Jan Woleński

The problem of philosophical assumptions and consequences of science

Studia Philosophiae Christianae 47/4, 117-134

2011

Studia Philosophiae Christianae
UKSW
47(2011)4

JAN WOLEŃSKI
Instytut Filozofii UJ, Kraków

THE PROBLEM OF PHILOSOPHICAL ASSUMPTIONS AND CONSEQUENCES OF SCIENCE

Key words: consequence operation, hermeneutics, interpretation, logie, theory

It is frequently asserted that science assumes some philosophical premises or/and leads to philosophical consequences. For instance, transcendental epistemologists (Kant, Neo-Kantians) argue that epistemology establishes conditions of validity for any kind of cognition, including scientific one. According to Kant, every experience locates its objects in space and time. Thus, assertions about space and time, more specifically that space is three-dimensional and time is absolute, belong to philosophical presuppositions of science. Husserl expressed a similar view, although oriented more ontologically than epistemologically, particularly strongly (italic in the original):

"If, however, all eidetic science is intrinsically independent of all science of fact, the opposite obtains, on the other hand, in respect of *the science of fact* itself. *No fully developed science of fact could subsist unmixed* with eidetic knowledge, and in consequent *independence of eidetic science formal or material.* For *in the first place* it is obvious that an empirical science, wherever it finds grounds for its judgments through mediate reasoning, must proceed according to the *formal* principles used by formal logic. And generally, since like every science it is directed towards objects, it must be bound by the laws, which pertain to the essence of *objectivity in general. Thereby it enters into relation with the group of formal-ontological* disciplines, which, besides formal logic in the narrower sense of the term, includes the disciplines figured formerly under the formal "*mathesis universalis*" (hus, arithmetic also pure analysis, theory of manifolds). Moreover, and in *the second place*, every fact includes an essential factor of a *material* order, and every eidetic truth pertaining to the pure essence thus included must furnish a law that binds the given concrete instance and generally every possible one as well. (...)

Every factual science (empirical science) *has essential theoretical bases in eidetic ontologies.* (...) In this way, for instance, the eidetic science of physical nature in general (the *Ontology of nature*) corresponds to all the natural science disciplines, so far indeed as an Eidos that can apprehended in its purity, the "essence" *nature in general*, with an infinite wealth of included essential contents, corresponds to actual nature."[1]

Husserl ascribes to formal ontology a very essential role, because, according to him, all factual (empirical) assertions have their ultimate basis in fundamentals established by eidetic analysis.

Another frequently explored link between science and philosophy consists in looking for philosophical consequences of scientific theories or even singular scientific theorems.[2] Mathematics provides a very good example in this respect. Some people maintain that classical mathematics implies Platonism, although others regard antirealism as a consequence of constructive mathematics. Passing to physics, Newtonian mechanics is reputed to entail determinism, but indeterminism is qualified as having its inferential foundation in quantum theory; this connection will be exploited several times in this paper. Similarly, vitalism is considered as following from embryology as a part of bio-

---

[1] E. Husserl, *Ideas. General Introduction to Pure Phenomenology*, tr. by W. F. Boyce Gibson, Collier Macmillan, London 1931, 57/58. For more recent similar statements see, for example: I. Stein, *The Concept of Object as the Foundation of Physics*, Peter Lang, Frankfurt am Main 1996 or M. Heller, *Ultimate Explanations of the Universe*, Springer, Berlin 2009. See also notes 2an d 5.

[2] See F. Weinert, *The Scientist as Philosopher. Philosophical Consequences of Great Scientific Discoveries*, Springer, Berlin 2004 for a historical survey. I choose this book for its subtitle clearly related to the problem announces by the title of the present paper. General and special literature about philosophical consequences (and assumptions as well) of science is enormous. In fact, every textbook of philosophy of science or monograph in this area addresses to this topic directly or indirectly. See note 5 for an additional selected bibliography.

logy, although theory of evolution goes together with mechanism as its philosophical output. Gödel's incompleteness theorems are sometimes taken as premises in arguments for the non-reducibility of mind to machines. Another use of the same metamathematical results consists of attempts to show that knowledge is essentially uncertain. There is a good example:

"I single out for discussion – the question whether the law of excluded middle, when it refers to statements in the future tense, forces us into a sort of logical Predestination. A typical argument is this. If it is true now that I shall to do a certain thing tomorrow, say to jump into the Thames, then no matter as fiercely I resist (...), when a day comes I cannot help jumping into the water; whereas, if this prediction is false now (...) it is impossible for me to spring. Yet that the prediction is either true or false is itself a necessary truth, asserted by the law of excluded middle. From this the startling consequence seems to follow (...) that indeed the entire future is somehow fixed, logically preordained."[3]

