Einstein versus Newton: Principle theory and Einstein's cosmos

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Abstract A theory of the universe has yet to be uncovered because nature is not merely mechanical. We thus promote Einstein's cosmos and principle theory, which we believe will lead the scientific community to the elusive pinnacle of science: a final theory of the universe. We first discuss the two scientific methods of Einstein's principle theory and Newton's mechanical universe and how they overcome the antithesis between empiricism and rationalism. We then apply these two methods to solve the problem of the universe as a (unified) whole. We demonstrate why Einstein's principle theory subsumes the mechanical universe and, subsequently, how Einstein's method can address this problem while Newton's method cannot. The goals of this paper are not only to promote Einstein's science, but also to begin to resolve the mysteries of the universe as a whole. We sincerely invite the scientific community to pursue principle theory and Einstein's cosmos collectively.

Keywords Cosmic inertia, Einstein's cosmos, Newton, Oscillating universe, Principle theory, Theory of the universe

1 Introduction

Science has proved itself trustworthy due to its methods and self-correction. Regarding a theory of the universe, there are only two salient methods in the scientific heritage: the mechanical universe and Einstein's cosmos and principle theory.[1-12] The mechanical universe includes quantum mechanics, general relativity, and other related concepts.[10] This approach considers the universe through the four fundamental forces: gravity, the electromagnetic force, the strong nuclear force, and the weak nuclear force. The forces concept and the mechanical universe can be traced back to Newton's theory of gravitation. From this perspective, which is the view that the entire scientific community currently holds, a theory of the universe would be a unified theory of the mechanical universe.[13-15] This approach is currently lingering on such problems as the creation of the original universe, the multiverse, the universe as a whole, and itself.[10,12]

Einstein was as great as Newton. For a theory of the universe, Einstein defined a scientific task called *Einstein's cosmos* and offered a methodical approach called *principle theory.*[1,2] With this approach, a theory of the universe, that is, Einstein's cosmos, is a single logical system of the universe as a whole.[9-12] To promote principle theory and Einstein's cosmos and elucidate his method, we have published several pioneering papers.[3-12] While we consider our calling to share this scientific inheritance to be resounding, we have received empty responses. Several reasons are provided below to explain this current situation.

First, Einstein published principle theory and Einstein's cosmos in popular literature,[1,2] which the scientific community may disregard but Einstein's admirers (and librarians) would and could cherish. However, popular literature[13-16] has revealed the lingering status of the mechanical universe after an avalanche of new discoveries since Newton. For example, Horgan[16] made the case that the era of truly profound scientific revelations about the universe is over, and that if science is ending, it is only because it has done its work so well. This status is not often acknowledged by the scientific community.

Second, the scientific community may only refer to general relativity, which allowed Einstein to consider gravity creatively through warped space and time, as Einstein's cosmos, remaining ignorant of principle theory and Einstein's cosmos in the broadest sense. General relativity defined the macrocosmos in the present universe, but this is by no means the universe as a whole.[10]

Third, the scientific community ensconced in the mechanical universe approach is only capable of solving the (supposed) problems of the mechanical universe but never encounters a problem that is not utterly mechanical, such as the mesocosmos.[3-12] Thus, this community cannot rise to the challenge of *the non-mechanical universe as a whole.*[12]

Now we need another avalanche of new discoveries relating to Einstein's cosmos with principle theory. We thus request the reader to examine critically the single logical system of the universe as a whole[3-12] progressively developed by us thus far through principle theory and which we continue to develop in this paper.

2 The antithesis between empiricism and rationalism

To contrast the mechanical universe in general, or Newton's mechanical universe in particular, with Einstein's principle theory with respect to a theory of the universe *fairly*, we first consider how well they address the antithesis between empiricism and rationalism,[5,10,12] an idea originating from Einstein's principle theory.[1,2] In other words, a scientific method for a theory of the universe must consider three possible constraints, which we discuss below:[10,12] (1) whether the method clearly depicts what the empirical universe was, is, or will be; (2) whether it clearly defines the logical structure of the empirical universe as a set of laws of nature; and (3) whether it has experiential or experimental support.

2.1 Einstein's principle theory

Einstein continues to be a scientific treasure, who is put on a pedestal over other scientists, perhaps with the exception of Newton. Einstein's genius lies in overcoming the antithesis between empiricism and rationalism by articulating a symmetry between the world of sense and the world of science on the scale of the universe.[3-12] Thus, nature dictates logical necessity.[5] All principle theories are also symmetry-principle theories, in which all the laws of nature can be viewed both empirically and logically.[10] We describe general principle theory below.

