The Method of Resolving the Inconsistencies that Stymie Scientific fields

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Abstract

The history of physics teaches us that the resolution of inconsistencies that stymie scientific fields is the reliable path to breakthroughs. What it does not teach us is the method by which Albert Einstein resolved inconsistencies in the process of developing General Relativity and how this method can be employed to resolve other inconsistencies that stymie scientific fields. Upon acquiring the capacity to use the method to resolve the inconsistencies that stymie public health after 13 years of the necessary philosophical and empirical immersion, it was found to be one in which the scientist forges a path to knowledge of reality by means of thought that begins in experimental results (pure thought) rather than thought that is founded on assumptions that are made about reality with the goal of giving greater explanatory and predictive power to theories. It was discovered that mathematics is not a "microscope" that has the capacity to uncover knowledge of reality by illuminating experimental results but rather a language into which the universal language of pure thought must be translated or in which such thought must be conducted if the doubtlessness of each step taken towards knowledge of reality will be ascertained before arrival at concepts and the principles that interrelate them. Thus, the mathematical equivalent of the universal language of pure thought, such as the non-Euclidean geometry of General Relativity, which increases the likelihood that the scientist will forge a path to empirical knowledge is analogous to the pictorial language in maps by which ancient voyagers ascertained the doubtlessness of their steps and increased the likelihood of success long before arrival at the destinations where they confirmed such doubtlessness. But fluency in the universal language of pure thought must be achieved when the realities to be understood are those to which paths cannot be forged in any known mathematics, such as the quantum reality which Einstein sought in the bid to unify knowledge in physics and that which must be grasped for the unification of the mono-causal theory of a disease, such as the germ theory, and the multi-causal theory of the same disease that takes into account the many factors epidemiology has linked with the outcome of the event which the former attributes to a specific factor. Together, these results reveal that the focus of scientists who aim to resolve the inconsistencies that stymie their fields must be such fluency in this non-mathematical language of pure thought which will permit them not only to forge paths to knowledge of reality when its mathematical equivalents do not already exist but also to communicate effectively with the mathematicians who will develop such equivalents.

Keywords: Experimental philosophy; Empirical philosophy; Experimental method; Empirical method; Mathematics

It was clear to Sir Isaac Newton, that the philosopher must forge a path to knowledge of reality from experience [1] after Galileo demonstrated convincingly with his observations that those speculative propositions which do not have their origin in experience are completely empty with regards to knowledge of reality [2]. But Sir Newton assumed that in order to forge paths from experience to knowledge of reality, the philosopher must interpret experimental data in a manner that uncovers such knowledge and therefore that whatever is not deduced from phenomena has no place in the philosophy of truth which he believed to be the same as his experimental philosophy [1].

This belief was stated clearly in the final General Scholium of the book, 'Principia Mathematica' in which he presented the propositions of his theory of gravity [1] which was superseded by Einstein's theory of general relativity [2]. "But hitherto I have not been able to discover the cause of those properties of gravity from phænomena, and I frame no hypotheses. For whatever is not deduc'd from the phænomena, is to be called an hypothesis; and hypotheses, whether metaphysical or physical, whether of occult qualities or mechanical, have no place in experimental philosophy. In this philosophy particular propositions are inferr'd from the phænomena, and afterwards render'd general by induction. … And to us it is enough, that gravity does really exist, and act according to the laws which we have explained, and abundantly serves to account for all the motions of the celestial bodies, and of our sea." [1].

By "I frame no hypotheses," Sir Newton meant that his law of gravity and his explanation of that law are as true as the phenomena that astronomers painstakingly observed for centuries in order to obtain the data that he interpreted in order to arrive at the law [3]. In fact, his fourth rule of reasoning requires the experimental philosopher to consider such logically deduced propositions as exactly true or as very nearly true if other phenomena must be observed before such propositions can be considered to be exactly true [3]. And for close to two hundred years, his practically successful theory of gravity [2], which proposed that all planets must move round the sun in an ellipse that maintains its position perpetually if we disregard the motion of the fixed stars and the action of the other planets [1], was seen as true by most philosophers [2]. But the redirection of the discussion about what the Newtonian rules of logical reasoning guarantee from truth to validity [3] by those philosophers who are concerned with the foundations, methods, and implications of science (philosophers of science) is what was demanded by those famous events that culminated in the appearance of the headline, 'Revolution in Science. New Theory of Universe. Newtonian Ideas Overthrown' in The Times of London [4].