Social sciences and humanities also share philosophical import with natural disciplines (*the* science in the traditional science), although one should notice that strict borderlines between philosophical and non (or less)-philosophical regions are difficult to depict them univocally. We easily observe that the relation between science and philosophy is less and less explicit if we go to further members in the sequence {mathematics, physics, chemistry, biology, social sciences, humanities}. By the way, this succession is almost identical with Comte's classification of abstract sciences. In order to simplify my considerations, I will entirely omit philosophical problems of social sciences and humanities, and limit discussion about formal sciences (logic and mathematics) to some illustrative examples. Thus, I focus on natural science, mostly physics.

I will try to introduce some conceptual order into the problem of philosophical assumption and consequences of science. The issue in

[3] F. Waismann, *How I See Philosophy*, Macmillan, London 1968, 8-9. Note that Waismann himself does not accept the argument from the excluded middle to logical Predestination. Thus, Waismann's text should be regarded as a reconstruction of an argument proposed by someone else (see below).

question requires some clarifications for several reasons. In general and to anticipate my position, I will argue that science does not need philosophical assumption as well as it does not have philosophical consequences. Yet this view does not imply that science and philosophy are mutually independent. On the contrary, science suggests a lot of philosophical problems and perhaps could lead to philosophical solutions, although the later hope should be taken modestly and with various additional constraints (I will return to this question at the end of this paper). The reverse dependence, that is, an influence of philosophy on science, is a much more delicate matter, although explicit philosophical roots of several scientific discoveries (for example, Platonic background of Copernicus' theory) are very well confirmed by the history of science. In fact, historical studies seem to suggest that the role of philosophy as a source of scientific results continuously weakens through the course of time. Anyway, we need to distinguish the question whether there are philosophical problems of science from the issue whether science has philosophical assumptions and leads to philosophical consequences. The lack of this distinction obscures any analysis of the problem in question. And this is the first motive for trying to do a clarifying work.

Secondly, philosophers and scientists are not always clear whether they speak about philosophical assumptions of science or its philosophical consequences. Let me illustrate this once again by the relation of logic to determinism and indeterminism:

"The law of bivalence is bivalence is the basis of our entire logic, yet it was already much disputed by the ancients. Known to Aristotle, although contested for propositions referring to future contingencies; peremptorily rejected by Epicureans, the law of bivalence makes its full appearance with Chrysippus and the Stoics as a principle of their dialectics, which represents the ancient propositional calculus (...). The quarrel about the law of bivalence has a metaphysical background, the advocates of the law being decides determinists, while its opponents tend towards an indeterministic *Weltanschaung*."[4]

[4] J. Łukasiewicz, *Philosophical Remarks on Many-Valued Logic*, in: J. Łukasiewicz, *Selected Works*, North-Holland, Amsterdam 1970, 165 (this paper was originally published in German in 1931; tr. O. Wojtasiewicz).

Łukasiewicz seems to suggest that there is a connection between bivalence and metaphysical positions represented by the determinism/indeterminism controversy. However, this dependence requires a further analysis. For instance, we can ask what is prior, logic or determinism (indeterminism), that is, what provides premises and what constitutes the conclusion. Since the ancients were unclear at the point, Łukasiewicz cannot be blamed that his parenthetical remark is incorrect. His own reasoning, similarly as that of Waismann's, investigates the argument from bivalence to determinism. According to him (Łukasiewicz), bivalence and the principle of causality entail determinism. Is the principle of causality scientific or merely philosophical? Disregarding Łukasiewicz's own view, we can interpret his inference (logic plus causality ⇒ determinism) either as based on scientific premises or mixed (one scientific, taken from logic and one philosophical). To complete this issue, let me note that most general as well concrete, systematic as well historical, elaborations looking at relations between philosophy and science consider both as co-existing and interrelated in many ways.[5]

A closer inspection of the relation between logic and determinism brings us to the next interpretative question. There are some minor