The world of sense determines the world of science on the scale of the universe. Einstein considered the following: "Pure logical thinking cannot yield us any knowledge of the empirical world; all knowledge of reality starts from experience and ends in it. Propositions arrived at by purely logical means are completely empty as regards reality…Experience is the alpha and the omega of all our knowledge of reality."[2:271;5]

What is the function of pure reason in science? Einstein answered, "We have thus assigned to pure reason and experience their places in a theoretical system of physics. The structure of the system is the work of reason; the empirical contents and their mutual relations must find their representation in the conclusions of the theory. In the possibility of such a representation lie the sole value and justification of the whole system, and especially of the concepts and fundamental principles which underlie it."[2:272;5] In short, the logical structure of nature (the universe) must represent the world of sense.

"If, then, it is true that the axiomatic basis of theoretical physics cannot be extracted from experience but must be freely invented, can we ever hope to find the right way?"[2:274;5] Einstein answered this question without hesitation: "there is, in my opinion, a right way, and that we are capable of finding it. Our experience hitherto justifies us in believing that nature is the realization of the simplest conceivable mathematical ideas. I am convinced that we can discover by means of purely mathematical constructions the concepts and the laws connecting them with each other, which furnish the key to the understanding of natural phenomena. Experience may suggest the appropriate mathematical concepts, but they most certainly cannot be deduced from it. Experience remains, of course, the sole criterion of the physical utility of a mathematical construction. But the creative principle resides in mathematics."[2:274;5]

Einstein continued, "In this methodological uncertainty, one might suppose that there were any number of possible systems of theoretical physics all equally well justified; and this opinion is no doubt correct, theoretically. But the development of physics has shown that at any given moment, out of all conceivable constructions, a single one has always proved itself decidedly superior to all the rest. Nobody who has really gone deeply into the matter will deny that in practice the world of phenomena uniquely determines the theoretical system, in spite of the fact that there is no logical bridge between phenomena and their theoretical principles; this is what Leibnitz described so happily as a 'pre-established harmony.'"[2:226;5]

In that case, what is the relation between principle theory and experiential or experimental validation? Einstein answered: "In guiding us in the creation of such an order of sense experiences, success [of the creation itself] alone is the determining factor [of a principle theory]"[2:292;5] and "It is always a blessing when a great and beautiful conception is proven to be in harmony with reality."[1:388;5] This indicates that laws of nature or a principle theory must be developed by identifying general facts from a sensed order of nature[5] in contrast to individual empirical facts that are used for validation and must be carefully considered within the logical system. A well-known example is that Newton's theory of gravitation was based on universal general facts about gravity whereas Tyco's data were concerned with the apparent motion of Mars and other planets through the constellations.[17,18] An accelerated expansion of the universe as a whole[13-15] could signify an erroneous empirical universe, which could have several meanings or explanations but is not a logical necessity. Thus, it cannot be used to build or validate a principle theory. "The Lord God is subtle, but malicious he is not,"[1:374] said Einstein. It must be taken as a fact, discovered by reflecting upon our knowledge, that we have the power to build a principle theory based on general facts from an order in the universe. General relativity is a case of interest. Another case is the success/failure system, which was developed to reflect the mesocosmos with a sensed order of an erring universe and a general fact concerning the part-whole structure.[3-12]

Finally, we provide some more examples of Einstein's methodical thinking to complete the general principle theory. Einstein said, "We do science when we reconstruct in the language of logic what we have seen and experienced"[1:415;5] with "the requirement of logical simplicity;"[1:344;5] "With the progress of science, the realm of physics has so expanded that it seems to be limited only by the limitations of the method itself;"[2:324] and "What I see in Nature is a magnificent structure that we can comprehend only very imperfectly, and that must fill a thinking person with a feeling of humility."[1:446]

2.2 Newton's mechanical universe

To see how Newton's mechanical universe overcomes the antithesis between empiricism and rationalism, we begin with a brief description of *the first scientific enlightenment*.

Humans inhabiting Earth, unlike religious angels described as wandering throughout the universe, originally imagined that the planets circled the Earth rather than that all of the planets, including Earth, orbited the Sun. In 1543, Copernicus,[17,18] inspired by Aristarchus, proposed that the Sun rather than Earth was at the centre of the planetary system.

The question then was exactly how the planets went around the Sun. Tyco[17,18] painstakingly observed and precisely recorded the apparent motion of Mars and other planets through the constellations for nearly over four decades at the end of the sixteenth century. Subsequently, Kepler[17,18] worked with a passionate intensity to understand these data. Eventually, he uncovered the three laws of planetary motion by describing that the orbit forms an ellipse (Kepler's first law), equal areas are swept in equal times (Kepler's second law), and the time to go around varies according to the square root of the cube of the size (Kepler's third law).

