will not cause great difficulties only if we deal, as in physics, with an experimental-theoretical research which, operating with experimentally substantiated idealizations, constructs itself its object of research (physical reality, or physical phenomena). The subject matter of post-Galilean physics is not determined by any definite objects of nature, or any fundamental level of nature itself, but only through theories we have constructed and experimentally substantiated. The structure, objects, facts, etc. of the natural world are not self-identified by the nature.[3] *In this sense*, the social constructivists are right when they say that "the natural world has a small, or nonexistent, role in the construction of scientific knowledge" (Collins 1981: 3). Nature is the subject matter of physics only on the basis of those of its characteristics, aspects and phenomena which can be expressed mathematically, which can be measured, exposed and reproduced experimentally. So, physics itself constructs its object of research, considering nature only through idealized and mathematically projected situations. Therefore, on the basis of physics can be constructed a theoretical model, representing an experimental exact science in general, in its purest form, i.e. as an idealization, making it possible to study the methodological structure and functions of the exact science theoretically. This idealized physics-like science as a theoretical model of science I have proposed to be called *φ-science*.

Chemistry and physics certainly differ from each other regarding their subject matter. Chemistry is probably not reducible to physics (though the very meaning of this issue is unclear[4]). This non-reducibility can be understood as a manifestation of a certain type of incommensurability: the concepts, models, laws etc. used in the paradigm of chemistry cannot be derived from those of physics; strictly speaking, from the viewpoint of physics they are even senseless. But this does not mean that chemistry and physics as sciences are incommensurable on the methodological level as well. On the contrary, from the viewpoint of theoretical model of science, i.e. *φ-science*, it is possible to speak about the philosophical-methodological identity of chemistry (insofar as it is a science!) and physics.[5] Too often, however, the categories that are identical for any science on the philosophical-methodological level, are identified with the corresponding physical concepts, ignoring the fact that their concrete content in physics and chemistry does not coincide.

I think, *pace* Whitehead and Prigogine with Stengers, that the premises and limits of a science which is – actually or in principle – an exact science have been distinctly recognized by I. Kant already. I mean his famous 'Copernican revolution'. I would like to interpret these Kantian ideas in my own context. For instance, I don't agree with Kant"s apriorism pre-

[3] Cf. Niiniluoto (1999), sections 7.3 and 3.1.

[4] See van Brakel (2003).

[5] For chemistry as a *φ-science* see, e.g., Vihalemm (1999, 2001, 2003, 2004, 2005).

supposing fixed and immutable prior principles. Any kind of prior knowledge is historico-culturally conditioned, it can be questioned and changed; on the other hand, there is no knowledge without some kinds of prior assumptions. And I would like to stress that there are very specific prior assumptions in the case of φ-science. Exact science is possible on the condition that the object of investigation is definable by cognition itself, by the very principles of exact science (as is the case with theoretical physics). If, however, we have the opposite situation: the task of cognition demands that we obtain knowledge about an object that is already 'given' to the researcher by some kind of pre- or non-scientific practices, before and independently of its scientific investigation, then purely scientific knowledge, or knowledge following the pattern of exact sciences about that object is impossible. Of course, there are no objects and subjects of cognition "ready-made" or "given" by nature itself, since they both have a historico-cultural character as well. Nevertheless, we can differentiate between objects of φ-science and non-φ-science. The research of the "given" objects cannot be φ-scientific in its nature, it cannot search for the laws of nature; rather, it has to be like natural history, classifying-descriptive-historical, where "laws" occur in quotation marks only, having the character of non-justifiable "universal generalizations" (these are in quotation marks, too).

So, in the field of empirical knowledge ("empirical" in the sense of "non-philosophical" and/or "non-formal/mathematical") there are two main types of cognition:

(i) scientific (more precisely – φ-scientific) cognition, being of a constructive–hypothetico-deductive character;

(ii) non-φ-scientific (or natural historical) cognition, being of a classifying–historico-descriptive character (ranging from classical biology to the humanities).

It should be emphasized that (a) both types of cognition embodied also philosophical and formal-mathematical cognition as their aspects or integral parts (these last types of cognition exist, of course, separately of empirical knowledge as well), (b) laws of nature and scientific theories are possible only in the first type of cognition, (c) in the second type of cognition theoretical part of knowledge can actually be only philosophical or methodological.

