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Key Components of the Ontological Scheme of the World in "Mathematical Principles of Natural Philosophy"

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Abstract

The author presents a version of the ontological scheme of Newton's mechanistic worldview based on both the study of previous versions of its understanding and the text of the "Mathematical Principles of Natural Philosophy". Newton developed a model of new universality or a homogeneous and isotropic world in which uniform laws operate. This model is based on several ontological postulates Newton introduced, which can be isolated from several provisions of his classic work. The new mechanistic worldview is based on the imputation of the world of universal simplicity. The quantitative "unit" of a simple, homogeneous, physical-geometric universe is an ambivalent corpuscle-point. The main constants of the "mechanistic universe" are the diversity of the numbers of masses, motions, and forces connected by clear reciprocal relationships. Newton also introduced theoretical space and time as a privileged, absolute reference system. Finally, in the Newtonian version of the mechanistic worldview, there are compelled metaphysical ingredients or inexplicable and transcendental qualities. They are gravity, ether, and God. Thus, the ontological scheme of Newton's mechanistic worldview is a construction based on the sequential mental experiment of presenting the universe exclusively from the side of its "objectivity" and "sensory certification".

Keywords: Ontological Scheme of Mechanism; Universal Simplicity; Quantitative Homogeneity of the Universe; Point Corpuscle; Common Elements and Forces

Introduction

Newton has been revered as the happiest of mortals who managed to recognize the basic structure of the universe and determine the developmental strategy of human knowledge for the foreseeable future. So overwhelming was the effect on the minds of a simple, elegant scheme of the laws of mechanics, which worked everywhere, according to which all then known earthly and celestial bodies behaved. However, such effectiveness allowed for different ontological explanations that took place then and now. Even canonical and authoritative interpretations are not free from one-sidedness, and only their new reconciliation with the text "Mathematical Principles of Natural Philosophy" will make it possible to propose for discussion the results of a study devoted to the reconstruction of the ontological scheme of mechanistic worldview, correlated with the original source.

The mechanistic worldview was affirmed in the fierce competitive struggle of its various versions, namely, the Cartesians, Newtonians, atomists, and Leibniz. Perhaps only the obviousness of Newton's laws turned out to be a decisive advantage in this dispute of directions. Moreover, all four mechanistic worldviews initially belonged to the same camp, one might say "progressive-mechanistic", formed under the influence of Galileo's innovations, which introduced experimental practice with idealized objects into scientific circulation and declared the mathematical essence of the

physical world [1].

Their theoretical opponents were Aristotle and the Peripatetics, as well as the scholastic teachings emanating from them like the physics of "impetus" or vis impressa. Their style of world outlook was based on attributing special hidden qualities to things yet was unable to explain how the interaction of individual bodies occurred. Accordingly, they believed that the individual actions of bodies occur due to their characteristics but did not consider what these features were. Although all the proponents of the mechanistic view had similar views, they emphasized their less significant differences to strengthen their personal reputation and authority. A new strong position in the field of intellectual attention tends to be fragmented into factions [2]. Newtonians, Cartesians, and followers of Leibniz confirmed the homogeneity of matter in the universe, where the differences between bodies result from the difference in the properties of the particles of which they are composed. They explained all events mechanically, that is, as manifestations of these simple properties of extension, figure, and movement. Only Newtonians believed that these positions were deducible by them only from observations, while others created purely speculative explanations. We will try to show that such statements were nothing more than polemical methods in factional struggle within the camp of supporters of the mechanistic worldview.

It is known that there is an extensive secondary literature about Newton and the features of his worldview and methodology, including relatively recent works [3-15]. What is commonly called the scientific revolution of the beginning of the modern era, in fact, as shown in several studies [10,16,17] was a natural philosophical revolution. Therefore, it is important to understand its philosophical foundations. So, Anastasia Dmitrieva tried to identify the metaphysical foundations of the Newtonian revolution in science [18] and Konstantin Sharov suggested the ontological dualism of the Newtonian worldview structure [19] Anna Shutaleva investigated the ontological and epistemological attitudes of the formation of modern European science [20] and Oleg Baksansky reconstructed the premise constructs and Newton's philosophical and methodological research program [21].

