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ЭЙНШТЕЙН И ФИЛОСОФСКИЕ ПРОБЛЕМЫ ФИЗИКИ XX ВЕКА

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PREFACE

March 14, 1979 was the centenary of Albert Einstein, the great physicist. The history of science knows but few scientists who were accorded the same popularity as Einstein. His fame far transcends the boundaries of physics: he is known not only to professional scientists but also to people whose interests are remote from science. This popularity is largely due to the fact that Einstein's work played a revolutionary role in the development of physical knowledge and, moreover, touched on the most profound problems of the scientific world outlook with which all thinking persons are concerned. Einstein's scientific creativity made a considerable impact on the development of 20th-century philosophical thought.

What were the factors that determined Einstein's part in the development of philosophical thought? The first of these was the role played by Einstein's special and general relativity theories in altering the scientific picture of the world. The picture of the world founded on these theories is radically different from that of classical physics, entrenched in the age-old tradition. The time-space structure of the universe was here explained in a new way. Thanks to Einstein, man in the 20th century sees the world in a different light from previous generations. The second factor was the impact of Einstein's scientific creativity on the style of scientific thinking. Einstein worked out new standards for scientific knowledge, which further developed the Copernican tradition rejecting anthropomorphic self-obviousness; these were standards for theories whose truth was substantively linked up with their paradoxical nature. The third factor here is Einstein's deliberations on the fundamental philosophical problems facing physics. Without these ideas, modern physics would be unthinkable. On the other hand, their solution goes beyond physics alone, assuming a general philosophical

significance.

The present work deals with the philosophical meaning of Einstein's creativity within the philosophy of the natural sciences. Accordingly, it includes papers on the philosophical interpretation of the special and general theories of relativity, analysis of the concepts of space and time, philosophical evaluation of Einstein's search for a unified field theory, Einstein's views on the role of probabilistic laws in quantum mechanics, and the problem of determinism in physics.

Although Einstein's theories have in a sense become classic, they continue to be objects of the most divers, at times mutually exclusive, philosophical interpretations. This is true, in particular, of the general theory of relativity. Along with the traditional view that this theory emerged from a generalisation on the special relativity principle, it is also identified with the relativistic gravitation theory. Einstein's programme for creating a unified field theory is also variously evaluated in present-day Soviet literature. Such differences of opinion are an attribute of developing knowledge. For this reason the editors deemed it expedient not to restrict the book to representing only one of the existing viewpoints, providing the reader with an opportunity for studying various approaches to debatable problems.

However, current in foreign literature are also philosophical interpretations of Einstein's heritage of a different kind—those made from the positions of neopositivism, conventionalism, and other conceptions of modern bourgeois philosophy. Some of these were reflected in the articles collected in *Albert Einstein: Philosopher-Scientist*, which was published in the USA on the occasion of Einstein's 70th birthday and became widely known.[1] In his comments on the articles published there Einstein pointed out the inadequacy of these conceptions.[2] These com-

[1] *Albert Einstein: Philosopher-Scientist*, ed. by P. A. Schilpp, Evanston, Illinois, 1949. See in particular papers by Philipp Frank, Hans Reichenbach, Percy Bridgman, Kurt Gödel, and others.

[2] These comments were published in the collection in ref. 1 (A. Einstein, "Reply to Criticisms. Remarks Concerning the Essays Brought Together in This Cooperative Volume", *Op. cit.*, pp. 663-688).

ments elucidate some very important aspects of Einstein's philosophical position. Therefore the present book includes papers analysing Einstein's attitude to Machist philosophy, neopositivism, and operationalism.