It was discovered in the time of Le Verrier [4, 5] that, contrary to Sir Newton's assumption that gravity acts according to the law he logically deduced from the data of experience [1], Mercury does not follow the path predicted by this law of gravity (Mercury's anomalous perihelion precession) [4, 5]. And when neither the motion of the fixed stars nor the action of the other planets, including the fictitious one that was named "Vulcan" [5], could account for the observed behavior of the orbit of Mercury, whether or not this logically deduced theory has a place in "the philosophy of truth" became an open question [4, 5]. This question was decisively answered when propositions which were not deduced from the phenomena as required by Newtonian experimental philosophy [1, 2] turned out to be the ones that solved the problem which questioned the place of the Newtonian theory of gravity in the philosophy of truth [4, 5]. We shall henceforth refer to the philosophy that is concerned with truth as "empirical philosophy" in order to distinguish it from the experimental philosophy of Sir Newton which is concerned with forging a path to propositions in a manner that makes them agree with facts to a large extent by means of assumptions about reality [2].

Einstein's theory of General Relativity described how gravity brings about the motion of the planets and its predictions matched the behavior of the paths of all planets including Mercury thereby rendering unnecessary, those Newtonian assumptions about this behavior which were demonstrated to have no place in reality by facts that include the failure of experience to accommodate the existence of Vulcan [4, 5]. Those events demonstrated clearly that, contrary to the belief of Sir Newton, the propositions of those logically deduced theories that have a place in Newtonian experimental philosophy are not truths [2] and have no place in empirical philosophy.

Are the propositions of logically deduced theories demonstrated to be true when their predictions agree with experience only to be demonstrated to be false when their predictions disagree with experience? The answer that reality accommodates in those events which culminated in the realization that the Newtonian theory of gravity has no place in empirical philosophy is the following. Logically deduced theories are already proven to be false and therefore to have no place in empirical philosophy from the moment they are born by their inability to describe phenomena from knowledge of reality which furnishes the scientist with the key to the description of the mechanisms that underlie experimental results [2]. That inability is what Sir Newton communicated with the statement, "But hitherto I have not been able to discover the cause of those properties of gravity from phænomena, and I frame no hypotheses."

And logically deduced theories are unable to describe phenomena from the knowledge of reality because they are obtained with methods which must bring them as close as possible to what we know about reality from experience in order to give them that capacity to account for a wider range of empirical facts on which their usefulness depends. Given the fact that what we know about reality from experience, such as Sir Newton's famous action at a distance without an intermediary medium [1, 2], is only our perception of reality rather than an accurate representation of reality [2, 6, 7], the assumptions that our useful logically deduced theories make about reality in order to acquire the capacity to account for a wider range of empirical facts must necessarily be wrong [2].

In agreement with this consequence is the aphorism that "All models are wrong, but some are useful" [8] which is now widely used to suggest that the usefulness of a model is not a measure of the accuracy of its representation of reality [7]. And given that all models are wrong, what is really hoped for is that any new model will be more useful than its predecessors and that the value added will exceed the total development costs [9].

It is such wrong assumptions about reality, which prevent logically deduced theories from verifiably describing the mechanisms that underlie phenomena, that demonstrate the falsehood of their hypotheses and not the eventual fate of such hypotheses, the recognition of their disagreement with experience. The disagreement between experience and the consequences of the hypotheses of logically deduced theories, such as the failure of planets to follow the path predicted by the Newtonian theory of gravity, which could no longer be explained away in the time of Le Verrier [4, 5], is only a manifestation of this inability to verifiably describe the mechanisms that underlie phenomena which has its origin in the falsehood of the assumptions that such theories make about reality at the very beginning of their lives. It therefore follows as a consequence of this result that it is not the survival of Einstein's theory of general relativity in the face of every test that has compared it with experience since it was born out of "pure thought" over 100 years ago [10] that proves it to be a theory which emerged from experimental results and not in assumptions about reality like its logically deduced predecessor.

What then proves General Relativity to be a theory to which a path was forged from experimental results by means of pure thought if agreement with experience does not? That General Relativity continues to survive confrontation with experiment long after its logically deduced predecessor has been demonstrated false by experiment must necessarily surprise anyone [10] in the absence of the results that have the capacity to answer that question. After all, upon recognizing the falsehood of the assumptions that logically deduced theories make about reality and the fact that their predictions must eventually disagree with experience, philosophers of science such as Karl Popper reasonably argued that the central property of science is falsifiability of every proposition, which is the capability of such propositions to be proven false [11].