One should not broaden the notion of science in order to cover all research fields and types of knowledge or value systems. One should rather understand clearly that the scientific treatment has certain premises and limits within the framework in which it is effective, but cannot pretend to have the status of ideal cognition and knowledge in general.

It is important to realize that chemistry as a field of inquiry has a dual character: its position is intermediate between science (in the narrow sense, i.e. as φ-science) and natural history (i.e. classifying-historico-descriptive type of knowledge and research). And it should be emphasized that the latter cannot be regarded as an inferior, less reliable or undeveloped type of knowledge and research. In chemistry the cooperation between these two approaches is needed. I would also like to stress that on the occasion of the birth of non-classical science we should speak about the cooperation between φ-scientific and non-φ-scientific approaches in physics as well. Let's not forget that chemistry was a starting point of Prigogine's non-classical physical theory.

As it has been shown (see, e.g., Vihalemm 2001, especially *Fig. 1*, on p. 193), it is possible to distinguish between four conceptual systems in the history of chemistry. The fourth of them is theories of chemical self-organization. The

most essential example of them is the Prigogine's theory of non-linear, non-equilibrium thermodynamics of chemical reactions. There is a reason to speak about Prigogine's stage in the physicalization of chemistry, which simultaneously is a paradigm change in physics. Prigogine has proceeded from complicated chemical processes as an original subject matter for a physical theory. This physical study of self-organization was not purely φ-scientific, but rather a combination of a classifying-historico-descriptive inquiry and constructive-hypothetico-deductive research, which is characteristic of chemistry.

5. As a Conclusion

Let me summarize, what does the new scientific understanding of the world declared by Prigogine and Stengers mean from the point of view of the theoretical conception of science. Prigogine and Stengers have put the new position of science as follows (1984: 54–55):

> As we have already stated, we subscribe to the view that classical science has now reached its limit. One aspect of this transformation is the discovery of the limitations of classical concepts that imply that a knowledge of the world "as it is" was possible. The omniscient beings, Laplace's or Maxwell's demon, or Einstein's God, beings that play such an important role in scientific reasoning, embody the kinds of extrapolation physicists thought they were allowed to make. As randomness, complexity, and irreversibility enter into physics as objects of positive knowledge, we are moving away from this rather naæve assumption of a direct connection between our description of the world and the world itself. Objectivity in theoretical physics takes on a more subtle meaning.
>
> [–] As a result, physicists had to introduce new mathematical tools that make the relation between perception and interpretation more complex. Whatever reality may mean, it always corresponds to an active intellectual construction. The descriptions presented by science can no longer disentangled from our questioning activity and therefore can no longer be attributed to some omniscient being.

Appreciating Prigogine's optimism concerning the chances of science that has liberated itself from the myth, I still find that this optimism can also be misleading as so we can neglect the specific character of physics-like science as a way of research and a type of knowledge, and in this connection the fact that non-classical science also clearly points out the limits of science. The drawback of classical exact science is not that it deals with idealizations only and cannot grasp reality in all its complexity. The drawbacks become evident when we do not take into account how and why these idealizations have been created, and under which conditions they are valid, but began to take them as the foundation of reality on which everything that objectively exist rests, and what does not result from this foundation and is not in accordance with it, does not actually exist, but is subjective, unreal and illusory (like irreversibility and historical time for classical physics). When Prigogine stressed that new science can move further than the idealizations of classical science, being able to embrace instability, chance, irreversibility, unpredictability, historical time, etc., which have been considered subjective or exceptional, or even illusory, it can create a false impression that this new science does not deal with idealizations any more, that it is not a means of inquiry resulting from special requirements and aims, but will really understand the real world "as it is" to the point that the problems of so called human world, including those of, e.g., ethics would be, in principle, scientifically understandable.

