

# Philosophical Foundations of Science: Their Structure and Functions

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**Abstract**—The article analyses the following problems: 1) whether philosophical foundations of science are included in the structure of scientific knowledge; 2) what types there exist; 3) what their functions in scientific cognition are. The author proves the position that philosophical foundations of science are one of the elements meta-theoretical level of scientific knowledge also including general scientific knowledge (scientific picture of the world and methodological ideals of science) and paradigm scientific theories. Unlike general scientific knowledge philosophical foundations of science are borrowed by science from different branches of philosophy: ontology, gnoseology, social philosophy, axiology, anthropology, praxeology. Thanks to pluralism of philosophical concepts and qualitative distinction of scientific knowledge fields there are no and there have never been any common for the entire science its philosophical foundations. This is true not only in relation to diachrony of science development but also to its synchronistic state in any historical period. The main functions of philosophical foundations of science are: 1) deductive reasoning of axioms, principles and laws of fundamental scientific theories as additional to their empirical, inductive reasoning; 2) philosophical interpretation of scientific knowledge content as necessary evaluation condition of its attitudinal significance; 3) relationship between science and philosophy as crucial culture fields; 4) creative resource of philosophical mindset and knowledge connected to science and scientific cognition; 5) scientific knowledge transmission into culture and its content learning by society.

**Keywords**—*science; levels of scientific knowledge; meta-theoretical knowledge; philosophical foundations of science*

## I. INTRODUCTION

Philosophical foundations of science are crucial structural element of meta-theoretical level of scientific knowledge [1]. Another also important element of meta-theoretical knowledge is general scientific knowledge (scientific picture of the world and methodological standards of scientific cognition). Despite great similarity in their functions these elements of meta-theoretical knowledge in science should be differentiate. They differ in their nature and their content as well. What are philosophical foundations of science? They are the set of philosophical ideas, categories, concepts which are used by scientists during formation and reasoning of scientific knowledge and

scientific theories especially. Philosophical foundations of science reflect attitudinal views of scientists, their most general ideas about the world, society, individual and cognition in terms of their essence, possibilities and purpose [2]. Philosophical foundations of science are qualitatively uneven in content. There are the following types of philosophical foundations of science: 1) ontological (general concepts of existence, its structures and properties); 2) gnoseological (general concepts of consciousness and cognition); 3) social (general concepts of society and social systems of various kinds); 4) axiological (general knowledge about culture, values and their influence on science); 5) anthropological (general concepts about nature and human essence [3]. Scientists' attention to philosophical foundations of science is explained by the following reasons: 1) necessity of general scientific knowledge reasoning (of certain scientific picture of the world and certain ideals and norms of scientific research); 2) necessity of scientific knowledge transmission into culture and its learning by society that is impossible without philosophical interpretation of scientific knowledge; 3) importance of including scientific knowledge via its link with philosophy into attitudinal potential of society [4][5]. Real science and its history show that most frequently scientists' attention is drawn to philosophy in two cases: 1) in times of crisis of previous fundamental theories and necessity to develop new ones; 2) if necessary to make rational choice between rival hypotheses when each of them meet all scientific rationality requirements accepted. Since both cases occur not often, scientists in their direct activity rarely use philosophical knowledge as necessary and important resource of scientific knowledge development. It is mainly done by theorists especially frequently by representatives of fundamental scientific theories. Such rare attention of most scientists to philosophy as a real tool of scientific knowledge development certainly cannot be considered as significance indicator of philosophy for science development. The fact is that scientists' attention to philosophy occurs in important moments in science and scientific knowledge development, in bifurcation points of their dynamics when its future direction is being decided [6]. And here as history of science demonstrates philosophy influence on science proves to be significant and sometimes critical. Paradigm examples: 1) Euclidean geometry appearance in Ancient Greece; 2) Copernicus' geocentric theory development in New Age; 3) difficulties with non-

Euclidean geometries acceptance in XIX century; 4) structural problems with appearance of relativity theories, quantum mechanics, genetics, big bang theory, constructive mathematics, synergetics into the science of XX century [7]. What is the necessity on the one hand and the main difficulty of scientists' attention to philosophical knowledge resources on the other hand? It is in the fact that philosophical knowledge by its nature has always been and remains not simply heterogeneous by content but pluralistic controversial. During long history of philosophy sufficiently great amount of provable and logically non-controversial concepts of existence and cognition appeared though by their content they were diametrically opposite: materialism and idealism, determinism and indeterminism, mechanicism and organicism, sensualism and rationalism, empiricism and apriorism, cognition as reflection of existence and only as its representation, etc. Due to existing pluralism in philosophy scientists seeking it always have to make choice between alternative philosophical concepts preferring one of them as most corresponding for certain science on its development stage. Therefore, science has never had and doesn't and cannot have common philosophical foundations in principle shared by all scientists. This is clearly proved by entire science history including its contemporary condition. Absence of common philosophical foundations in science causes difficulties in development of commonly significant interpretation of scientific knowledge meanwhile it has certain positive significance being important resource of creativity and consciousness of complex nature of scientific knowledge content and its development perspectives. Uncertainty provokes intention to avoid it and faces a challenge. Challenge is one of the main sources of creativity. Content reconstruction of the main types of philosophical foundations of science is done below.