[5] Here is a small sample of books discussing the relation between physics and philosophy: A. Eddington, *The Philosophy of Physical Science*, Cambridge University Press, Cambridge 1939; W. Heisenberg, *Philosophy and Physics*, Harper&Row, New York 1958; M. Čapek, *The Philosophical Impact of Contemporary* Physics, Van Nostrand, New York 1961; B. Gal-Or, *Cosmology, Physics and Philosophy. Recent Advances as a Core Curriculum Course*, Springer, New York 1981; J. T. Cushing, *Philosophical Concepts in Physics. The Historical relations between Philosophy and Scientific Theories*, Cambridge University Press, Cambridge 1998; R. Toretti, *The Philosophy of Physics*, Cambridge University Press, Cambridge 1999. For a comprehensive and up-to-dated survey, see *The Handbook of the Philosophy of Science*, ed. by D. Gabbay, P. Thagard and J. Woods, Elsevier, Amsterdam. The following volumes are available (I mention only titles and dates; particular books have own editors): *General Philosophy of Science: Focal Issues* (2006), *Philosophy of Logic* (2006), *Philosophy of Psychology and Cognitive Science* (2006), *Philosophy of Anthropology and Sociology* (2006), *Philosophy of Physics* (2007), *Philosophy of Biology* (2007), *Philosophy of Information* (2008), *Philosophy of Mathematics* (2009), *Philosophy of Technology and Engineering Sciences* (2009), *Philosophy of Statistics* (2011), *Philosophy of Medicine* (2011), *Philosophy of Complex Systems* (2011) and *Philosophy of Linguistics* (2012).

differences between Łukasiewicz and Waismann. Whereas the latter speaks about the excluded middle and logical Predestination, the former refers to bivalence and determinism without further qualification. Yet we can overcome these disparities by saying, firstly, that Waismann employed the metalogical law of excluded middle, which functions as the most essential part of the principle of bivalence (in fact, the latter conjoins the former and the metalogical non-contradiction), and, secondly, pointing out that Łukasiewicz's determinism and Waismann's logical Predestination refer to the same philosophical position. However, other differences cannot be reconciled by so simple moves; Waismann explicitly says that he reconstructed Łukasiewicz's argument, but it is not quite true. As I have already noted, for Łukasiewicz, bivalence plus causality entails determinism, but Waismann's reconstruction omits causality. The crucial point is that Waismann denies that the (metalogical) excluded middle entails logical Predestination. He justifies his position to the use of "true" and "false" (details as irrelevant here). A lot of serious questions arise in this situation. Does Waismann's argument hold if we add causality to the excluded middle? What is the actual difference between both authors? Should we say that whereas Łukasiewicz argues that classical logic plus some additional premises imply determinism, Waismann says "since this argument is invalid for such and such reasons, classical logic does not entail determinism"? Łukasiewicz wanted to demonstrate that bivalence is incompatible with freedom and claimed that logic should be changed; he introduced many-valued logic for solving the problem. On the other hand, Waismann offered an argument for compatibility of logic and free action. I have no intention to decide who was right. My main task consists in showing how complex and many-sided is the application of logical theorems in order to derive from them philosophical statements.

We have to do with a fairly similar situation in the case of a famous controversy concerning the relation between quantum mechanics and determinism (and indeterminism, of course).[6] The most typical des-

[6] See G. Auletta, *Foundations and Interpretation of Quantum Mechanics in the Light of a Historical Analysis of the Problems and of a Synthesis of the Results*, World Scientific, Singapore 2001 for a comprehensive survey. Of course, the scope of this

cription is this (I omit the idea of hidden parametres advanced by Bohm and other proposals in the same spirit). Einstein and the representatives of the Copenhagen interpretations (Bohr, Heisenberg) appeared as the main protagonists. The former defended determinism, but Bohr and Heisenberg favored indeterminism. Einstein proposed various thought experiments, for example, that elaborated together with Podolsky and Rosen, in order to demonstrate that the Copenhagen interpretation was essentially incomplete. His opponents argued that all Einstein's attempts to abolish the "indeterministic" (I will later explain the use of quotes in this context) reading of quantum mechanics failed. Finally, Einstein agreed that since the Copenhagen interpretation is empirical faithful, he recognized it as legitimate, at least from the physical point of view. How to interpret this controversy? Did Einstein use the thesis of determinism as a premise in his arguments? Is so, his strategy is hardly comparable with that of Heisenberg who inferred the thesis of indeterminism from the uncertainty principle, but not assumed the former in his reasoning. Should we say that Einstein rejected "indeterministic" consequences of the Copenhagen interpretation and thereby came to the conclusion that determinism was still tenable, but Heisenberg rejected determinism, because he deduced non-deterministic consequences from physics? Once again, we encounter here a very complex issue in which philosophical and empirical questions are mixed and interrelated in many ways. A striking fact is that natural scientists accepting the same empirical theories, share quite different, even inconsistent, philosophical views. This suggests that the premises/conclusion link without further clarifications does not suffice for accounting relations between science and philosophy. I will return to this issue after introducing precise conceptual machinery. Looking at relevant texts, we encounter several other terms used in discussions about philosophical arguments based on science. Except "premise" and "conclusion", we have "supposition", "presupposition", "assumption", "consequence" or "result". I propose to consider the three first words as synonymous with "premise", but the two last as having the same meaning as "conclusion". I do not deny that there are other intuitions,