I am closest to the position of Igor Dmitriev, who presented Newton's worldview in the form of a formal universal and universalizing order [21]. It is my hope that my research on "Principia" provide a relatively new understanding of the book compared to what has already been done in this area. I'm use the following paths for this, namely:

- This is an analysis of the philosophical fragments of the book.
- This is the structural design of analytical results in accordance with the model of the "ontological scheme" [22].
- This is presentation the scheme in the text of the article through the sequence from simple and abstract to concrete and complex.

Thus, here we restrict ourselves to an attempt to reconstruct the ontological scheme of the mechanistic worldview of the Newtonian version from the philosophical fragments of the "Principia".

Theoretical Framework

First, let us say a few words about the key concepts of our work, namely, "ontological scheme" and "mechanistic worldview". People tend to develop short, capacious descriptions of the world while improving their ability to abstract and analyse. This is especially true for specific areas of spiritual activity such as science and philosophy. Here, we can observe the processes of crystallization of abstractions that represent in consciousness the fundamental foundations of our presence in the world, then their configuration into universal scientific and philosophical formulas. Ontological schemes are taxonomies of philosophical ontologies and scientific pictures of the world. They are conceptual frameworks or supporting bases, organizing in a characteristic way consciousness in its understanding of the environment. Their purpose is to briefly and concisely present the principles that are considered key to understanding the sector of reality or the world.

Even during Newton's lifetime, his contemporaries and followers created one of the myths of classical science about exceptional inductivism and analytics as the main distinguishing features of Newtonianism. Later, this myth was debunked by another great physicist, namely, Albert Einstein [23] who argued that physics is such a logical system of thinking, the foundations of which are obtained not by deriving them from experiments but only because of the work of a powerful, disciplined imagination. Moreover, the foundations or ontological principles of physics are increasingly moving away from the data of experience. Moreover, this can be said not only about his own theory, which truly assumed the most complex speculative flight of constructivist fantasy but also about simpler and empirically obvious Newtonian mechanics. Einstein explicitly states that early physics-originally constructed phenomenologically-was reduced with the help of Newtonian mechanics to a system of principles far removed from direct experience but of a more universal character.

Thus, a mechanistic worldview or a new universality is also set axiomatically, and Newton, according to Einstein, is a successful theorist who constructed an abstract scheme

that turned out to be workable in different branches of physics. Therefore, let us follow the thought of Newton in his reasoning about nature. We reinforce the propositions proposed for consideration by referring to the statements and conclusions of the author of "Mathematical Principles of Natural Philosophy".

Discussion

If someone offers a new understanding, then they should initially be justified by its very possibility. In Newton's time, in contrast to the Aristotelian understanding of the cosmos as hierarchical, multilayered, and specific, researchers became convinced of a different interpretation of the world as homogeneous and isotropic, in which the laws of nature manifest themselves in the same way at any point and in any direction of space. It is clear to us today that this is an ontological assumption, but Newton presents it as an axiom, supported by an appeal to the evidence of reality itself.

Therefore, the initial position of the mechanistic view that we meet in Newton's treatise can be represented in such a statement, namely, "the scheme of the world is simple, because nature itself is simple". Indeed, Newton states that for nature is simple and does not indulge in the luxury of superfluous causes. Such simplicity is due to the presence of universal properties of bodies. "Those qualities of bodies that cannot be intended and remitted [i.e., qualities that cannot be increased and diminished] and that belong to all bodies on which experiments can be made should be taken as qualities of all bodies universally" [24]. Such a position about the simplicity of nature and its universal properties is speculative; this is idealization because the experience of everyday life testifies to the complexity of the environment and the gradation of the diversity of its specific properties. However, to construct a scheme of the worldview that embraces and uniformly describes the world, it was precisely the initial fundamental simplification that was necessary for the subsequent introduction of the remaining basic ingredients.

