HUMAN AFFAIRS, *10*, 2000, 1, 53–67

IGOR HRUŠOVSKÝ, THE THEORY OF SCIENCE AND THE HISTORICAL BACKGROUND (SELECTED PROBLEMS)

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The paper discusses selected problems, which were considered by Igor Hrušovský during the first, basic period of his intellectual development between 1930 and 1948. It shows Hrušovský's work as determined by the historical background, the plurality of existing philosophical streams and by temporary favourable conditions, which made the integration, discussion and assimilation of modern scientific thought possible. The author outlines Hrušovský's specific way to his own theory of science, the logic and methodology of science, which were remarkably influenced by logical empiricism. On the basis of his conception of scientific induction, Hrušovský rejected extreme verificationism – his model of science was a confirmationist one. His understanding of basic propositions was antipsychological and antisubjectivist. The author also outlines the changes in his theory of science due to the shift of his attention to the problem of noetics.

The subject of our analysis are the selected issues of the philosophy of science as they were studied by Hrušovský in the period of his basic intellectual development.

I. Hrušovský's reflection of his route towards the conception of the theory of science. He recalls the city of Bratislava of the 1930s in his booklet 'Monológy a dialógy' (Monologues and Dialogues) [23]. It also contains his declarations and reflections of his intellectual ripening but also of the problems which he considered to be important and which both attracted and worried him.

Hrušovský finished his studies of natural sciences in Prague in 1930, he wrote his first philosophical study about Nietzsche and began to work in the Bratislava University Library. It was the period when, as he says, "I devoted much time to the study of some theoretical and methodological questions of natural sciences and I also followed contemporary philosophical currents in the world. I was preoccupied with some scientifically-oriented works of the thinkers gathered in the Vienna Circle (at first particularly Schlick, Carnap, Frank, and Neurath) published – apart from the collections of works and monographs – mainly in the renowned journal

Erkenntnis. My interest was stimulated by the fact that conferences, symposia, and discussions of the Vienna Circle were attended by world famous scientists such as Einstein, Bohr, Heisenberg, Schrödinger and Bertalanffy,.... My studies led at the end of the thirties to a scientific theoretical monograph" ([23], 25–26). It was his work 'Teória vedy. Úvod do všeobecnej metodológie' ((The Theory of Science. Introduction to General Methodology, 1941). It was not, as will be seen later, his only work devoted to the problems associated with the theory of science.

The theory of science in Hrušovský's development of thought. Within self-reflection, I. Hrušovský tried to specify the milestones in the development of his ideas and to organize them into phases and periods. In his study [22] he determined two essential milestones of his "theoretical activities" associated with his efforts 1. building up the philosophical structurology and 2. building up his own ontology of being. His philosophical and scientific development was analogously categorized into stages based on the same dominant problem, namely the gradual "crystallization of the conception of structural dialectics of being" ([19], 126–142). Hrušovský distinguished and described three basic stages in the shaping of this conception. "From the global perspective on his life work he should be considered right" ([4], 7). The situation appears to be a little different from the point of view of the topic of the theory and methodology of sciences and its dominance in the particular period of the development of his thought.

His organization of his "theoretical activity" into particular stages pushes other problems, themes, and ideas, which have their place in his work, in to the background. M. Zigo was right to note that in his effort to arrange his development into particular stages, I. Hrušovský himself ignores the period of the formation of the main topic areas of his future theoretical activities as well as the shaping of his own views on the questions explored. It concerns the period between 1930 and 1936. M. Zigo ([31], 436–440) and J. Bodnár ([4], 6) offer a more adequate and differentiated organization of Hrušovský's prolific and thematically structured development of his thought into particular stages and periods.