---

monograph (almost 1000 pp.) very considerably exceeds the determinism/ indeterminism/ quantum mechanics issue.

for example, referring to subjective attitudes, styles of thought or even prejudices, but I tend to have devices subjected to logical analysis.

We have also to do with several accounts of the relation between premises and conclusions, like consequence of, entailment, derivation, following, implication or forcing. Let us agree that if **X** is a set of premises and A is a conclusion of **X**, we say that $A \in Cn\mathbf{X}$, that is, **X** is a logical consequence of **X** if and only if A can be formally derived from X. For simplicity, I equate the syntactic concept of logical consequence with the semantic concept of logical entailment (the set **X** entails A if and only if A is true in all models in which all sentences belonging to set **X** are true). Anyway, this description entails that rules of inference coded by Cn are infallible (correct, sound), that is, true premises inevitably lead to true conclusions. The metalogical characterization of the premise/conclusion relation forces a similar treatment of other methodological concepts. Let me list some definitions (they are simpliefed to some extent). The set **X** of sentences is a theory if and only if it is closed by Cn as an operation in the mathematical sense, that is, $Cn\mathbf{X} = \mathbf{X}$. Otherwise speaking, X is a theory if it is equal to the set of own logical consequences. Since the inclusion $\mathbf{X} \subseteq Cn\mathbf{X}$ is trivial (it directly follows from the definition of Cn), the substantial content of being a theory reduces itself to the inclusion $\mathbf{X} \subseteq Cn\mathbf{X}$. Thus, **X** is a theory if it contains own consequences. If there is a set $\mathbf{Y} \subseteq \mathbf{X}$ such that ,$Cn\mathbf{Y} = \mathbf{X}$, we say that **Y** axiomatizes **X** (**Y** is an axiomatic for **X**). Dependently whether **Y** is finite, infinite or recursive, we say that **Y** is finitely (infinitely, recursively) axiomatizable. A theory **T** is consistent if and only if no pair $\{A, \neg A\}$ belongs to its consequences. **T** is (syntactically) complete if and only if for any A, $A \in Cn\mathbf{T}$ or $\neg A \in Cn\mathbf{T}$, and it is semantically complete if its every truth is provable from its axioms (one of my previous statements about Cn means that logic is semantically complete). Consistency is an obligatory property of theories (it practically means that inconsistent theories should be improved; this is common tendency in the history of science), but syntactic and semantic completeness are demanded, but, due to Gödel's theorems, inaccessible on level of arithmetic of natural numbers and beyond). If we take all arithmetical truth as axioms of arithmetic (of natural numbers), it becomes complete in both senses, although he is not finitely axiomatizable, because there are infinitely many true arithmetical assertions. However, and this is an important methodological observation, every theory is an axiomatic system.

The concept of theory in the metalogical (metamathematical) sense is idealised. In particular, any set of consequences of a given set of axioms is always infinite, but the actual theorizing is restricted to finite sets, because humans are able to perform effective cognitive acts operating on such collections. Hence we face the question of how far the metalogical account of theories is faithful with respect to scientific practice. Since mathematics can be regarded as a collection of axiomatic systems, the metamathematical research widely exploits the concept of a theory as the logical closure of a given set of axioms. This perspective raises doubts as far as the matter concerns physics. Yet Hilbert in his famous lecture on mathematical problems delivered in 1900, raised the question of axiomatization of physics (problem 6), more precisely, he postulated a mathematical treatment of physical axioms, particularly of mechanics. Since he referred to earlier works of Mach, Boltzmann and Hertz, the issue was at stake about 1900. In fact, if **Z** includes Newton's three dynamical principles plus the law of gravitation, the set $\mathbf{T} = Cn\mathbf{Z}$ can be considered as an idealized picture of the classical mechanics. Further examples are provided by the relativity theory, quantum mechanics or quantum field theory.[7] Yet it would be difficult to maintain that axiomatic method became dominant in physics, even theoretical. On the other side, the following idealization is possible. We can consider even single physical laws together with their logical consequences as miniature theories. This is compatible with a notorious interest of physicists in particular theorems. Generally speaking, every theory **T** is formulated in a language $\mathbf{J}^{\mathbf{T}}$. We can identify **T** with a tri-