The next step is also logical. If the previous paradigmatic version of the worldview was based on qualitative complexity, then simplicity requires a universal unity based on quantity. Therefore, we can formulate the second axiom of Newtonism as the thesis that simplicity is determined by the universal quantitative homogeneity of the universe, consisting of simple elements and forces that can be calculated and used. Newton introduces simple quantities as fundamental units of the physical universe, and this axiom also contradicts the data of our senses, as well as the introduction of simplicity itself.

Newton states that the key quantitative relationships constitute the logical-ontological framework of the universe in which "quantity of matter is a measure of matter that arises from its density and volume [24].

However, if the universe is inherently universally quantitative, then it is necessary to point to its simplest basic element. Here, we can assume that Newtons could have a serious problem. On the one hand, as Einstein believed, such an element for mechanics should be the concept of a "material point" [23]. Newton says the same. The constituent parts of his world are formed by "not indivisibles but evanescent divisible" [24] or by moving points. Accordingly, the forms of material bodies for him consist of points, where lines are formed by the continuous movement of points, surfaces are formed by the movement of lines, and volumes arise from the movement of surfaces.

Strictly speaking, mechanics as a universal physical-geometric explanation should, according to Einstein, be built precisely in the dynamics of moving points. However, experience gives us a different picture. Real perceived objects are not collections of qualitatively unchanging points that move according to unchanging laws. Einstein believed that the existence of qualitatively diverse bodies could be considered in the mechanistic theory of the world only by returning to the previous atomistic explanation of the diversity of matter [23].

Indeed, there was an influential tradition of ancient atomism with interpretations that were conceptually close to the mechanistic worldview. However, from the point of view of Newton and his followers, atomism was too speculative. Atomists proclaimed atoms indivisible and solid, which was too reminiscent of the "essential properties" of Aristotle, Peripatetics, and scholastics. As a result, the theoretical mathematical-physical ambivalence of Newtonianism arose in relation to the understanding of the basic elements of the world. Everything that exists is an endless hierarchy of discrete "relatively indivisible" particles of matter. At the same time, as Einstein believed, even "in his corpuscular theory of light, Newton tried to reduce light to the motion of material points" [23].

Therefore, we can say that the third assumption of the mechanistic worldview can be considered the provision of a quantitative "unit" of a simple, homogeneous, physico-geometric universe as an ambivalent corpuscle point. The "elements" by themselves cannot define the main modes of existence. Only a certain number of elements form bodies with forces that manifest themselves in a variety of movements. The rest of the elements of Newton's ontological scheme, which are already the laws of the connection of elements and forces, are also quantitatively established by him. He does not speak about matter but only its quantity

or mass because, unlike the modern interpretation, Newton's mass was not a property of the body but the body itself, taken from the side of the amount of matter. He understood movement only as the amount of movement or "the measure of such, established in proportion to the speed and mass." He interpreted inertia as the ability to resist, which is "always proportional to the mass." Newton considered the main world configurations established by him in "Definitions" exclusively through the prism of measures, quantities, and clear spatial orientations [24].

These considerations will allow us to formulate the fourth position of the mechanistic worldview, namely, the main foundations of the "mechanistic universe" are the variety of quantities of masses, movements, and forces quantized by clear mutual relations. It is clear, however, that all this quantitative diversity of masses, movements, and forces must also be combined in one format. As such a format of the universe of quantity, Newton introduced idealizations of the same space and time, in contrast to the sensually perceived qualitative diversity. They were the result of maximum abstraction, and Newton found unambiguous relationships between forces and accelerations. This is absolute and everywhere the same space and time, in the unchanging coordinates of which the world movement unfolds.
Absolute true or mathematical time is a uniform duration, which has some potential equal value assumed by scientists, in contrast to the chaos of possible everyday divisions of time in different cultures and eras. Absolute space is motionless, simple, and homogeneous. It consists of "places" or parts of space, which are not "positions in space", since a "piece" is quantifiable as opposed to an unclear and potentially qualitative "provision". Absolute movement is movement from "place" to "place", i.e., concretely, and quantitatively.