In our opinion, the first basic stage of Hrušovský's development can be limited by the years 1930–1948. What is new in this division is that it covers the years between 1930 and 1935, which Hrušovský ignores in his self-reflection of his work and that the dominant topic in this period is the theory of science together with noetic issues. This period of his activities can further be subdivided. The **first** sub-stage (1930–1935) is characterized by rather non-systematic steps on his philosophical and scientific pathway. Its culmination is the work 'Invencia a vývoj' (Invention and Development) (1935). This is the period of the "ripening of his philosophical interests, crystallization of the main topic areas, and the first formulations of his own or his more or less independent attitudes and views" ([31], 436). The **second** sub-stage (1936–1942) covers the activities in 'Vedecká syntéza' (Scientific Synthesis), the influence of logical empiricism on the content of his works and lectures. The beginnings of his interest in the issues of the dialectic of being and the

growing impact of Marxist philosophy on his development can also be included here. The issues of the theory of science were dominant. This period culminates in his works 'Teória vedy' (Theory of Science) (1941) and 'Vývin vedeckého poznania' (Development of Scientific Knowledge) (1942). The **third** sub-stage (1943–1948) is characterized by an intensified interest in the historical-philosophical issues in his works 'Francis Bacon a rozkvet anglickej filozofie' (Francis Bacon and the flowering of English philosophy) (1945) and 'Engels ako filozof' (Engels as a Philosopher) (1946). 'Problémy noetiky' (The Problems of Noetics) marks the culmination of this period and his rapid return to the issues of the methodology of sciences (theory of science) and to the noetic topics and their development. After that period, Hrušovský did not develop the problems of the theory of science any more.

The first basic stage of Hrušovský's development, beginning with the year 1941 (in our opinion in 1937) ending in 1948, is, even according to his declaration, characterized by "the orientation to the internal issues of the topics laid out". In the period following the year 1948, and in the fifties, in particular, his works "focused on applied problems" ([23], 29, 30), strongly influenced by the spirit of the time.

Hrušovský's development of thought (1930–1948) and the historical background Hrušovský's scientific and philosophical development did not take place in a ideological, political or cultural vacuum. Between 1918 and 1945, a wide spectrum and plurality of various philosophical currents and orientations developed gradually. They were cultivated at different institutions and by individuals. The results were published in current journals, collections of works, monographs. The process of institutionalization and professionalization of philosophical and other scientific disciplines was in progress. Philosophical thought developed at the Faculty of Philosophy of the Slovak University in Bratislava, particularly thanks to Czech professors, was characterized by a "positivist-realistic orientation" ([2], 16). It followed the sources of the older positivism of A. Comte and the teaching of T.G. Masaryk. In the thirties, the ideas of the logical empiricism of the Vienna Circle penetrated into Slovakia; as we have already mentioned, they strongly influenced the work and thought of I. Hrušovský. One of the results of such an influence was the establishment of 'The Scientific Synthesis' (1937–1940). It was founded by the representatives of "the young scientific generation", who "began to feel the need to give vent to common theoretical and methodological problems, chiefly the problems of the humanities and some boundary and interdisciplinary questions" ([19], 126). A space was formed, although temporary, for integration, dialogue, discussion, criticism, non-dogmatic thought, assimilation, and development of the achievements of modern science in our environment. The establishment of this association was undoubtedly also a reaction to the spreading influence of irrationalist philosophical currents as well as to conservative academic philosophical and methodological eclecticism. That period had also witnessed the increasingly stronger influence of Marxist philosophy which became one of the determinants of

Hrušovský's development of thought. Christian philosophy, particularly neothomism, cultivated by Catholic philosophers, found its place and its growth was recorded in our conditions. Christian philosophy was also developed by Lutheran philosophers. At the beginning of the 1940s, critical or intuitive realism was established in our setting. It was this current represented by N. O. Losskii that was criticized by I. Hrušovský. Philosophical currents and orientations were rather atomized and autonomous and often contradictory; this made the factual mutual influence and critical discussions and dialogue more difficult. The isolation and "ignoring" of one another did not naturally mean that there would not emerge information on the results of efforts and critical reviews of the published philosophical and scientific works, which were in some cases of a confrontational character. Hrušovský's creation and his exploration activities were undoubtedly also influenced by intense contacts with the renowned representatives of science and the artistic avant-garde. Hrušovský sensitively perceived the nearing political changes together with his young scientific and artistic peers and particularly "the increased pressures of social and cultural reaction" ([23, 28]) after the advent of fascism. It had an indisputable effect on his thought orientation.

Thematization of the problems of the theory of science. The problems, themes and "inspiring sources" of Hrušovský's conception of the theory of science occurred rather systematically in his work 'Invention and Development'(1935). It was also noticed by the authors who analysed various aspects of Hrušovský's work. J. Bodnár showed that the publication 'Invention and Development' contained a rough draft of his future interests and ideas central to his future theoretical conceptions' ([4], 8). M. Zigo also indicated that many 'inspiring sources' from this work and other studies by Hrušovský were present "throughout his work" ([31], 437).