But what the results presented here reveal is that theories of science that are able to verifiably describe the mechanisms that underlie phenomena because they do not originate from false assumptions about reality are verified by agreement between experience and such descriptions that elude logically deduced alternatives. The ability to verifiably describe gravity, which is possessed by General Relativity alone [12], is what gave it the capacity to accurately predict the behavior of the orbits of all planets without such assumptions that the Newtonian theory must make in order to achieve the same result [5]. That description of the mechanism that underlies gravitational phenomena which eluded its Newtonian predecessor and all other logically deduced theories of gravity [12], the curvature of that fabric of space (space-time) which is so great near the sun that the light from the distant stars bends while passing through the neighborhood of this massive body on its way to us, is what Sir Arthur Eddington and his colleagues demonstrated with the famous 1919 measurements which showed us that such light is indeed deflected by the sun [4]. And the inability of experiment to falsify the theory since it was born over 100 years ago is only a consequence of the truthfulness of that description.

Given the fact that the Newtonian theory of gravity was able to predict light deflection when the corpuscular theory of light was introduced by Johann Georg von Soldner in 1801 [4, 13], some philosophers of science claimed that the 1919 light deflection measurements were not sufficiently accurate to decide between the two theories of gravity [13]. But this is because such philosophers did not understand the grounds on which Sir Arthur Eddington and his colleagues founded the claim that the 1919 measurements were not compatible with the Newtonian theory, which have been argued to be reasonable [13] and which the results presented here have elucidated. The light deflection measurements were not supposed to decide between the Newtonian and Einsteinian theory as assumed but rather to further confirm the latter's verifiable description of gravity which is beyond the reach of the former and all other logically deduced theories.

Theories that are obtained with the logical method of reasoning, such as the Newtonian theory of gravity, are not of a nature that requires them to be overthrown by alternatives that are obtained with the empirical method, such as General Relativity. The Newtonian theory of gravity was only overthrown because it claimed, with the famous “I frame no hypotheses” declaration, to be a theory which was developed with a method that guarantees truth because it does not invent propositions and therefore to be the occupant of the only position in empirical philosophy that belongs to a theory of gravity when the position was found to belong to a theory which was developed with a method that invents propositions without making assumptions about reality [2].

While General Relativity, which has its origin in direct experimental results instead of assumptions [2], is the only one that can be accommodated in empirical philosophy where truth is the essence, all theories of gravity that are useful because they agree with experience to a large extent have a place in the experimental philosophy of Sir Newton. Einstein, who became able to develop an empirical theory of gravity upon sufficient immersion in the necessary philosophy [14], explained this by comparing the character of nature, as perceived by our senses, with that of a word puzzle which we may attempt to solve by proposing different words but which can only be solved in all its parts by one word [15]. We may develop useful theories like the Newtonian theory of gravity by interpreting data but we can only solve the puzzle of nature when we develop empirical theories like General Relativity by forging a path to knowledge of reality which gives us the key to that understanding of the phenomena of nature which enables us to describe the mechanisms that underlie them [2].

What then is the source of the pure thought by which the philosopher-scientist [15, 16] who employs the empirical method (who we may henceforth refer to as the empirical philosopher-scientist) invents theories such as General Relativity which, by describing phenomena from knowledge of reality, are able to take account of a wider range of empirical facts without making assumptions about reality like theories that are invented with the experimental method [2]? Such pure thought is the kind that is conducted in a mind that sees what is known about phenomena from experience as a guide and not a source from which knowledge of the reality can be derived by means of pure logical thinking as assumed by experimental philosopher-scientists such as Sir Newton [2]. It is with such a mind that the empirical philosopher-scientist achieves the philosophical immersion that changes the language of pure thought into one in which the creative principle resides [2]. And the empirical philosopher-scientist becomes able to forge a path to knowledge of reality only when this principle that begins the process of theoretical construction from direct experimental results and not in assumptions about reality resides in the language of pure thought [2]. This is how Einstein forged a path to the knowledge of reality that astronomy needed at such a time when it was, as other sciences are today, “drowning in a sea of data and starving for knowledge” [17].