"Just as the order of the parts of time is unchangeable, so, too, is the order of the parts of space. Let the parts of space move from their places, and they will move (so to speak) from themselves. For times and spaces are, as it were, the places of themselves and of all things" [24]. Space and time are introduced by Newton by means of quantitatively assigned values of "place" and "order" or a configuration, algebraic in relation to time, geometric in relation to space. Place and order "move" together with their contents, thus being not separate entities from things but associated with them. Therefore, they "move" from themselves and into themselves and contain both themselves and beings, and this already looks like a relativistic interpretation.

We believe that absolute space and time were introduced by Newton, at least in the work under consideration, to model a quantitatively homogeneous world and not as "metaphysical containers". In this regard, we join the opinion of Thomas Kuhn that the constructions of "absolute space and time" are given an exaggerated meaning. It is rather just an idealization. Therefore, the fifth component of the ontological scheme of a mechanistic worldview can be considered the introduction of model space and time as a privileged absolute frame of reference in a homogeneous quantitative universe. All the previous provisions Newton designed as a scheme of the mathematical-mechanistic universe, but it still had to be combined with sensually perceived reality, and here one could not do without qualities. The speculatively built model worked well in the context of established physical idealizations such as "corpuscle", "force", "mass", and "velocity", and geometric idealizations such as "point", "surface", and "volume". However, there is also empirical evidence that had to somehow be legalized in the Newtonian model of the "mathematical-mechanistic universe".

As Albert Einstein justly noted, the experimental-physical world, with its infinite diversity, directly contradicts the idealized simplicity of the mathematical description. How can one explain this, accept it, and include it in the scheme of a mechanistic vision of the world? Most likely, Newton believed that one should simply consider the obviousness of the existence of a variety of experimental qualities instead of looking for their causes other than their quantifiable sides, established in the mechanistic schematic of the universe. In his third book, The System of the World, Newton introduced the nonquantitative qualities or foundations of physics. "Those qualities of bodies that cannot be intended and remitted [i.e., qualities that cannot be increased and diminished] and that belong to all bodies on which experiments can be made should be taken as qualities of all bodies universally" [24]. These are the qualities of stretch, hardness, impermeability, mobility, and inertia. Newton here is not trying to somehow speak about them, i.e., introduce any definitions, establish laws. He simply states their presence and limits himself to indicating the criteria based on which they are accepted. They are common because they are comprehended only by experience and cannot be eliminated; they are recognized only by our feelings and the evidence of feelings.

Therefore, Newton left the solid ground of his clear and unambiguously defined coordinate system of the geometrically mechanistic universe, entering the domain of the qualitatively multiple empirical worlds, and therefore he became extremely cautious and often hesitated between accepting certain popular explanations that existed at that time. Therefore, he does not give an unambiguous solution to the dilemma of "emptiness or material environment, action at a distance or transmission through contact" in "Mathematical Principles", and his judgements are often marked by duality. He seems to hesitate between these positions, for him it is rather only "didactic hypotheses", turned by his followers into "Newtonian principles." As the sixth empirical-physical

ingredient of the Newtonian ontological scheme, one should call the statement of the existence of "general properties" or qualities of material bodies, which are obtained and verified only empirically.

However, among these qualities, there are incredibly special qualities due to their omnipresence and extraordinary influence, about which Newton considered it necessary to speak out separately. He speaks especially about gravity, ether, and God. The gravitational force of bodies is the last reason for the entire world motion, which, however, has no explanation within the framework of mechanics. "Thus far, I have explained the phenomena of the heavens and of our sea by the force of gravity, but I have not yet assigned a cause to gravity. Indeed, this force arises from some cause that penetrates as far as the centres of the sun and planets without any diminution of its power to act and that acts not in proportion to the quantity of the surfaces of the particles on which it acts (as mechanical causes are wont to do) but in proportion to the quantity of solid matter and whose action is extended everywhere to immense distances, always decreasing as the squares of the distances.... In addition, it is enough that gravity truly exists and acts according to the laws that we have set forth and is sufficient to explain all the motions of the heavenly bodies and of our sea" [24].