[7] See H. Reichenbach, *Axiomatization of the Theory of Relativity*, University of California Press 1970 (German original appeared in 1924), G. Ludwig, *An Axiomatic Basis for Quantum Mechanics* I-II, Springer, Berlin 1985 and N. N. Bogolubov, A. A. Logunov, I. T. Todorov, *Introduction to Axiomatic Quantum Field Theory*, The Benjamin Cummins, London 1975. One can find further examples in J. Schröter, *Zur Meta-theorie der Physik*, de Gruyter, Berlin 1996 (this is a very comprehensive monograph about physical theories from the metalogical point of view) and G. Ludwig, G. Turler, *A New Foundation for Physical Theory*, Springer, Berlin 2006.

ple $<\mathbf{J}^{\mathrm{T}}, \mathbf{Y}, Cn>$, where **Y** is an axiomatic base, a collection of informal assumptions (postulates) or even a singleton. Although less mathematical fields, for example, chemistry and biology, are still less suitable to full and strict axiomatic reconstruction, but they fall under a more general model of theories, introduced above. I do not insist that single assertions with their logical consequences should be regarded as theories in the metamathematical sense, although I think that the triple $<\mathbf{J}^{\mathrm{T}}, \mathbf{Y}, Cn>$ is an admissible approximation of $\mathbf{T} = Cn\mathbf{T}$.

The proposal to regard physical theories as axiomatic systems can be (in fact, it is the case) questioned by physicists. They will probably say that theories are rather models than set of sentences. I see no conflict here. We can consider theories as sets of sentences as well as speak about them as models. I would like also to stress that I do not claim that theories should be axiomatize or formalize. My enterprise is merely methodological and entirely belongs to philosophy of science. In particular, my special motivation consists in the decision to perform an analysis of the question undertaken in this study by the concept of logical consequence in its literal meaning. However, one can add something in favor of the "statement view of theories". First of all, physicists often say that theories are based on some postulates, for instance, that the velocity of light is constant. Secondly, they demonstrate something from the adopted postulates, for example that $v + c = c$, for every velocity v. These notorious facts allow for the interpretation of postulates as axioms and demonstrations as proofs in the formal sense. Thirdly, physicists apply several metalogical concepts to physical theories, for instance, independence (of postulates), equivalence (of theories or postulates), extension or reduction (of theories) or consistency (of theories). Of course, one should be careful in using such analogies, because, for instance, Einstein's objection that quantum mechanics in the Copenhagen interpretation is incomplete did not refer to syntactic incompleteness, but pointed out that something had been overlooked by Bohr and Heisenberg. However, such differences do not invalidate applying metalogic to the analysis of empirical scientific theories. Skeptics, with respect to the proposed analysis, can eventually say that it does not produce such important results as it has place in metamathematics. I do not like to appeal to a typical answer that nothing should be decided a priori, although it is quite possible that investigations about computational complexity will find applications in physical calculations. I stress once again that my task is philosophical. I hope to show that treating physical theories as axiomatic systems allows to exhibit some misunderstandings concerning relations between science and philosophy.

If we adopt the proposed approach (even liberalized) to scientific theories, the problem of the relation between science and philosophy can be shaped in the following way. We ask whether philosophical statements occur among axioms of scientific theories and whether philosophical assertions belong to *Cn***T**, where **T** is philosophy-free. One should remember that a given theory **T**, independently of its understanding as **T** = *Cn***T** or **T** = <$\mathbf{J}^{\mathrm{T}}$, **Y**, *Cn*>, contains its axioms and their consequences and nothing more. Thus, the set *Cn***T** forms the scope (or the domain of application) of **T**. Clearly, the scope of a given theory **T** determines its limits (borderlines) as well. This statement has a clear meaning only in the case of considering assumptions used in theories as axioms and conclusions derived from them as logical consequences. It is easily to confirm by numerous historical data that scientists *qua* scientists are not ready to extend the scope of theories by philosophical assertions. Let me illustrate this tendency by concrete examples. The thesis that every phenomenon is defined univocally by its mechanical parametres (position, mass, velocity) represents the core of the mechanistic world-view. Materialists of the 18$^{\text{th}}$ century supported this view by an appeal to classical dynamics (**CD**, for brevity). However, it was a considerable extension of the scope this theory (see also below). Its standard scope contains everything definable inside **CD** and nothing more. Even if philosophers find this formula as controversial and open for a further interpretation, the physicists have no doubt that the scope of **CD** and the scope of the philosophical mechanistic world-view are different. This precisely suggests that the mechanistic world-view is neither assumed (understood as an axiom) of **CD,** nor functions as its logical consequence. Similarly, philosophical atomism is neither an assumption of chemistry nor its consequence, and the same concerns the relation between vitalism and biology. Returning to determinism, indeterminism and physics, quantum mechanics neither assumes nor entails indeterminism, and classical physics has no inferential relations with determinism (see also below). This is the reason for writing "(in)deterministic" interpretation of quantum mechanics. To use a fashionable terminology, the language of physics (science in general) is incommensurable with the language of philosophy. This is the main circumstance blocking the use of *Cn* across both.