Regrettably, it is still believed in the West that Soviet philosophers take a negative attitude to the theory of relativity which is allegedly incompatible with dialectical materialism. This view is completely unjustified. It should be pointed out, first of all, that the relativity theory had opponents amongst Western scientists adhering to the traditionally classical style of thinking and narrow empirical or idealist philosophical attitudes. We all know that the American scientist P. W. Bridgman gave an erroneous interpretation of the special theory of relativity and rejected the general theory of relativity. A more recent example is provided by the French physicist Léon Brillouin's book *Relativity Reexamined* containing a critique of the general theory of relativity which is, in the author's view, a purely speculative construction. Although there have been men, philosophers included, in the USSR, just as abroad, who rejected the relativity theory, their view does not reflect the position of dialectical materialism on this question. On the contrary, practically all Soviet philosophers believe Einstein's theory of relativity to be a most important natural-scientific premise of further development of materialist dialectics and in the first place of the doctrine of the dialectic connection between matter, motion, space, and time.

D. P. GRIBANOV

EINSTEIN'S PHILOSOPHICAL WORLDVIEW

The theory of relativity holds a prominent position amongst the outstanding attainments of modern scientific thought. It has enabled scientists to revise the traditional views and conceptions of the structure of the material world, revealing deep and close ties between philosophy and natural science. For this reason neither physicists nor philosophers were indifferent to Einstein's work. Both were attracted by its special novelty. Natural scientists saw the relativity theory as the resolution of the inner contradictions between classical mechanics and electrodynamics, while dialectical materialists regarded it as natural scientific confirmation of the ideas of matter and its attributes reflected in the doctrines of the founders of Marxism.

Einstein's worldview has been debated for several decades already. The most contradictory views are current in the abundant philosophical literature on this problem. Einstein has been made out to be a Berkeleyan, a Machist, a Kantian, a positivist, an adherent of conventionalism, an empiricist, a rationalist, and so on. Some philosophers included him among proponents of dialectical materialism.

One thing stands out, however. Einstein always had a great liking for philosophy: "The critical thinking of the physicist cannot possibly be restricted to the examination of the concepts of his own specific field" [1, p. 290]. On many occasions he emphasised that modern physics cannot cope with its problems without philosophical knowledge: "The present difficulties of his science force

the physicist to come to grips with philosophical problems to a greater degree than was the case with earlier generations" [2, p. 279].

Einstein's articles analyse the most divers philosophical trends. He read the works of Aristotle, Plato, Democritus, La Mettrie, Spinoza, Berkeley, Hume, Mach, Kant, Russell, and others, but did not share any of the basic tenets of any single system of idealist philosophy he studied.

It would be a mistake to believe that Einstein's philosophical views were moulded by the idealist philosophy he was familiar with.

Einstein had a profound knowledge of the natural science, having absorbed the progressive science and culture of his times. It would be quite appropriate to apply to him Hegel's words that "in experience everything depends upon the mind we bring to bear upon actuality. A great mind is great in its experience; and in the motley play of phenomena at once perceives the point of real significance" [3, p. 206].

1. Attitude to Idealism and Positivism: the Relationship Between Experience and Theory

Apart from other problems, Einstein was interested in epistemological ones like the following: "What knowledge is pure thought able to supply independently of sense perception? Is there any such knowledge? If not, what precisely is the relation between our knowledge and the raw-material furnished by sense-impressions?" [2, p. 279].

He found extremely contradictory answers to these questions in the profuse philosophical literature. He sympathised with the "increasing scepticism" towards attempts to obtain knowledge of the external world through pure thought only. But Einstein did not share the views of those philosophers who took the stand of naive realism. He wrote: "This more aristocratic illusion concerning the unlimited penetrative power of thought has as its counterpart the more plebeian illusion of naive realism, according to which things 'are' as they are perceived by us through our senses" [2, p. 281].

To overcome these "two illusions" Einstein resorted to

some propositions from Berkeley, Hume, and Kant. He rejected the basic philosophical ideas constituting the essence of their idealist systems, their conceptions of space and time, Hume's agnostic doctrine [2, pp. 283-289], referring to the fundamental Berkeleyan tenet "*esse est percipi*" as "untenable" [4, p. 669]. What attracted Einstein in the works of Berkeley, Hume, and Kant was their deviation from the generally accepted metaphysical epistemology dominating classical physics.

In Berkeley's teachings Einstein found, to take an instance, the proposition that our senses directly perceive only processes and not objects of the external world, as empiricists insisted. However, Berkeley viewed objects of the external world as complexes of ideas (sensations), whereas Einstein's materialist intuition prompted him to believe that the processes perceived by our sense organs are causally linked with the things which exist quite objectively and independently from the subject's perceptions.