Thus, he refuses to talk about gravitation more fully and somehow define it. Here, there is a real problem, namely, gravity is clearly observable, but its cause is unknown. In fact, this is one of the "hidden reasons" against which the adherents of the new "experimental philosophy" fought so hard. Therefore, Newton is forced to be cautious and does not attribute gravitation to the qualities of things, such as extension, saying that it is enough that it exists and obeys open phenomenological laws. However, he cannot pass over in silence another world entity popular at that time and makes a kind of curtsy towards "a certain very subtle spirit pervading gross bodies and lying hidden in them", the strength of which determines mutual attraction. However, it is immediately corrected by the remark that "there is not a sufficient number of experiments to determine and demonstrate accurately the laws governing the actions of this spirit" [24]. Later, his followers will violently exclude the assumption of the ether and approve the idea of universal emptiness.

Finally, a few words about God and his place are included in the Newtonian ontological scheme. As you know, Newton was a sincere and deeply religious person, as evidenced by his subsequent studies of the Bible for many years. At the same time, it is possible that its transformation in the form of a turn to earnest faith occurred later, as it happened repeatedly with other naturalists. At least in "Mathematical Principles" he rather laconically and dryly states theological "commonplaces", for example, God "is not eternity and infinity, but eternal and infinite; he is not duration and space, but he endures and is present. He endures always and is present everywhere, and by existing always and everywhere he constitutes duration and space" [24]. This is remarkably like deism. Therefore, although God "establishes", but does not act, constantly and actual, as a participant in the world movement, and we can take it not into account in our specific research. Therefore, we will formulate the seventh provision of the ontological scheme of a mechanistic worldview in "Mathematical Principles" as follows: initially, the world is formed by inexplicable and transcendental qualities.

Conclusion

It is time for us to draw final conclusions on the above. We think that the ontological scheme of the mechanistic worldview, which we have identified in the "Gospel of Science", looks like a construction based on a consistent thought experiment of representing the universe solely from the side of its "objectivity" and "experiential verification". Newton focused more on the quantitative side of the universe, on its mathematically constructed image, which realized "objectivity" as the elimination of everything qualitative as "subjective", according to the principle "everything that cannot be measured and calculated does not exist for a scientist." Therefore, he created the most impressive and workable part of his ontological scheme, namely, as a speculative scheme of a quantitatively homogeneous geometrically physical universe built based on the necessary mutual relations of elements, movements, and forces in the format of model space and time.

The second, experiential certification, determined the statements of qualities, the task of which is to bring mathematical models and the surrounding reality into agreement. Newton agreed that the qualities exist, but it is, as it were, the "mask" of the hidden. The qualities are revealed by mathematical penetration, the true reasons for what is happening, namely, the mechanics of existence. The third part of the ontological scheme is situational-cultural or mental. All metaphysics was placed by Newton in a kind of "aviary" of transcendental entities, namely, unconditionally assured entities such as God and unconditionally unidentified entities such as gravity and ether, about which something had to be said.

Why, however, did the Newtonian version of the mechanistic worldview prevail? First, we believe that it was because of the effectiveness of using the laws of mechanics in explaining the widest range of phenomena. Second was the advantages of simplicity, logic, and consistency of the scheme: Newton substantiated a new universal image of the world on quantitative grounds, in which qualities, as a

synonym for metaphysics and subjectivism, were reduced to the level of rather ideological hypotheses. Third, the adherents of Newtonianism turned out to be more persistent and decisive in the struggle of directions, and they found significant support from the growing strengths of the rising strata of the emerging new industrial society, which had a particularly strong position in Foggy Albion.

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