We naturally do not want to maintain that all themes and problems in the work 'Invention and Development' belong to the domain of the theory of science within Hrušovský's understanding. Our aim is to show in brief a) what did I.Hrušovský understand under the terms "theory of science", "logic of science", "general methodology of sciences", etc.; b) that many themes and problem he was interested in, were in agreement with the "codified" content of the theory of science (methodology of sciences) in the thirties and later and that some problems did not belong to this framework or were beyond it, and c) how Hrušovský solved the selected problems of the theory of science as well as shifts and changes in solutions in his works.

Theory of science, logic of science, methodology of sciences. I. Hrušovský uses the orientation definition of the concept of scientific knowledge as a basis for his specification of the content of the given terms. He says that "in contrast to common knowledge, it is systematic and controlled by defined logical and methodological rules". The "region of empirical knowledge" which is expressed by "empirical statements" and "the area of formal-logical knowledge" are also the objects of scientific knowledge. According to Hrušovský, this also holds for philosophical knowledge, if it wants to have the status of scientific knowledge ([25], 21). The di-

chotomy of the synthetic and the analytic as understood by neopositivists is in the background of the fields of scientific knowledge understood in this way. In the 1930s, I. Hrušovský's attitude was the same. The above mentioned definition of the subject of the scientific knowledge closely corresponds to Hrušovský's understanding of the concepts of the theory of science, logic of science, and methodology of the sciences.

The **logic of science** is understood by Hrušovský as "the logical analysis of concepts, statements and also of the whole statement structures of science". If we add semantics to the logic of science understood in this way, studying the relations between linguistic expressions and extralingual objects or real objects of science, it will enable us to study the conditions of the adequacy of scientific sentences with respect to "the proper factual material". The logic of science, Hrušovský concludes, "completed in this way assumes the character of the general methodology of science and can be named the **theory of science** because it examines the conditions of the theoretical scientific work" ([25], 22, 39). Such an understanding of the logic of science is in line with Carnap's understanding and with the understanding of the content of the logic of science by logical positivism in the first syntactic stage of its development. It will be enough to state that, according to Carnap, the logic of science "should be, within our understanding, characterized more precisely as a logical syntax of the language of science ([9], 23). Hrušovský's term the "theory of science" agrees with that of "the logical theory of science", where logical means a syntactic-semantic analysis of science of both the results and the methods of scientific exploration, which can be expressed by means of logical and methodological rules. Hrušovský's concept of the theory of science can also be said to be in agreement with the understanding of this term in the later semantic stage of development of logical positivism as well as – with some objections – with the use of the concept of the "theory of scientific knowledge" (Wissenschaftstheorie) in terms of the logical, methodological, and epistemological problems of the scientific knowledge. And further, the meaning of Hrušovský's term "the theory of science" is close to the concept of the philosophy of science (particularly within its analytically developed conceptions). Hrušovský's interests also encompassed special topics, such as the issues of causality, determinism, indeterminism, etc., which can also be included into the above mentioned conceptions of philosophy of science without any difficulties. Hrušovský's understanding of the theory of science does not contain psychology-related issues (they belong to psychology as an empirical science). Hrušovský devoted much attention to invention, which cannot be the subject of the theory of science either. In this direction, his attitude is in line with the opinions of the logical positivists and of K.R. Popper. This did not mean, however, that other scientific disciplines should not have dealt with these problems. Hrušovský's original understanding of the theory of science could not have encompassed the issues of the dynamics of scientific knowledge, which Hrušovský closely associates with human activity and creativity and a series of other problems.

