BASIC PRINCIPLES OF V. A. SMIRNOV'S CONCEPTION
OF SCIENTIFIC PHILOSOPHY AND LOGIC*

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The place of scientific philosophy in the system of philosophical knowledge

The conception of scientific philosophy developed by the outstanding Russian logician Vladimir Aleksandrovich Smirnov is based on the idea of application of scientific methods to the analysis of philosophical problems. The shortest definition of the main feature of scientific philosophy is the following: *scientific philosophy is based on use of scientific methods.* But what they would be? Obviously, by the essence of philosophy, pre-dominance of the research methods such as observation of the objects located in space and time, experiments with them etc. is out of the question here. Methods of scientific theory must mainly be theoretical and absract. Like the methods of mathematical analysis, theory of functions and other mathematical theories which proved to be fruitful in physics *the logical methods* have been successfully applied to various fields of philosophy. Several problems of philosophical knowledge turned out to be non-trivially treated by means of them.

The central position of logical methods in scientific philosophy do not exclude any usage of other methods of investigations. The main point is that only scientific methods are to be used. In V. A. Smirnov's opinion, nowdays scientific philosophy consists of the following philosophical disciplines: logic, epistemology, methodology, theory of values, theory of actions, philosophy of language, philosophy of law, philosophy of mathe-matics, foundations of natural sciences, social sciences and humanities. Thus, scientific philosophy is not identical with philosophy of science but contains the last as a component.

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The role of language

From V. A. Smirnov's viewpoint, the key point of the scientific method in general is the selection of a suitable *language* of description for the domain under investigation. He wrote [Smirnov *1987*, 129]:

> Important scientific discoveries which form whole epoch are just an acceptance of new language. One model of the world, cheme of description of the world, is replaced by another; a transition from one scheme in which facts are described to another, more expedient with respect to some purposes and more adequate, occurs. It can be said that the transition from one model to another is correlative to the acceptance of a new language.

Modern logic to a great extent is oriented to analysis of the languages of science, and this is just the explanation of its significance for philosophy of science and methodology.

For the right comprehension of the idea of the role of language, it must be taken into account that modern approach to logical languages has nothing in common with the theory according to which the main purpose of languages is to assign names and, in general, to place marks of pointers on things and processes. Logical language is a system of *methods* of division of the *universum* upon which the success of cognition ultimately depends. The methods must be general in respect of comprehension of phenomena as well as in respect of their application in a process of knowledge. That is why all sciences are directed to maximum generalization on the one hand and to intersubjectivity on the other. Concrete science needs logic as far as processes of reasoning are presupposed by its methods. Thus, logic forms an universal core of scientific knowledge.

But why do we need science? One can get quite general and deep knowledge without any science. V. A. Smirnov answered ingeniously: the purpose of science is to transform problems which can not be solved without creative activity into routine tasks. He wrote [Smirnov *1986*, 112]:

> If methods of solution of some task do not exist yet, the task appears to be exclusively creative. An elaboration of the methods transforms it into standard routine task. Then creative activity is displaced to a higher level — the sphere where methods of solution are created.

Note that "routine" does not mean "simple"; it means "non-creative". Routine solutions may be very complicated.

Of course, it is possible that some tasks which need creative activity will be solved without science. However, these solutions would seem as "solutions which have fallen down from the heaven", for they are accessible only for the indivudal who is a genius. But when a scientific solution is found it becomes a property of everybody because of intersubjectivity of science.

Extensionality and intensionality

In the beginning of '60s of our century it became clear that the apparatus of classical symbolic logic is insufficient for a solution of new methodo-logical problems. For these purposes a new logical system, which would be more adequate for real processes of shaping and functioning of scientific knowledge, must be elaborated. However, the creation of non-classical logic appeared to be so difficult that logician's efforts was concentrated on "pure" logical problems during a namber of decades when methodological problems were by necessity left aside. Now, according to V. A. Smirnov's opinion, the arsenal of new logical tools for analysis of knowledge has obtained its "critical mass" which allows us to apply the results obtained in non-classical logic to the methodology of science on the widest scale. At the same time, these must be applied together with old justified methods.