## II. ONTOLOGICAL PHILOSOPHICAL FOUNDATIONS OF SCIENCE [7]

- 1) Existence is a variety of material objects and nothing more.
- 2) There are reasonably not only material objects but also ideal ones including global intelligence.
- 3) Existence is supercomplex one-tier system of interrelated and interactive objects.
- 4) Existence is supercomplex multi-tier system of objects and substances of different nature.
- 5) In the world only unequivocal and causal relations between its objects take place.
- 6) Between the objects relations of different kinds take place: necessary and accidental, causal and intentional, unequivocal and probable and others [8].
- 7) Everything in the world is in the process of constant change.
- 8) The foundation (essence) of the world is unchanging (invariant).

- 9) The world is supercomplex, self-organized and self-governed (based on its internal laws) system.
- 10) The world is huge dissipated system, governed on basis of necessities and accidents [7].
- 11) Space, time and matter are independent substances linked to each other but only externally.
- 12) Properties of space, time and matter are interlinked to each other and greatly influence each other.
- 13) Existence as a whole is continuous reality.
- 14) Existence is discretereality.
- 15) There is a smallest unit of existence.
- 16) There are no absolutely elementary units of existence.
- 17) The world (Universe) has origin in time.
- 18) The world doesn't have origin in time, it exists eternally.
- 19) The world is generally finite regarding space.
- 20) The world is infinite regarding space.
- 21) The essence in the world is primary, event is secondary.
- 22) The event is primary, essence is secondary.
- 23) Dynamic (unequivocal) laws are primary in the world, static laws are secondary.
- 24) Static laws of the world are primary, dynamic ones are secondary.
- 25) In the reality there are no controversies, but only diversities.
- 26) Reality is dialectically controversial.
- 27) The whole exhausts the sum of its parts and their interactions.
- 28) The whole is more than the sum of its parts and their interactions.
- 29) The law is primary, the accident is secondary.
- 30) The accident is primary, the law is secondary.
- 31) In the reality there is no place for accident. Accident is something the reason of that is unknown.
- 32) There is no motion without applied force.
- 33) The motion without applied force is not only possible but that is natural state of any object.
- 34) Coherent links and relations between different objects have no less fundamental importance than causal links between them [7].
- 35) No structure no object. Every real object has its structure.
- 36) Everything in the world is interrelated.
- 37) Not everything in the world is interrelated.

38) There is only finite speed of material objects and information propagation, it doesn't exceed speed value of light in vacuum.

39) Infinite (instantaneous) influence speed of one object on the other is possible.

40) Time is local and relative quality of an object [9].

41) There is universal and absolute time.

42) Energy is continuous reality.

43) Energy is quantitative reality.

44) Available structure of object is the result of its history.

45) History of any object is defined by its structure.

46) Possibility is primary and precedes reality.

47) Object quality is primary, its qualitative descriptions are secondary.

48) Quantitative and structural descriptions of any object are primary, quantitative ones are secondary.

49) Motion (change) is primary and absolute, rest is secondary and relative.

50) Rest as primary and absolute, motion (change) is secondary and relative.

51) Living things and non-living things differ qualitatively.

52) Living things and non-living things differ quantitatively and contingently.

53) Mind is the universal property of existence.

54) Mind is the property of only certain kinds of existence.

55) Existence is unitary and uniform on its basis. The basis of its unity is relatively small set of fundamental elements, their properties and relations (laws). All parts and systems of existence follow the action of the same universal laws and constants. Diversity of existence is secondary, it is the consequence of combinatorics and probable distribution of original set of fundamental elements and their properties.

56) Existence is pluralistic in that fundamental case about every its element and every its subsystem are unique in their kind and qualitatively differ from other elements and subsystems. There are no universal laws of existence, every element of existence obeys their own laws, though a lot of them are similar. Unity of existence is secondary and it is the consequence of external (quantitative and structural) similarity of elements and parts of existence.

57) Despite their qualitative differences all elements of existence are informationally open and interrelated. Each element has absolutely complete information about all other elements of existence (monads) and about existence as a whole.