My previous remarks do not imply that physics (or other science, but I concentrate on physics) has no connections with philosophy. The links between both appeared at the very beginning of European philosophy. The Ionian philosophy mostly concerned *physis*, that is, nature. Thus, philosophy and physics had the same subject and method in the first phase of philosophical thought and no matter if we will refer to theories of the Ionians as belonging to the philosophy of nature, physics or cosmology. In fact, they combined all these fields in the modern sense. It was Aristotle who explicitly distinguished *prote filosofia* (the first philosophy) as the science on being as being and physics as based on *empereia.* This distinction was respected by Archimedes and Ptolemy, two greatest ancient scientists, and never disappeared again. Newton's title *Philosophiae naturalis principia mathematica* does not provide any counterexample, because it only witnesses a terminological custom of English nomenclature; speaking about physics as natural philosophy still occurs in British academic life. By the way, Newton's famous *hypotheses non fingo* can be understood as his claim that one should carefully distinguish philosophical hypotheses from statements based on experience. On the other hand, many physicists of the first rank, Newton himself, but also Galileo, Maxwell, Planck, Einstein, Bohr or Heisenberg, to mention only few, studied various philosophical problems. They considered them as important and published books titled *Physics and Philosophy* or somehow similarly (see note 5). Philosophers were (and still are) divided in their relation to physics as a source of philosophical insights. For example, Locke essentially used Newton's optical results, but Bergson or Heidegger maintained that physics has no importance for *the* philosophical understanding of reality. Disregarding thinkers unconditionally disrespecting the role of physics in philosophy, we encounter the question whether a physicist who discusses philosophical questions acts as just physicist or plays the role of a philosopher. In my view, he or she performs a philosophical job. Moreover, physicists *qua* physicists do not need to consider philosophical matters. These observations imply, contrary to Husserl (see the passage quoted from his *Ideas* above), that the link between physics and philosophy is factual, but not necessary. Yet I do not deny that philosophical views played (and still play) an important heuristic role in the development of physics. Einstein's belief that the world is well ordered by the laws of nature motivated his attempts towards so-called deterministic interpretation of quantum mechanics. The reverse factual connection, that is, going from physics to philosophy should also be noted. For instance, the rise of classical mechanics resulted (philosophically) in the mentioned mechanistic world-view, according to which h everything, including human action, is governed by the laws of dynamics. Since factual connections between physics and philosophy, although evident and frequently pointed out by historians of science (see Weiner's book mentioned in note 3), are not enough for accounting logical links between philosophical assertions and statements make by scientists *qua* scientists. Hence, my proposal to employ *Cn* and other metalogical tools in the analysis of the main issue. The conclusion is negative: there are no logical relations between science and philosophy, provided that being a premise or conclusion is understood in the precise logical sense.