A question arises whether Hrušovský kept to the scope and the content of the term "the theory of science" from the thirties or whether his understanding of the theory of science (general methodology of sciences) changed. There is no doubt that the extent and the content of the term changed. Hrušovský himself did not keep strictly to the limits of the term originally defined by him. We shall show it in the analysis of some problems of the theory of science. In our opinion, we cannot doubt that his reply to the question whether the issues of the dynamics of scientific knowledge, determinants of its development belong to the theory of science and noetics, would be affirmative as early as in the forties. His other works also confirm changes in his approach to the scope and the content of the term of the "theory of science". The core of his work "The Problems of Noetics" [24] were the problems associated with the theory of science including many new problems in the noetic issues, for example dialectization of the understanding of scientific knowledge, dialectics of the theory and experience, etc. In his work 'Dialektika bytia a kultúry' (Dialectics of Being and Culture) [19] Hrušovský gives an explicitly wider definition of the theory of science (methodology of sciences), referring thereby to the researches within the Marxist methodology of science. His acceptance of the understanding of the logic of science in terms of its being a "complex and dialectical analysis of the structure and genesis of scientific knowledge, scientific production of ideas" was without doubt positive ([19], 77). In his booklet 'Dialektika bytia' (Dialectics of Being) ([18], 67–78) Hrušovský develops and modifies solutions to many epistemological problems, which had been the subjects of his interest as early as between 1935 and 1948. Hrušovský's modification of the understanding of the theory of science was strongly influenced by his effort (although often controversial) to make a synthesis of Marxist dialectics and certain results of logical empiricism ([16], 403–407) as well as his endeavour to "interconnect ontology and noetics". ([15], 6).

Let us now try to give a more precise account of contemplations on Hrušovský's theory of science through an analysis of selected problems. Our literature includes some other authors who studied Hrušovský's approach to the issues of the theory of science. V. Filkorn analysed Hrušovský's understanding of science, the structure of science and the related problems [17]. P. Cmorej analysed the influence of neopositivism on the shaping of Hrušovský's theory of science and the contribution of his work "Theory of Science" to the history of philosophical thought in Slovakia, particularly from the point of view of a "broader culturally open, sufficiently vivid, differentiated and attractive picture of the issues related to the theory of science and scientist style of philosophizing" ([13], 647). V. Bakoš analysed various aspects of Hrušovský's scientism and showed some differences in his understanding of the issues and the character of scientific knowledge ([2], 82–98).

In logical empiricism, one can sense "permanent fascination by particular results of logic, mathematics, and physics" (M. Grabowski), fascination with clarity, exactness, the ideal of the deductive theory. The approach to philosophizing, which

contrasted with the preceding mode of philosophizing, was fascinating. It was attractive and stimulating to many – also to I. Hrušovský. His 'Theory of Science' can serve as evidence. By this work Hrušovský formed a passageway for the penetration of modern scientific and philosophical thoughts into Slovakia at the turn of the 1930s and 1940s. Later on, those ideas influenced the relatively immobile and traditional intellectual milieu but they also fulfilled, without doubt, many expectations of the young scientific generation and its visions of a new and non-traditional way of articulating and solving particular problems. Now we shall look at the selected problems of the theory of science presented by I.Hrušovský, chiefly in the works 'Theory of Science', 'Development of Scientific Thought', 'Problems of Noetics-Related Problems' [25], [26],[24].

Scientific induction-related problems. Questions whether the methods of inductive inference are used in empirical sciences and what are their functions in science are sometimes the subjects of methodological discussion. One of the functions of induction is connected with the acquisition of universal assertions (hypotheses, laws, theories). The second function concerns the question of the validity or truth of universal assertions of the above kinds which are based on experiences (problem of their verification). I. Hrušovský sought for answers to these questions.

I. Hrušovský tried to answer the question "How is new knowledge formed?", or "How should the problems of creating new statements be understood?" ([25], 55). Inductive inference, that is going from unique statements to universal ones, was traditionally considered to be such a method. What did Hrušovský understand under the term "induction" and what was his reply to the question of forming new knowledge?