Studies in Hume prompted Einstein that such general and most essential concepts as causality could not be directly and unambiguously obtained from sense data. Hume made that the basis of an agnostic conclusion: "Whatever in knowledge is of empirical origin is never certain", while Einstein, discarding Hume's agnosticism, used his idea to fight extreme empiricism: "All knowledge about things is exclusively a working-over of the raw-material furnished by the senses" [2, pp. 283, 285].

The gap in the chain of knowledge left by Hume had to be bridged. Einstein understood that. He found a kind of way out of the difficulty in Kant. Kant believed that if empirical data could not result in reliable knowledge (Hume's position), while without such concepts as causality, time, space, and so on, cognitive activity is impossible (they are, according to Kant, the premise of any thinking), it followed that reliable knowledge was based on pure thought, being apriori in nature. However, it was not this conclusion that attracted Einstein.

The positive elements he borrowed from Kant were formulated in this way: "I did not grow up in the Kantian tradition, but came to understand the truly valuable which is to be found in his doctrine, alongside of errors which today are quite obvious, only quite late. It is contained in

the sentence: 'The real is not given to us, but put to us (*aufgegeben*) (by way of a riddle).' This obviously means: There is such a thing as a conceptual construction for the grasping of the inter-personal, the authority of which lies purely in its validation" [4, p. 680]. Einstein saw that Kant had taken a step forward in the solution of the Humean dilemma, but, as distinct from Kant, he came to the conclusion that our knowledge of the external world was obtained from actuality through mental working-over of the sense-data. Einstein did not share Kant's assertion of the existence of apriori concepts. He saw the cause of apriorism in that Kant "was misled by the erroneous opinion ... that the Euclidean geometry is necessary to thinking and offers *assured* (i.e., not dependent upon sensory experience) knowledge concerning the objects of 'external' perception. From this easily understandable error he concluded the existence of synthetic judgments *a priori*, which are produced by the reason alone, and which, consequently, can lay claim to absolute validity" [4, p. 679].

So we see that Einstein's familiarity with the works of Berkeley, Hume, and Kant did not bring him under the influence of the idealist direction in philosophy with which these names are linked. Einstein interpreted the works of these idealist philosophers as a spontaneous materialist and dialectician. He used certain ideas of these philosophers to fight against idealism, agnosticism, and metaphysics, in particular against the two illusions, referred to earlier, of the metaphysical and idealist approaches to the source of our knowledge.

Einstein often cites Mach's works. We must, of course, distinguish between Mach's natural scientific works and the philosophical ones. What attracted Einstein about Mach's philosophy was not its actual content but rather Mach's inclination for epistemological problems. Although Einstein did not at first study Mach's epistemology deeply, he found inspiring the very fact that the Austrian physicist was concerned with these aspects, to which he himself paid considerable attention in his works. That is why he began his obituary for Mach (1916) with questions that he was often asked about Mach's preoccupation with epistemology: "How come, in general, that such a gifted natural scientist should be concerned with epistemology? Isn't

there enough worthwhile work to be done in his own field?" [5, S. 101]. His answer is: "I cannot share such convictions ... If I have turned to science not for some external reasons, such as making money or ambition, not (or at least not only) for the pleasure it affords as sport or mental gymnastics, then I as a servant of this science must be acutely interested in this question: what objective can and will that science achieve to which I have devoted myself? To what extent are its general results 'true'? What is essential and what is only dependent on the accidents of development?" [5, S. 101].