The principal difference betweeen classical and non-classical logical systems is connected with extensionality and intensionality. According to the principle of extensionality, properties and relations are considered precisely up to their extensions. Properties and relations which have equal extensions are identified. In intensional analysis much more logical characteristics which can not be reduced to descriptions of the extentions of concepts are taken into account. Formerly the prevalent idea was that the extensional approach is sufficient to solve all methodological tasks. Particularly, R. Carnap expressed this idea. Some researchers share it up to now. V. A. Smirnov's viewpoint was different. He clearly pointed out that extensional systems provide a research apparatus with powerful expressional abilities; therefore, its refutation is out of the question. At the same time, he insisted on the necessity of the development of more powerful intensional methods of analysis of scientific knowledge. He practically demonstrated a possibility of creation of the methods elaborating intensional logics of different types (modal, temporal, paraconsistent, relevant).

Comparision of scientific theories

The question about the comparability of scientific theories is broadly discussed in works on methodology of science. But, as V. A. Smirnov pointed out, the results obtained in logic are ignored in the discussions. In the first place to the arguments in favour of the thesis of the "incommensurability" of the theories, languages and paradigms proposed by the historical school in methodology. The arguments are invalid, for they are "based on false assumption which substitutes sociological problems for gnoseological [problems]". But the point is not only in the false idea of incommensurability of systems based on different conceptual suppositions. There is also the danger of discrediting complicated philosophical problems for the constructing and investigating of the systems along with criticism of the idea mentioned above. (See [Smirnov *1983*, 86–87]).

A number of V. A. Smirnov's works dwell on elaboration o theoretical methods for comparision of scientific theories and their applcations. The results show that theories formulated in different languages can be successfully compared. A method of embedding operations appared to be the most effective for the comparision. The essence of the method is a search for a recursive function ϕ such that for any formula A and theory T1 or T2, if A is theorem of T1, then $\phi(A)$ is theorem of T2, and *vice versa.*

For example, the language based on categorial suppositions different from those of classical predicate logic is the language of Lesniewski's ontology. V. A. Smirnov [*1982*] found the operation of embedding of Lesniewski's elementary ontology into second-order predicate calculus that proves comparability of these essentially different theories. Note that the words "elementary ontology" must not lead into misunderstanding: the theory and the proof are by no means elementary.

Genetical method of constructing a theory

In investigating different methods of constructing of scientific theories, Smirnov came to conclusion that there are two fundamental systems of thought. On the semantical level first of them is represented by set-theoretical thought. It is realised in the axiomatic method of constructing of a theory. The second is based on genetical, constructive thought, and the genetic method of constructing of a theory matches it. (See [Smirnov *1962*].)

The genetical method differs from the axiomatic method in the mode of introduction of objects of the theory as well as in the logical devices applied

in the theory. When the axiomatic method is used, objects of the theory are not "initial". The initial elements are the statements about the objects. Accordingly, logical operations are performed on propositions of the theory. The genetical method presupposes a fixation of a set of constructed objects and a system of effective means for their transformations. New objects of theory are consstructed from initial objects by means of the transformations.

Already in the beginning of '60s V. A. Smirnov arrived at the important conclusion: it is necessary to extend the meaning of the notion "logical" to include in the field of logic investigations of systems of manipulations with logical objects along with the consideration of their logical relations. It is a non-trivial extension for the set-theoretical and genetical systems of thought, which are based on different, even incompatible, conceptions of truth.

Problems of methodology of the empirical science

In our opinion, one of important results obtained by V. A. Smirnov is a new understanding of notions "empirical" and "theoretical" (see [Smirnov *1987*]) which is alternative to their set-theoretical interpretation, although he never considered that set-theoretical methods must not be applied to the methodology of empirical sciences.