Hrušovský gradually made his replies to the above questions more and more precise. In his work 'Invention and Development' [20], Hrušovský uses terms like "methodical induction", "empirical induction", "mechanical synthesis", "rational induction", "scientific induction" etc., to denote induction. Under scientific method he understood "an operational plan how to theoretically grasp reality and how to acquire new scientific achievements by means of a proper theoretical apparatus and a coreet inductive procedure" ([20], 8). Within another context, he emphasizes the importance of the use of methodical induction, abstraction, and generalization in organizing the particular material ([20], 10–11). The use of the terms "corest inductive procedure" and "methodical induction" indicates that in these cases the processes involved are implemented according to particular schemes or they follow certain rules. However, Hrušovský's answer is more complicated. He distinguished two types of induction, namely **empirical induction** and **rational induction**. "Empirical induction, when properly implemented, takes always place, as far as possible from an extensive set of experiences and by means of the whole apparatus of valid hypotheses. And if a new real fact is justifiably beyond deductive understanding of the existent hypotheses, this elementary fact indicates rational induction for building a new hypothesis, that would respect it." ([20], 16). One should realize, however, Hrušovský's opinion that "only a negligible and unimportant part of the real

experimental and investigative work is exhausted through mechanical synthesis" ([20], 14, 15). At the same time, he underlines that induction is a "dynamic cognitive process" as well as "a creative synthesis, not a mere mechanical synthesis" ([20], 14). He also says: "There are no objective hindrances to our declaration of the concepts of invention, imagination, induction, synthesis, intuition cum grano salis as synonymous." ([20], 16). To make the assertion about these synonymous concepts intelligible and consistent, the attribute "rational" should be added to the terms of "induction", "invention" (this is in agreement with Hrušovský's sentences) and an attribute "creative" to the term "synthesis". This will do away with the possibly ambiguous interpretation. On the basis of our preceding considerations, Hrušovský's understanding of induction can be interpreted as follows: rational induction (creative synthesis) is dominant and, as an act of human creativity, it brings new knowledge. This is real scientific induction as understood by Hrušovský. The validity and possibilities of the empirical induction (mechanical synthesis) are limited. It is used in sciences and knowledge (statements) is acquired through its use, which must be logically consistent with the existing hypotheses. The fact that would not be in agreement with, would be beyond or would contradict, the existent valid hypotheses, must not be inferable from the recognized hypotheses and assertions obtained by rational induction. If this happens, we face a task to build up a new hypothesis on the basis of the application of scientific induction (invention). It is one of the possible, relatively consistent interpretations of Hrušovský's views on the induction in a particular period. There remain some unclear matters, for example what will be the difference between the assertions obtained by empirical induction and those obtained by scientific induction, etc.

A further shift in Hrušovský's understanding of induction can be followed in his work 'The Theory of Science' [25]. In this connection, one should realize that after 1935, when his 'Invention and Development' was published, views on induction and its function in science rapidly changed in the philosophy of science. In his work 'The Logic of Scientific Discovery' [27], K. R. Popper strongly criticized various forms of induction and inductionism. This criticism also led logical empiricists to abandon the traditional understanding of inductive inference as a procedure of acquiring universal assertions from singular assertions according to certain schemes and methodological or "mechanical" rules. Hrušovský also criticizes the "mechanical" aspects of understanding induction in Hume but also Kant's efforts to justify a priori the use of empirical induction. He also refers to the standpoint of H. Schlick (1939) who rejected attempts to justify induction logically and regarded it as a psychological process. In 1938 H. Schlick analogously said: "Induction is nothing else than methodically directed exploration, a psychological, biological process, the procedure of which has nothing to do with 'logic'" ([33, 250]). A similar standpoint was formulated by R. Carnap in his later works (he rejected any possibility of formulating a particular set of rules to secure obtaining the theory from facts) as well as by C. G. Hempel (who also denied a possibility to formulate and

use the mechanical rules which would lead from observable statements to laws). Hrušovský's view of 1941 on this type of induction is identical with the views of logical empiricists. "Strictly taken, problems of the formation of new sentences do not belong to the theory of science as such but are closely interconnected with it in many respects. Through their character, the questions of scientific creation are actually the subject-matter of psychology, and also so-called scientific induction is in fact a psychological question because scientific inductions cannot be carried out mechanically by means of some ready logical schemes or "inductive rules". ([25], 55). The attitudes of logical empiricists and of I. Hrušovský to the formation of new knowledge agree in this direction with those of K.R. Popper. According to him, theories are thought out or found out, they are the result of "creative intuition" ([27], 7, 9). Only after having been discovered and formulated, can they become the subject of logical analysis. Evidently, the opinion on the formation of hypotheses (universal statements) of I. Hrušovský differed from that of K.R. Popper merely in the fact that Popper had never used the term "induction" to name that creative psychological process (in no case and in no connection).