The content of Mach's philosophical ideas failed to become for Einstein the basis on which his worldview was founded. Neither did it become part of the fabric of his physical ideas. Mach's idealism affected rather the "styling of expression" in Einstein's creative work on various problems of epistemology and physics. Thus in his "Autobiographical Notes" Einstein wrote of Mach's epistemology that it appeared to him "essentially untenable" [6, p. 21]. His attitude to the ideas expressing the primary content of Mach's philosophy was more concretely outlined in a conversation with Rabindranath Tagore. Tagore insisted: "This world is a human world—the scientific view of it is also that of the scientific man. Therefore, the world apart from us does not exist; it is relative world, depending for its reality upon our consciousness" [7, p. 42]. Einstein's reply was quite categorical: "Even in our everyday life, we feel compelled to ascribe a reality independent of man to the objects we use.... For instance, if nobody is in this house, yet that table remains where it is" [7, p. 43].

The clarity of this rejoinder against the philosophy of subjective idealism and, by the same token, against Machism, leaves no room for comment. One may therefore assume that in his early years Einstein treated Mach's philosophy in a superficial manner, and its essence eluded him. The assumption is all the more justified that, as distinct from Mach, Einstein always discerned the objective world behind the sense perceptions, which for him were always images of this world.

At the same time Einstein was far from superficial in his attitude to Mach's historical-critical natural-scientific papers where Mach, as Lenin put it, reasoned in a straight-

forward manner, without idealist extravaganza. Mach the natural scientist, as is well known, put in a great deal of work studying the history of the development of classical physics. He was one of the first amongst physicists to overthrow the absolutes of classical mechanics, pointing to its relative character as a whole and to the relativity of some of its concepts and principles which had been believed to be final, and stressing the universal connectedness of natural phenomena. However, Mach's idea of the relative nature of scientific knowledge led him to negate its objective character, while Einstein's study of Mach's *History of Mechanics* only gave him a chance to see nature through the eyes of a spontaneous dialectician and materialist. "...All physicists of the last century [wrote Einstein] saw in classical mechanics a firm and final foundation for all physics, yes, indeed, for all natural science.... It was Ernst Mach who, in his *History of Mechanics*, shook this dogmatic faith; this book exercised a profound influence upon me in this regard while I was a student" [6, p. 21].

Einstein's world outlook was often linked with positivism. This view was taken by such positivists as Moritz Schlick, Philipp Frank, Lincoln Barnett, Herbert W. Carr, and others. We have made it clear already that Einstein did not share the main ideas of one of the basic varieties of positivism—Mach's philosophy. To show more conclusively the untenability of the assertion that Einstein's worldview was identical with positivism, let us see what Einstein himself wrote on the question.

Positivist philosophers are hostile to "metaphysics" (philosophy) and its problems. In their view, the basic concepts of "traditional" philosophy have no scientific meaning, and philosophy should be freed from them. This positivist attitude worried Einstein. He believed that Hume had "created a danger for philosophy in that ... a fateful 'fear of metaphysics' arose which has come to be a malady of contemporary empiricistic philosophizing" [2, p. 289]. In his comments on Bertrand Russell's book *Meaning and Truth* he pointed out the paradoxes that may arise out of the positivists' attempt to banish philosophy from science: "This fear seems to me, for example, to be the cause for conceiving of the 'thing' as a 'bundle of qualities', such that the 'qualities' are to be taken from the sensory raw-

material. Now the fact that two things are said to be one and the same thing, if they coincide in all qualities, forces one to consider the geometrical relations between things as belonging to their qualities. (Otherwise one is forced to look upon the Eiffel Tower in Paris and that in New York as 'the same thing')" [2, p. 289].

Einstein understood that the positivists' intention to reduce philosophical tasks entirely to operations upon sense data and their neglect for studying the essence of the phenomena of the external world are profound errors fraught with fatal consequences.

He is even more critical of the positions of positivists in a letter to his friend Maurice Solovine: "In these days, the subjective and positivist viewpoint dominates in a most excessive manner. The need for conceiving nature as an objective reality is declared to be an obsolete prejudice, and thus a virtue is made of the necessity of quantum theory. Men are just as subject to suggestion as horses, and each epoch is dominated by a fashion, and the majority do not even see the tyrant who dominates them" [8, pp. 70, 71].

Einstein pointed out that the roots of positivism were in Berkeley's philosophy: "What I dislike in this kind of argumentation is the basic positivistic attitude, which from my point of view is untenable, and which seems to me to come to the same thing as Berkeley's principle, *esse est percipi*" [4, p. 669].