58) Existence is absolutely complete and continuous, that is why there are no non-existence and death as well as appearance of something absolutely new in the world.

59) Existence and all its elements are capable of creativity, they have not only consciousness but also will.

60) The basis of *will* as overall ontological description is in self-love of every element of existence, their need for self-preservation and longer life.

61) In existence between all its elements and systems there is rivalry (war of all against all) for their guaranteed living.

62) Existence is controversial in its essence. It is unitary and qualitatively diverse, invariant and changeable, reproducible and creative, directional ('strong') and indirectional ('weak'), born and dying, repeated and changeable, slow and fast, evolutionary and revolutionary (quick change of its qualitative state), interrelated and separate, holistic and additive (aggregate), necessary and accidental.

63) Existence is governed by measure. The essence of existence is harmony and beauty.

64) Existence is governed by accident, uncertainty and spontaneity.

65) There is only existence, there is no non-existence.

### III. GNOSEOLOGICAL PHILOSOPHICAL FOUNDATIONS OF SCIENCE [2][5]

1) There is reasonably only that what can be sensually perceived at least in principle.

2) Sensual consciousness detects only events but not substances.

3) The only source of knowledge is senses. There is nothing in the content of our knowledge that would not have sensual perceptions as their source.

4) Sensual cognition is primary, mindset is secondary.

5) Mindset is synthesis (logical processing) of sensual data.

6) There is no congenital knowledge.

7) Cognition is the reflection of objective reality cognition, its properties, relations and laws.

8) The basic methods of obtaining new scientific knowledge are observation, experimenting and induction.

9) Absolute adequate knowledge (absolute verity) about reality is possible.

10) Mindset performs only instrumental role in cognition being just a processing tool of sensual data.

11) All ideas are only the result of abstracting activity of mindset towards the content of sensual cognition.

12) There is no a priori knowledge, knowledge is always a posteriori, only the result of experimental (sensual) reality cognition.

13) Intuition is not the source of objective knowledge especially not the criterion of its veracity.

14) The source, basis and criterion of veracity of any knowledge are only data of experience, only data of sensual perception of cognitive reality.

15) Scientific knowledge is only facts and their generalizations.

16) Theories are the essence of fact generalizations.

17) The knowledge content and its dynamics depend on the contents of objects studied and their logical processing. The knowledge content shouldn't be influenced by social and cultural conditions of cognition.

18) The process of scientific cognition is a continuous process adding still new truths to the existing knowledge.

19) During cognition there is development from simple truths to complex, from the least complete and deep knowledge about reality to the most complete and deepest one.

20) There cannot be two controversial truths about the same subject of cognition.

21) Experience definitely determines the contents of mindset. The freedom of mindset is only the freedom of processing of its contents.

22) If mindset is true, it cannot contradict the data of sensual cognition, observation and experimenting.

23) Absolute true and absolute provable knowledge is possible.

24) Object influence is necessary to exclude completely.

25) Scientific knowledge is self-developing system.

26) Any knowledge in its essence is hypothesis.

27) Any knowledge is subject-objective [10].

28) Subject influence on the knowledge contents is impossible to eliminate completely.

29) Absolute certainty of the knowledge contents is unachievable in principle.

30) Absolute knowledge proof is impossible in principle.

31) Mindset is independent knowledge source as well as senses.

32) The most objective kind of knowledge is rational knowledge.

33) Rational knowledge essentially does not reduce to sensual knowledge.

34) The source and criterion of knowledge veracity are not senses but mindset.

35) A priori knowledge exists, and not only relative but also absolute one.

36) Intuition is independent and the most important knowledge source along with sensual cognition and mindset.

37) There are two types of activity: mind and intelligence.

38) Only relatively true and relatively provable knowledge is possible.

39) All cognition results (sensual as well as rational) have constructive nature.

40) Idealization is independent and critical method of cognition along with abstraction.

41) Knowledge system is heterogeneous and controversial.

42) Knowledge dynamics comprises not only evolutionary (accumulative) periods but also revolutionary stages, stages of partial denial of previous results and statement of qualitatively new ideas [11].

43) Classification of any comments both analytical and synthetical is always relative and conditional.

44) Objects definitely do not determine the contents of knowledge about them.

45) Experience (empirically gained knowledge about the object) definitely does not determine the mindset content [9].

46) Sensual information about the object is not able not only to prove rational knowledge about it but also to confirm the veracity of the latter.

47) Sensual information about the object is not able to deny any rational knowledge about it.

48) The contents of mindset do not imply sensual perceptions just like the contents of sensual perceptions do not logically imply the mindset. There are representative and correlative link between the sensual perception contents of the object and mental model contents of the object.