Hrušovský's view according to which he discriminates between the psychological questions (formation of new knowledge, scientific induction, invention) and the questions which are the subject of the theory of science is worth noticing. It is in line with the standpoint of the adherents of logical empiricism, who, in the interest of better definition of the subject of the logical theory of science (methodology of sciences), began thoroughly distinguishing between the issues belonging to the **context of discovery** (they are the subject of empirical psychology) and the issues belonging to the **context of justification** (they are the subject of the theory of science or methodology of sciences). This differentiation between the two contexts was done by H. Reichenbach in 1938 – Hrušovský also refers to him.

A shift in Hrušovský's understanding of induction with respect to the work 'Invention and Development' consisted in the fact that he did not either mention or analyse empirical induction (mechanical synthesis) in his 'Theory of Science' any more [25]. He only developed the attitude of scientific induction (rational invention). Instead of the term "rational induction" he began to use the term "scientific induction". He criticized Tvrdý's understanding of induction who called it "rational induction". He rejected Tvrdý's opinion that particular, apodictic knowledge can be obtained by rational induction. We can say that Hrušovský's standpoint was identical with that of logical empiricists, expressed by R. Carnap: "Hume's criticism of the common forms of induction was correct" ([34], 339). It does not mean that disputes about induction were a matter of the past. The change was that the efforts were transferred to the analysis of the place, role and function of inductive inference in the process of the verification of the validity or truth of universal assertions in science. These questions are connected with the investigation of various models of science (cycles of scientific knowledge): therefore, they will be analysed in the following part.

The model of science. What was the situation in elaborating the theory of science (methodology of sciences) in 1935–1941, when, particularly under the influence of logical empiricism, Hrušovský's view on the model of science was shaped? Three models were known in that period, represented by **verificationism**, **confirmationism** and **falsificationism**). The conception of verificationism survived until about 1935. Verification fulfilled the function of determining the empirical meaning of statements and verification (justification) of statements (hypotheses, laws, etc.). It was shown that the demand for complete verification of the synthetic statements was not possible. Many interesting universal scientific laws would have had to be rejected as unverifiable and eliminated from the system of scientific knowledge. The reason is the fact that universal scientific laws cannot be deductively inferred from any finite set of protocol sentences since they speak about an infinite set of objects. It was a consequence unacceptable even for logical empiricists. The principle of complete verification as a criterion of the meaningfulness of statements was shown to be ineffective.

It was necessary to liberalize the standpoint of radical empiricism connected with the demand for the complete verifiability of synthetic statements as well as their complete reducibility to the finite number of statements about observation. Supporters of logical empiricism changed their view on the process of the verification of statements also under the influence of Popper's criticism of complete verification and modified the cycle of scientific knowledge. R. Carnap maintains: "We cannot verify a law, but we can test it so that we would test its particular instances, that is special sentences, which we infer from the law and other sentences, which were confirmed in the past. If no negative instance occurs in a continuous series of such testing experiments and if the number of positive instances increases, then our trust in the law will increase step-by step. Instead of verification we can then speak about the **confirmation** of the law increasing stepwise." ([9], 32). R. Carnap emphasized that it is a matter of "practical decision-making" which degree will be regarded as sufficient. W. Krajewski speaks about confirmationism as of a certain variant of hypothetism.

K. R. Popper's 'The Logic of Scientific Discovery' appeared in 1935 [27]. He developed a conception of falsificationism (hypothetical deductionism). He does not assume either verification or confirmation of hypotheses (theories) on the basis of true singular statements. According to Popper, we begin from the hypothesis (it is a result of our intuition, imagination). We obtain from it consequences by deduction. They are tested by comparing them (logically one with the other to find out whether they are consistent but also with other theories). Ultimately, we subject them to empirical tests, that is compare them with the results from observations, experiments, practical applications. If the theories bear the strict tests, the given theory is temporarily confirmed (corroborated). If the tests of the theory are negative (there is a repeatable, reproducible phenomenon contradicting the theory), the theory will be falsified and should be refused. According to Popper, the scientific

system "can be demarcated by means of the empirical tests in the negative sense: **the empirical scientific system must allow for its refutating by experience**" ([27, 20]). Popper does not require positive demarcation of the scientific system. Its negative demarcation (falsifiability) is dominant.