The indifference of some scientists to atomic theory Einstein imputed exclusively to positivism. "This is an interesting example [he wrote] of the fact that even scholars of audacious spirit and fine instinct can be obstructed in the interpretation of facts by philosophical prejudices. The prejudice—which has by no means died out in the meantime—consists in the faith that facts by themselves can and should yield scientific knowledge without free conceptual construction" [6, p. 49]. According to Einstein, "that which is" is the product of our conceptual, speculative construction, although knowledge is not the result of pure thought. It is extracted from the sense data which by themselves, without conceptual processing, give no idea of facts.

2. Attitude to Religion

On a few occasions, Einstein spoke of religion. Are there any grounds, however, to conclude that Einstein was religious—a conclusion that divers philosophising theologians have often endeavoured to substantiate? Let us consider Einstein's attitude to religion—what he said about it and how he understood it. In his autobiography he admits that in his young years, just as many of his contemporaries, he came "to a deep religiosity, which, however, found an abrupt ending at the age of 12. Through the reading of popular scientific books I soon reached the conviction that much in the stories of the Bible could not be true. The consequence was a positively fanatic [orgy of] free-thinking" [6, p. 5].

In his article "Religion and Science" Einstein tried to identify the causes of religious ideas, belief in the supernatural forces, etc. He believed that religion was historical in nature, emerging as it did at a certain stage in the development of society. In different peoples at different stages of their development religious ideas were engendered by different causes. In Einstein's view, "eternal man ... is a realisation of human entity" [7, p. 42].

Einstein saw no reason to resort to religious dogmata in explaining mysterious phenomena. "The man who is thoroughly convinced of the universal operation of the law of causation cannot for a moment entertain the idea of a being who interferes in the course of events—provided, of course, that he takes the hypothesis of causality really seriously. He has no use for the religion of fear and equally little for social or moral religion. A God who rewards and punishes is inconceivable to him for the simple reason that a man's actions are determined by necessity, external and internal, so that in God's eyes he cannot be responsible, any more than an inanimate object is responsible for the motions it undergoes" [1, p. 39]. Despite Einstein's negative attitude to religion and the idea of God, he turns to the so-called "cosmic religion". What is it, this religious feeling, in actual fact? Disappointment in the dominant "official" religion demanding humbleness and pointing a way to eternal paradise, pushed Einstein in the opposite direction—towards the great world existing independently

of man. "The contemplation of this world [he said] beckoned like a liberation, and I soon noticed that many a man whom I had learned to esteem and to admire had found inner freedom and security in devoted occupation with it.... The road to this paradise was not as comfortable and alluring as the road to the religious paradise; but it has proved itself as trustworthy, and I have never regretted having chosen it" [6, p. 5].

The mystery of the universe captivated Einstein. His most profound and fascinating experiences came from encounters with the unknown. "It is enough for me [he wrote] to make amazed surmises about these mysteries and to attempt humbly to form a limited impression in my mind of the perfect structure of all that exists" [9, S. 255].

Einstein believed in the power of the human mind, in its ability to solve the hidden mysteries of the universe. But he also believed that that goal could only be achieved through freeing oneself from the shackles of the "purely personal", from habits breeding the tyranny of primitive emotions. "To feel that behind that which is available to experience there is something inaccessible to our spirit, something of which the beauty and perfection reaches only indirectly and as a weak echo—*that* is religiosity. In *this* sense I am religious" [9, S. 255]. According to Einstein, "cosmic religious feeling ... can give rise to no definite notion of a God and no theology" [1, p. 38]. It merely inspires the scientist to perceive the loftiness and the marvellous order of the universe.

3. On the Independence of the World from Consciousness

We have seen that Einstein did not share the idealism as it was formulated by its classic representatives, although from time to time he turned to their works. He either ignored the basic philosophical propositions of the idealists or openly spoke of their negative impact on natural science. Of course, there are expressions in Einstein's works that were used by idealists. He did not always employ certain terms, borrowed from them, in a strict sense. As a result, the impression might be formed that Einstein