49) The veracity criterion of rational knowledge is intuitive obviousness of its general ideas as well as logical consequence of some true comments from other true comments as their result.

50) Mindset and knowledge are not self-developed systems, creators of their contents and changes are subjects of cognition.

51) Any verity has preconditions and therefore it has conditional event.

52) Scientific knowledge is logically organized and provable knowledge.

53) General ideas of any scientific knowledge systems have not only conventional nature but also conventional or consensual event of its veracity.

54) Scientific knowledge development obeys the principle of evolution from simple to something complex, from abstract to concrete.

55) The starting point of knowledge development is not sensual experience and not theoretical idea (hypothesis) but the problem, i.e. controversy between them and disability from the idea standpoint to explain some new sensual information.

56) Real subject of cognition is a thought (idea) reflecting itself.

57) The subject of scientific cognition is an individual.

58) The subject of scientific cognition is professional and scientific community.

59) The subject of cognition not only reflects but also creates [2].

60) The necessary component of any creativity is the will of the subject.

61) Human knowledge system in general represents super complex, controversial and developing system.

62) Human cognition is social by its nature, and its contents are determined not only with objects studied but also social conditions of cognition.

63) The knowledge veracity criterion is its correspondence for the object studied.

64) Absolute identity between the object and knowledge about it is impossible.

65) The knowledge veracity criterion is not only the matching rate of the object but its usefulness during practical performance.

66) Any apparent and discursive knowledge is always based on some non-apparent and intuitive knowledge.

67) Any knowledge is always not fully determined and not fully reasonable.

68) Opinions on adequacy, certainty and reasonableness of any knowledge are always based on cognitive will of object cognition and its practical interests [2].

#### IV. SOCIAL PHILOSOPHICAL FOUNDATIONS OF SCIENCE

1) Knowledge contents don't depend on the society and its interests and determined only by considerations of verity achievements.

2) Knowledge content depends on socio-cultural context of its gaining and also use (practice).

3) The main purpose of knowledge is objective-attitudinal.

4) The main purpose of knowledge is its adaptive role and practical performance for society and individual.

5) Knowledge is that society has.

6) Society is that its knowledge is.

7) Culture and its various institutions greatly influence on the cognition process and its results [12, 13].

8) Contents of scientific knowledge don't depend on socio-cultural context and its gaining but is determined only by its subject.

9) The subject of scientific cognition is social.

10) The subject of scientific cognition is transcendental.

11) Social organization of cognition process greatly influences its dynamics [14].

12) The process of scientific cognition is regulated by rules of scientific ethos which have human, international character and don't depend on time and social conditions of cognition.

#### V. AXIOLOGICAL PHILOSOPHICAL FOUNDATIONS OF SCIENCE

1) Objective knowledge is neutral in relation to all values except verity value.

2) The whole human cognition including science is experiencing influence of various human values, the main one is not verity but use [5].

3) Cognition and knowledge is impossible without esthetical values of beauty and harmony.

4) Any knowledge including scientific has ethical measurement.

5) Science and morality are irrelevant to each other.

6) Values are social and subjective, knowledge is objectively true and commonly significant.

7) Knowledge is adaptability tool of society and multiplying material power.

8) Knowledge is tool for further knowledge development.

#### VI. ANTROPOLOGICAL PHILOSOPHICAL FOUNDATIONS OF SCIENCE

1) Scientist is impassive registrar and observer of objective verity.

2) Scientific verity cannot be obtained beyond the process of its personal experience and statement with the help of will.

3) It is impossible to become a great scientist without being a strong personality.

4) Scientist and researcher are not the same thing. For the real scientist science is not only profession but vocation and meaning of life.

5) Verity cannot be obtained and learned without struggle, conflicts and controversies inside scientific community.

6) Scientific cognition requires courageous, brave and dedicated subjects.

7) Scientist should be able to admit defeat honestly.

8) There is no place for dogmatism and fundamentalism in science.

9) Freedom and responsibility are equally important qualities of any scientist.

10) Scientist should seek not brilliant but fruitful results of their researches.

## VII. CONCLUSION

Philosophical foundations of science are crucial element of meta-theoretical level of scientific knowledge. There are the following kinds of philosophical foundations of science: ontological, gnoseological, social, axiological, anthropological. The main functions of philosophical foundations of science are 1) reasoning of scientific theories with the help of philosophical knowledge as more general kind of rational knowledge than specifically scientific; 2) attitudinal evaluation of scientific knowledge content; 3) relationship between philosophical and specifically scientific knowledge; 4) use of creative resources of philosophical mindset for science development; 5) transmission of new scientific knowledge into culture for its learning by society.

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