V. A. Smirnov proposed to replace the set-theoretical interpretation of the notion "empirical" by an intensional and constructive one. At the same time he pointed on the analogy between this proposed approach and Hilbert's finitism. Since discreteness and finiteness are fundamental charac-teristics of our experience, empirical objects can, according to V. A. Smirnov, be considered as constructively-set objects. A predicate on the objects is not a set-theoretical structure but some discerning algorithm. To get to know whether an object has a property, an appropriate algorithmic procedure must be applied to it. Then an empirical statement will simply be an account of the algorithm's work.

V. A. Smirnov replied to the objection against an opertionalistic interpretation of predicates. Critics of operationalism pointed out that methods of verification of the presence or absence of a property may be dif-ferent. If an empirical predicate is a instruction which describes operations with object, then each such instruction is a specific empirical concept. The solution is to establish a correspondence between empirical predicates and the function which is computed by concrete instructions or algorithms. As a result, the "problem which seems to be unsolvable under operationalistic approach is transformed into an ordinary task of identification of different instructions and procedures which represent one and the same function"

[Smirnov *1987*, 236]. However, in. Smirnov's opinion, sometimes it is more interesting to establish a correspondence between predicates of observation and just concrete instructions, for otherwise we lose a technical aspect of the matter which may be very important in empirical investigations.

Problem of a proof search

The result of V. A. Smirnov's non-standard philosophical standpoint was that he had shown how logic can be applied where the question is about a discovery and creative work, where it seems to have nothing to do with logic at all. Realizibility of logical analysis of creative processes of proof search follows from the objective characteristics of correct reasonings. Since methods of reasoning appear to be objective, there is a possibility to represent them in symbols. This allows us not only to fix precisely a structure of proofs, but also to find the methods of proof search.

V. A. Smirnov [*1986*, 102] drew a distinction between the following three questions:

1) *What is a proof?*

2) *How to search [for] a proof?*

3) *How to search for the proposition in which we are interested?*

Formerly, logic was restricted to the first question — there was a need to define which reasonings are to be considered as proofs, under which conditions a true conclusion is guaranteed by true premises. A successful description of these conditions became possible only after the ideas of psychologism where refuted, for it was necessary to find criteria of correct reasoning independently of whether anybody used the reasoning. In other words, a definition of criteria of correct reasoning must inevitably obtain a symbolic form. Formalization of logic allowed the explication of the concept of proof.

In a formal system, after the proof is obtained, its verification may be hecked by a computer. But how can a diserable proof be found? In general, the creative approach is necessary to find a solution of the task. For a long time the task of proof search was considered as rather psychological than logical. Now the problem of proof search has its theoretical basis and is investigated by many logicians, and V. A. Smirnov was among them.

In the system where all rules of inference have the subformula property a proof can be searched by moving not from premises to a conclusion but in opposite direction — from the conclusion to premises. Since in this way we pass from formulae to subformulae, a proof — if only it exists — will certainly be found. This method of proof search can be used not only by a human but also by an appropriately programmed computer. The last will do it more effectively, for this method demands looking over a very large number of possible variants.

V. A. Smirnov pointed out the following difference between mechanical and human methods of proof search. The method used by the machine is based upon a complete checking of all possibilities in a cut-free system and does not presuppose anything that is called "an idea of proof". On the contrary, the human method of proof search is used in a system with cut that allows the picking out of large blocks of proof which correspond to the "idea of proof".

As to the third question mentioned above, the situation is more complicated. How are the hypothesis in which we are interested selected from a set of hypotheses, and how are the set of hypotheses produced? V. A. Smirnov noted that the creation of the space of selection and the selection which follows are performed on the basis of existing theories and empirical data. In the meanwhile regularities of this stage of creative activity remain insufficiently investigated.

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