Yet the distinction between factual connections and logical consequence does not suffice for philosophical analysis of how science and philosophy are mutually related. To be more specific, the issue also concerns possible uses of scientific theories and assertions in philosophical debates. Let me return to some previously discussed questions in their typical traditional setting. I restrict my further remarks to so-called philosophical consequences of physical theories. Once again, look at the mechanistic world-view as a consequence of **CD**, ask whether classical physics entails determinism and whether indeterminism can be derived from quantum mechanics. The sense of these (and similar) questions remains vague until we introduce references of "the mechanical world-view", "determinism" and "indeterminism" in a way acceptable for physicists and simultaneously compatible with philosophical intuitions, because this step means a necessary condition of using the phrases "consequence", "entails" and "can be derived" in the logical meaning. Otherwise speaking, we extend the intended scope of related physical theories by new phenomena. If, for example, the mechanical world-view is understood as the thesis that the entire reality consists of material points, which behave according to laws of **CD**, the extension in question appears as illegitimate until we show that, for instance, mental phenomena are mechanistic in this sense. Now the mechanistic conception of psyche is either correct or incorrect. If the first case occurs, the mechanistic world-view with respect to mental events becomes a trivial consequence of **CD**, but if the second alternative is adopted, this world-view must be qualified as an illegal extension of the scope of **CD**. However, the main philosophical problem consists in choosing one of possibilities occurring in the disjunction "the mechanistic conception of psyche is correct or incorrect" (and other similar dilemmas). For example, La Mettrie, the author of *Man A Machine* (the title is very instructive for materialism of the 18th century) was less interested in deriving his account of psyche from **CD** than in a materialistic analysis of mind. Thus, he chose the first member of the disjunction in question.

Consider now the question whether quantum mechanics (**QM**) entails indeterminism. The uncertainty principle (**UP**) stating (I simplify) that $\Delta p_1 . \Delta p_2 \geq h$ (the uncertainty of position times the uncertainty of momentum is greater or equal to the Planck constant). This formula functions as the main premise of deriving indeterminism from quantum mechanics. However, it is problematic, because **UP** does not contain the word "indeterminism". According to elementary logic, a term occurring in a conclusion of deductive reasoning, must occur in its premises or be defined by earlier available linguistic means. Thus, one should introduce the term "indeterminism" (or "determinism") to **QM** in order to investigate the importance of this theory for the determinism/indeterminism issue. Heisenberg himself made such a step and said that determinism consists in predictability of future states of objects on the base of their past states. Since **UP** precludes the precise calculation of the past (including present) states, it also abolished the thesis of determinism on the level of the microworld and entails indeterminism. This argument is correct and shows how classical physics

(**CD**, the relativity theory) differs from **QM**. Clearly, we are tempted to say that the latter is indeterministic, but to view the former as deterministic. Yet we have a variety of approaches to determinism and determinism. For instance, the former can not only be defined by predictability, but also causally, statistically, probabilistically or by partial order in the Minkowski space. More importantly, different consequences of such definitions can be derived with respect to determinism and indeterminism of **QM**. Doubtless, all essential problems of **QM** and their solutions can be formulated without any reference to determinism and indeterminism. On the other hand, what is important for philosophy does not directly follows from the literal content of physical laws. Incidentally, the same is to be said about so-called philosophical assumptions of science. In particular, they do not belong to assumptions made in deductions inside scientific theories.

However, some interpretative work is always done when philosophers use science in their arguments and speak, for example, that a physical theory has such and such philosophical consequences. The problem is that, on the one hand, we cannot handle this work as deriving philosophy form science, but, on the other hand, the reduction of the connection in question to merely factual coincidences seems not proper. What is going on? In my opinion, philosophers employ some hermeneutical operation (or insight), when they try to show that this or that scientific result has philosophical importance or not. This operation has in its background a postulate (the normative aspect of hermeneutic is substantial) that something, for example, determinism and indeterminism, should be understood in some way. One can look for hermeneutic hints in science, religion, ideology, politics, morality, ordinary life, etc., but I am particularly interested in hermeneutic insights motivated by science. If a hermeneutic is applied, further arguments can be deductive (this is frequent in the case of scientific hermeneutic), but they are mediated by an interpretation. Hence, we can label such consequences as interpretative. Briefly, indeterminism functions as an interpretative consequence of **QM**, modulo the definition referring to **UP**. The reasons for adopting a hermeneutic are different. Doubtless, empirical data play a role in this respect, but they do not force solutions. Bohr's and Heisenberg's approach to philosophical problems of physics was definitely epistemological and motivated defining (in)determinism via predictability, but Einstein preferred the ontological way of thinking and believed in causality as the fundamental ingredient of determinism. Anyway, this perspective does not mean that science has no philosophical problems.