The myth about science could come into being namely because the limits were not un-

derstood. The limits, however, result already from the premises of scientific inquiry – from the specific character of scientific approach and its aims. Non-classical science, as long as it remains exact science will not lose this feature. If it manages rid itself from the myth of classical science, the only change will be that it does not equate the scientific picture of world and scientifically *modelled* reality with the world itself, with reality itself. Scientific description – modelling – is primarily essential for the formulation of laws of nature which make explanation and prediction possible. The question about the limits of science is actually the question about the possibility of describing reality in a way regulated by laws of nature. The myth of classical science is connected with the idea that everything was considered to be determined by laws of nature in a way that in principle (from the position of God, so to say) everything can be predicted and controlled. Non-classical science, however, claims that there are objective limits to what can be predicted and controlled, and these limits can be fixed by laws of nature. Due to this and in the sense that there are non-predictable, non-controllable, irreversible, self-organizing etc. phenomena in the world, non-classical science has not only determined the limits of science, but has on the other hand also opened up new perspectives for it. These new perspectives do not concern the specific character of scientific approach and its aims, but the world or reality described by science including the position of science and scientists in it.

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A. WHITEHEADO METAFIZINĖ ONTOLOGIJA IR I. PRIGOGINE'O MOKSLINĖ ONTOLOGIJA TEORINĖS MOKSLO KONCEPCIJOS POŽIŪRIU

Rein Vihalemm

Santrauka

Whiteheado ir Prigogine'o mokslo filosofines koncepcijas jungia tai, kad juos abu domina ontologija, grindžiama modernaus mokslo duomenimis. Mokslo filosofija ontologinį požiūrį, ypač tokį kaip Whiteheado metafizinis mąstymas, paprastai laiko spekuliatyviu, todėl vengtinu. Tačiau Ilya Prigogine'as ir Isabelle Stengers į Whiteheado metafiziką žvelgė kaip į kosmologiją ir vertino ją už tai, kad, būdama ambicingiausias, tegu spekuliatyvus, gamtos filosofijos projektas, ji vis dėlto nėra nei nukreipta prieš mokslą, nei siekia supriešinti filosofiją ir dabarties mokslą. Whiteheadas kritikavo klasikinį mokslą, tačiau netapatino jo su mokslu bendrąja prasme ir tyrimo sričių bei siekiamų tikslų požiūriu nepripažino principinio skirtumo tarp mokslo ir filosofijos. Pasak Prigogine'o ir Stengers, Whiteheado filosofija turėtų būti vertinama kaip Prigogine'o ne-klasikinio mokslo pirmtakė. Toks požiūris suteikia naują turinį Whiteheado spekuliacijoms. Prigogine'o ne-klasikinės fizikos koncepcijos atspirties taškas yra chemija. Šiame straipsnyje Prigogine'o koncepcija nagrinėjama chemijos filosofijos siūlomos teorinės mokslo sampratos požiūriu. Iš tikrųjų nei Prigogine'as ir Stengers, nei Whiteheadas nepateikė teorinės mokslo koncepcijos. Tačiau straipsnyje teigiama, kad būtent teorinė mokslo samprata duoda raktą, padedantį atrakinti ne vieną mokslo filosofijos, mokslo bendrąja prasme, taip pat ir Prigogine'o ne-klasikinio mokslo keliamą klausimą. Autorius simpatizuoja Prigogine'o optimizmui, kad mokslas išsilaisvino iš mito, tačiau, autoriaus požiūriu, šis optimizmas visgi klaidina. Gali susidaryti įspūdis, kad ne-klasikinis mokslas neturi nieko ben-

dra su idealizacijomis, kad jis nėra vien tyrimo būdas, priklausantis nuo konkrečių reikalavimų ir tikslų, kad naujasis mokslas iš tikrųjų supras pasaulį „tokį, koks jis yra“, kad net vadinamojo žmogaus pasaulio problemos (pvz., etikos) taps iš principo moksliškai suprantamos. Tačiau jei ne-klasikinis mokslas gebėtų atsikratyti klasikinio mokslo mito, tai vienintelė skirtybė būtų ta, kad jis netapatintų mokslinio pasaulio vaizdo ir moksliškai sumodeliuotos realybės su pasauliu, „koks jis yra“ iš tikrųjų.

Pagrindiniai žodžiai: ne-klasikinis mokslas, chemijos filosofija, Prigogine'o mokslinė ontologija, teorinis mokslo modelis, Whiteheado metafizinė ontologija.

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