In 1935–1941 I.Hrušovský was conversant with the literature analysing problems of verification, confirmation, and falsification. The conception of complete verification was at that time a matter of the past to Hrušovský, and he actually repudiated it. When construing his standpoint on the nature of the model of science, his frequent use of the term "verification" might be confusing. This, however, does not hinder the assessment of Hrušovský's own attitude. It would be enough to follow the context, connections, and sense in which the term "verification" is used.

I. Hrušovský repudiates clearly and explicitly the possibility – as he puts it – "to completely verify, that is to implement total verification" of empirical statements. It is not even required by scientific practice and "it is usually enough if the validity of the particular statement is verified by a limited number of tests" ([25], 42). The result of empirical testing of the statements is their probability. "In short, empirical science should be satisfied with a plain probability of its assertions and to resign on any particular truths for ever." ([25], 42). Accoring to Hrušovský, all empirical statements are of a hypothetical or probability character, beginning with elementary statements that form a "verification basis", that is protocol statements, which are simultaneously primary for performing "semantic verification" up to the most abstract empirical statements, namely hypotheses, laws, and theories (contemporary, but also future, which will replace current theories). None of them can be verified completely and exhaustively. "And we have the right to oppose rigorous empiricism, according to which empirical statements are verifiable semantically without residues." ([25], 42).

In our opinion, it is now clear that, when using the term "verification", Hrušovský did not have in mind complete "total" verification. The term "verification, "semantic verification", "factual verification" is shown to be used in terms of the "confirmation", determination of "the degree of probability", "the degree of verification" of empirical statements on the basis of the implementation of empirical positive tests. I. Hrušovský accepted the standpoint of the **confirmationist model of science** (scientific knowledge) which was recognized by logical empiricism after 1935. The 1940s and 1950s witnessed its development by R. Carnap, who focused on the preparation of inductive logic aimed to express exactly the degree of the confirmability of the hypothesis by means of concept- logical probability. He tried to formulate a theory which would provide a system of rules of for inductive inference [34]. Later, many logical empiricists began to recognize hypothetical-deductive or falsificationist models of science.

For the purpose of illustration of the procedure of semantic verification, I.Hrušovský used Carnap's example of the theory testing T (about planetary motion), from which predictions of the position of the planet were inferred, in his

'Theory of Science'([25], 42–43). By comparing the prediction P with the protocol (results about observations) "it will be found out whether it is confirmed or not" ([12], 92–93). The term "confirmed" occurs here explicitly. Hrušovský himself returns to the issues of semantic verification (confirmation) in his works. In his 'Theory of Science' he speaks about **syntactic verification** which precedes semantic interpretation and its role is to find out whether the statement which we intend to test empirically, is logically consistent with other statements or with the recognized theories. In this way it cannot be found whether the particular statement is true (or to what degree it is probable). This is the role of semantic verification. A more precise account of what he understands under verification is given in his later work. "We have already said that scientific discoveries stimulated by controversy between valid theories and new, raw experiences are in principle a result of the inventive process. They are thus not safely logically determined. But if they arise by inventive process, the question of their validity is still not answered. It is therefore necessary to distinguish between the way of their formation which is prevalently a psychological matter and the method of verification, which is in principle logical." ([24], 60). It is again confirmed that the formulation of new knowledge (hypotheses) is an object of empirical psychology and, with the exception of the work 'Invention and Development' [20], he does not pay attention to this process. The verification of hypothesis begins when it is ready (expressed in language, accessible to intersubjective control). This process of verification (testing) of empirical statements is the matter of exploration of the theory of science, remaining true to the existing tradition.

The aim of semantic verification (confirmation) is to find out whether the hypothesis or law is "adequate to the factual material", whether it corresponds with it ([25, 40]). The standpoint of Hrušovský in his works is evidently that of confirmationism. Its core can be expressed as follows: consequences (sentences about observation) are inferred deductively from hypothesis H. They are tested by comparison with the results of observations and experiments. With the increasing number of positive tests of the consequences derived from the hypothesis, the degree of probability increases (the degree of confirmation of the particular hypothesis). Hrušovský's views on the character of verification in science were influenced by logical empiricists, and, after 1935, particularly by R. Carnap.