A few additional observations are in order. Firstly, every hermeneutic has its explicit roots in philosophical traditions. There is no other way of catching a given hermeneutic than embedding it into the history of philosophy, for instance, taking into account the development of the determinism/indeterminism debate. Secondly, there is no unique reading of data, including theoretical and empirical ones, motivating hermeneutic interpretation. Thirdly, the adopted hermeneutic never liquidates a given philosophical controversy. Fourthly, explicit logical schemes of arguments supporting philosophical proposals are important, because they allow us to control arguments; hermeneutical parametres do not go against this function. Moreover, but it is related to my metaphilosophical view, the main philosophical aim does not consist in solving problems arising in philosophy, but rather making them explicit and clear. Thus, philosophical solutions are always relative to a given hermeneutic. Fifthly, the presence of hermeneutic in philosophy explains why philosophy basically remains in the same circle of problems and answers. However, there is no reason to be desperate by this fact. Every époque requires own philosophical hermeneutic, but it does not justify treating past hermeneutics as irrelevant. Although, as I earlier argued, indeterminism does not follows from **QM**, similarly as **CD** does not entail indeterminism, debating both philosophical views about the order of reality without taking into account modern physics, should be considered as irrational. On the other hand, there is probably no chance that philosophers ignoring physics in ontological or epistemological discussions disappear. This situation is regrettable for philosophers sharing my metaphilosophy, but should be tolerated. Sixthly, the role of philosophy in so-called context of discovery is obvious and cannot be denied. Even if we say that the borderline between discovery and justification is somehow vague, metaphysical views should not function as justifying scientific theories.

Let me finally consider the following view: "It is perhaps easier to say what philosophy is not than what it is. The first thing, then I should like to say that philosophy, as it practiced today, is very unlike science; and this in three respects: in philosophy there are no proofs; there are no theorems; and there are no questions which can be decided, Yes or Not. In saying that there are no proofs I do not mean to say that there are no arguments. Arguments certainly there are, and first-rate philosophers are recognized by the originality of their arguments; only these not work in the sort of way they do in mathematics or in the science."[8]

Apparently, the view expressed by this quotation is puzzling. Waismann says that there are no proofs in philosophy, but they are arguments. We can add that philosophy has no deductive proofs, but deductive arguments occur in it. The problem is not verbal and cannot be answered by referring to the ambiguity of the word "proof". My reading of Waismann's diagnosis essentially employs the idea that hermeneutic parametre is substantially embedded in philosophical work; this concerns all kinds of philosophy, not only doctrines guided by methodological principles of analytic philosophy. The hermeneutical parametre just determines that they are not proofs in philosophy, but arguments, deductive or not, related to hermeneutic. The latter are more or less original or even completely unoriginal, dependently of used hermeneutic and how it is done and developed. Philosophical considerations about physics belong to philosophy, not to physics even if they are made by physicists acting as philosophers. Otherwise, commensurability of science and philosophy can be achieved in philosophy via hermeneutic interpretation.

[8] F. Waismann, ibidem, 1.

PROBLEM PRESUPOZYCJI FILOZOFICZNYCH I ICH KONSEKWENCJI W NAUCE

Streszczenie

Pogląd, zgodnie z którym nauka wymaga filozoficznych presupozycji i prowadzi do filozoficznych konsekwencji jest formułowany nader często. Dla przykładu, niektórzy argumentują (tak filozofowie jak i naukowcy), że nauka zakłada realność badanych obiektów, obiektywność wiedzy, determinizm itp. Podobnie, często mówi się także iż nauka, np. fizyka prowadzi do determinizmu albo indeterminizmu. W niniejszym artykule zajmuje się stanowisko przeciwne względem tego rodzaju poglądów. Jeśli terminy takie jak „założenie", „konsekwencja" mają swoje standardowe znaczenie, to znaczy odnoszą się do przesłanek dedukcyjnych czy nawet indukcyjnych argumentów, to rozumowania naukowe nie są oparte na presupozycjach filozoficznych zaś twierdzenia naukowe nie implikują filozoficznych konsekwencji. Takie stanowisko można uzasadnić odwołując się do analizy przykładów z historii. Takim przykładem jest fakt, że te same (lub przynajmniej bardzo podobne) interpretacje teorii naukowych proponowane są przez naukowców o radykalnie różnych poglądach filozoficznych. Ten stan rzeczy dobrze obrazuje przypadek Einsteina, Bohra oraz mechaniki kwantowej. Podobny argument dotyczy filozoficznych wniosków wyprowadzanych z naukowych twierdzeń.

Prezentowany punkt widzenia nie sugeruje stanowiska, zgodnie z którym nauka i filozofia są dyscyplinami wzajemnie odseparowanymi. Przeciwnie, są one ze sobą sprzężone, ale ich wzajemne związki powinny być analizowane bardziej skomplikowanym narzędziami niż tylko struktura typu: przesłanka/wniosek.

Słowa kluczowe: operacja konsekwencji, hermeneutyka, interpretacja, logika, teoria