The next question was what made the planets orbit the Sun. Inspired by Galileo's and Descartes' principle of inertia,[17,18] that is, if an object on Earth has nothing acting on it and is going along a constant velocity in a straight line, it will go exactly the same way forever, Newton[17,18] answered that a force is needed to change the velocity of a planet to make it go around the Sun. Newton called this force "gravity" and believed that it acted at a distance. Eventually, he developed his theory of gravitation, which includes gravity and the three laws of motion, in *Principia Mathematics* in 1687.

All three of Kepler's laws of planetary motion can be derived from Newton's theory of gravitation.[17,18] Newton showed that the same force that pulls an apple down to Earth keeps Mars in its orbit around the sun. The same law of gravitation applies everywhere in the universe. Gravity was the first force that made humanity see or feel a mechanical universe. The law of universal gravitation states that the gravitational force between two masses is proportional to the magnitudes of these masses and the inverse square of their separation.

The above scientific enlightenment was succinctly summarized by Einstein: "Individual facts [Tyco's data] are selected and grouped together such that their lawful connection [each of Kepler's laws] becomes clearly apparent. By grouping these laws [Kepler's three laws] together, one [Newton] can achieve other more general laws [Newton's theory of gravitation] until a more or less uniform system [Newton's mechanical universe] for the available individual facts has been achieved."[1:367]

We can see that Newton's mechanical universe overcomes the antithesis between empiricism and rationalism in the opposite way to Einstein's principle theory. This is why Einstein called Newton's mechanical universe an induction, but one beyond empirical induction and with cosmic-level scope.[2,5] In 1915, Einstein applied principle theory to reinvent Newton's mechanical universe as general relativity, a new theory of gravitation.

The force concept is both empirical and logical with cosmic-level scope. We can experience it according to the senses of pull and push on Earth. The force concept has since been extended to include the electromagnetic force, strong nuclear force, and weak nuclear force. Thus, a unified theory of the mechanical universe,[13-15] which includes quantum mechanics and general relativity, constitutes a theory of the universe being pursued by the scientific community. However, principle theory does not restrict itself to the confines of the mechanical universe and indeed *subsumes* the mechanical universe in general and Newton's mechanical universe in particular. *Remarkably, a unified theory of the mechanical universe must be comprehensible as a principle theory.*[2,5]

3 The universe as a whole

We have just described two scientific methods: Einstein's principle theory and Newton's mechanical universe. A method is best learned by example in an application. Einstein wanted to experience the universe as a whole[1,2] and so we will use it as our example. It is remarkable that cosmic inertia can be perceived through Einstein's principle theory but not through Newton's mechanical universe.

3.1 Einstein's cosmos

How can principle theory be applied to experience and understand the universe as a whole?[12] To overcome the antithesis between empiricism and rationalism, principle theory begins with a sensed order on the scale of the universe. About fourteen billion years ago, the Big Bang, where the universe was exploding, occurred, and the universe is still expanding today, according to Hubble's indirect observations in 1929. Empirically and logically, what exactly was exploding and is now still expanding? The foremost law of nature in mathematics, $E = mc^2$, giving an answer of mass and energy, clearly reveals the logical structure of the universe as a whole. Specifically, the totality of the mass-energy of the universe in time series is a cosmic constant denoted as α, signifying its highest importance among the cosmic constants. As the empirical universe evolves, this totality of mass-energy distributes, redistributes, and transforms while maintaining its overall volume.

The next question is whether our empirical universe is expanding indefinitely or is an oscillating universe (i.e., an endlessly expanding and contracting universe).[12] Einstein said, "The world of phenomena uniquely determines the theoretical system."[2:226;5] Thus, intuitively, we start by saying that[12] if the universe is expanding indefinitely, the totality of mass-energy must be mathematically infinite. Since the totality of mass-energy must be finite, our universe must be an endlessly expanding and contracting universe. Thus, the universe exploded after a Big Bang (when the universe had its smallest volume) and has since been radially expanding its space progressively slowly across time until it will eventually stop, reverse itself, and radially contract its space progressively rapidly across time until it stops again. Then, there will be another Big Bang and the universe will cycle forever. Since principle theory successfully builds the logical structure of the universe as a whole, which completely represents, orders, and surveys the world of sense, this ends the proof.