The question why I. Hrušovský regarded verification (confirmation) as a logical operation ([25], 56) or whether he approached the standpoint of falsificationism represented by K. R. Popper ([17], 428–429), etc. might be the topic of discussion. Replies to these questions are, however, beyond the scope of this paper.

The shaping of Hrušovský's view on the character of the model of science was primarily influenced by the representatives of logical empiricism. He was familiar with the work of K.R. Popper 'The Logic of Scientific Discovery' (1935) as well as his critical studies on inductive logic ([25], 56, note 68). Although he refers to Popper's opinion that the analysis of the procedure of verification "does not lead to

any inductive logical elements", he also maintains that verification "is in principle a rational or logical operation" ([25], 56). On this matter Popper would have disagreed in principle with Hrušovský's view. In our opinion, Hrušovský undervalued Popper's arguments against the attempts to use inductive inferences on the basis of the determination and justification of the **principle of induction** in science – whether by acquiring universal assertions or in the process of their verification. He did not analyse Popper's arguments against the use of the inductive procedures in science separately, probably also because of the fact that he wrongly thought Popper was a member of the Vienna Circle. Popper's views had not yet been influential at that time and Hrušovský directed his attention towards the conception of confirmation, which better corresponded to his visions of how it is proceeded in science.

By appraising Hrušovský, we can face an opinion that 1. Hrušovský regarded induction as the psychological and not the logical method and that 2. each scientific view was according to him deductive. These assertions lead to the conclusion that he approached Popper's deductionism, that is falsificationism. In support of this assertions, Hrušovský's statement from 'The Problems of Noetics'is given, namely that "the progress of science is actually a series of successive falsifications and substitutions of the more adequate axiomatized systems" ([17], 428–429).

We think that I. Hrušovský neither joined Popper's falsificationism nor approached it. It is true that in 'The Theory of Science' Hrušovský's induction appears as invention, that is as a psychological process of obtaining universal statements but his attitude to induction in the process of verification is – as we have already shown, controversial. He considered verification (confirmation) to be a logical operation, in our opinion, under the influence of Carnap, who, in his earlier as well as later works, regarded an attempt to construct inductive logic as "part of logic with regard to the fact that concepts occurring there are logical concepts" ([34], 330). The frequency of the term "falsification" in Hrušovský's works is minimal. He had never tried to define the understanding of falsification, let alone Popper's understanding of falsification and, particularly his opinion that the "method of falsification does not presume any inductive inference, but merely tautological transformations of the deductive logic, whose validity is unquestionable" ([27], 22). One should also realize that logical empiricists did not eliminate any negative result, that is refutation (falsification) even under the dominance of positive verification. In his last work published before his death, I.Hrušovský used the terms "confirmation", and "disconfirmation". "Disconfirmations of empirical sentences are thus a positive factor of scientific development, since they encourage reconstruction and modification of knowledge structures and thus also the amelioration of science." ([19], 69). In Hrušovský, the core of the procedure of verification was the confirmationist model.

In Hrušovský's work we meet formulations concerning for example induction, which can be perceived as inconsistent with his total understanding of the issue. Without doubt, these are certain residues of traditional inductionism, which might

cause some interpretation difficulties. In spite of that we think that they are nonessential within this context.

Conclusion

Selected problems of the theory of science were analysed in view of Hrušovský's scientific and philosophical interest. We showed that Hrušovský's views on many problems associated with the character of science shaped in the 1930s and at the beginning of the 1940s had been influenced by logical empiricism (neopositivism). We indicated that Hrušovský's views on the character of science and the content and the scope of the theory of science changed. In the thirties and forties his opinions differed from those of logical empiricists in many directions. A more vivid image of the agreement and differences between the views of I. Hrušovský and those of logical empiricists on the solution to the philosophical and methodological problems of science might be obtained by an analysis of the problems which have not been analysed in this paper. The problems concern: basic statements, the understanding of the ideal of the scientific theory and its development, understanding of the criterion of demarcation and pseudo-problems in philosophy, understanding of scientific philosophy and its changes, dynamics, development of scientific knowledge, properties of scientific knowledge, its characteristics, realistic attitude, and arguments against indeterminism, the influence of Marxist philosophy on the shaping of Hrušovský's theory of science.

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