Einstein said, "What a deep conviction of the rationality of the universe and what a yearning to understand."[2:39] We consider the question: Why did the Big Bang happen? We intuitively suppose that, as gravity itself cannot account for the Big Bang or an oscillating universe and as there is only one universe, it was due to *the principle of cosmic inertia*. Then, we verify whether a single consistent logical system can still be guaranteed by principle theory when the principle of cosmic inertia is assumed. Since we consider the universe as a whole, that is, the system in its largest context, the universe has nothing acting on itself. Thus, *by definition,* the universe is governed by the principle of cosmic inertia. How the universe works due to the principle of cosmic inertia has been described previously: an endless cycle of decelerated expansion followed by accelerated contraction. Science methodically discovers that the universe causes itself and is governed by gravity superimposed on cosmic inertia, which remains a single consistent logical system by principle theory. It is noted that a single logical system of the universe as a whole or Einstein's cosmos developed thus far by us has included quantum mechanics, general relativity, and the success/failure system as the triadic axioms[3-12] and now further includes two theorems of the foremost law of nature and the principle of cosmic inertia in a scientific axiomatic system. All axioms and theorems are symmetry-principle theories.[10]

Now, we want to repudiate the concept of the multiverse[13-15] in the mechanical universe. Like the emperor's new clothes, there is no evidence of the existence of the empirical multiverse. Thus, the scientific community's efforts can be saved by excluding the multiverse from a theory of the universe. Einstein used a metaphor while wondering if it was possible to build more than one universe that is logically consistent by saying, "What really interests me is whether God could have created the world any differently; in other words, whether the requirement of logical simplicity admits a margin of freedom."[1:344] When the scientific community consciously created the pure logical concept of the multiverse, they were unconsciously destroying the empirical (and logical) pillar of gravity, which interconnects all of the parts as the totality of existence. The scientific community has taken turns creating, guarding, and destroying Newton's science. As there is only one empirical universe, there can be no such thing as the empirical multiverse or detached wholes. General relativity holds the general fact that the space-time structure interconnects all mass and energy as a whole. In a sense, nature is the cleverest logician because it determines its own logical system.

3.2 Newton's mechanical universe

The mechanical universe focuses on four forces[13-15] and ignores or fails to perceive the principle of cosmic inertia, which is the basic cause of the universe as a whole, as explained above. Thus, the scientific community has measured and compared the amount of matter in the universe with the expansion rate of the universe to determine whether the gravitation of the receding galaxies can stop the expansion of the universe.[18] They have considered definitions of the universe as closed, flat, or open, depending on the comparison results. By contrast, principle theory sees the universe as an endlessly oscillating universe and as a closed system definitely. If the universe truly oscillates, some scientists in the mechanical universe will be worried about some arcane logical questions, such as the effects preceding causes and the catastrophic restructuring of natural laws.[18] They pose such arcane questions simply because they do not acknowledge or understand that nature causes itself. By contrast, principle theory has no such questions because nature determines its own logical system, the oft-referenced *rationality* or *logical necessity* manifested in nature and revealed by principle theory.

We learn two lessons from resolving the problem of the universe as a whole. First, it is said that a magnificent discovery is usually frustrated by a world fully loaded with mistakes and that before gaining its broadest acceptance, it must resolve these fallacies. For example, Newton's science first faced the world of religion, myths, and pre-science, but once established, quickly obtained acceptance of its supremacy. By contrast, Einstein's science, although a century-old idea, is struggling to transcend empirically and logically the four forces (or is it five forces including antigravity?) and their comprehensive unification with which the current scientific community is constantly preoccupied.[13-15] *The problem is that the scientific community cherishes Newton's science but disregards Einstein's science.* The second lesson is that, although written within the limited space of a paper, a new scientific discovery must be considered a scientific advancement based on the scientific heritage.

4 Conclusions

Einstein said, "Science as something already in existence, already completed, is the most objective, impersonal thing that we humans know."[1:384] During his life, Einstein was dedicated to a theory of the universe. To support the earliest possible discovery of this theory, he defined the cosmos and offered principle theory. However, Einstein's cosmos and principle theory, which may be called *the second scientific enlightenment,* remain relatively unknown.[1-12]

Einstein continued, "Science as something coming into being, as a goal, is just as subjectively, psychologically conditioned as are all other human endeavors."[1:384] This past, if not ancient, statement exactly reflects the current lingering status of a unified theory of the mechanical universe. In this paper, we demonstrated that Einstein's cosmos and principle theory subsume the mechanical universe. A theory of the universe is a single logical system of the universe as a whole inspired by both Newton and Einstein, rather than a unified theory of the mechanical universe inspired only by Newton. We hope that our call for the scientific community's attention to this insightful approach to the theory of the universe will form part of the second scientific enlightenment.

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