Anyone who considers the fact that Sir Isaac Newton invented the mathematics of calculus in order to logically deduce his theory of gravity which agrees with experience to a large extent may assume that mathematics is some sort of “microscope” that elucidates the phenomena of nature by interpreting data [18]. After all, Charles Darwin, who was so influenced by Sir Newton that he compared his logically deduced theory of evolution with the Newtonian theory of gravity in the final sentence of ‘On the Origin of Species’ [19], wrote that an “extra sense” appears to be possessed by people who understand the great leading principles of mathematics [18]. And anyone who considers the fact that the theories in certain fields such as the biological sciences are still far from being able to do justice to experience like theories of physics such as the Newtonian theory of gravity may assume some 'new mathematics' that does not yet exist is required to interpret data in such fields just as Sir Newton invented calculus in order to logically deduce that theory of gravity [20].

But Einstein did not forge a path to the knowledge of reality that gave him the capacity to describe gravity which eluded Sir Newton by interpreting data with 'new mathematics' but rather by achieving the necessary philosophical mastery which is the source of the creative principle by which the empirical philosopher-scientist forges such a path through pure thought. And he employed mathematics because the doubtlessness of each step through which a path is forged to knowledge of reality can be ascertained when pure thought is conducted in a mathematical language which, in the manner of the ancient geometry of Euclid, proceeds from step to step with such precision that not a single one of its propositions can be doubted [2] or when the universal non-mathematical language of pure thought is translated into such a mathematical equivalent.

The truthfulness of the knowledge to which Einstein forged a path lies in the doubtlessness of the steps of pure thought and perfect correspondence between the data of experience and their mutual relations and the concepts and the principles that interrelate them to which such steps led him is only a manifestation of such doubtlessness. But such doubtlessness must never be assumed to be ascertained by the mathematical steps through which paths are forged to knowledge from the interpretation of data or the experiences with which such logically deduced knowledge is made to agree because such steps do not originate from pure thought that begins in experience but rather from logical thought that begins in wrong assumptions about reality.

It is because the reality to the knowledge of which Einstein forged a path is one in which the things to be described have properties which can be represented by shapes and numbers that he conducted pure thought in the mathematical "language" of geometry in which such properties can be described and not because geometry is the source of the creative principle which, upon sufficient immersion in philosophy, began to reside in the language in which he thought his way to such knowledge [2]. And he employed non-Euclidean geometry because it was only in this mathematical language that is concerned with curved, rather than flat, surfaces, that he could communicate the curvature of that fabric of space (space-time), the description of gravity to which he forged a path by conducting pure thought in the mathematical language of geometry [21].

It follows therefore that mathematical language is empty with regards to knowledge of reality unless it is spoken while forging a path to knowledge of reality with pure thought [2] or as a language into which the universal non-mathematical language of pure thought has been translated after a path has been forged to such knowledge. Without the creative principle that emerges from the pure thought of the empirical philosopher-scientist, theories that are developed in the language of mathematics are completely empty as regards reality [2], however simple or "mathematically beautiful" such mathematical language may be to scientists who, without the necessary philosophical immersion, see mathematics as a "microscope" that has the capacity to uncover knowledge of the observed phenomena and the mechanisms that underlie them by illuminating experimental results. And indeed, the result which was obtained upon examining the mathematical structure of General Relativity is a soberer definition of mathematical "simplicity" which accords with the results presented here, that this "simplicity does not automatically bring truth" [12].

Without a mathematical language in which the empirical philosopher-scientist can conduct pure thought or into which the non-mathematical language of pure thought can be translated, the doubtlessness of the steps that lead to knowledge of reality cannot be ascertained until the data of experience and their mutual relations have corresponded perfectly with the concepts and those laws or principles that connect them. But unlike Einstein, who was fortunate that geometry, the mathematical equivalent of the universal non-mathematical language of pure thought through which a path can be forged to the empirical theory of gravity, had already been developed before he began developing this theory, empirical philosopher-scientists who do not have such mathematical equivalents at their disposal must first become fluent in this universal language and may need to forge a path to the knowledge of reality in this language before mathematicians can develop such mathematical equivalents.

Indeed, it must necessarily be much more difficult to forge a path to knowledge of reality in the universal non-mathematical language of pure thought than in its mathematical equivalents. We may compare the empirical philosopher-scientist who forges a path to knowledge of reality in the universal non-mathematical language of pure thought with those ancients who voyaged at such a time in the history of humankind when the pictorial language of maps did not exist. Such ancients, who would have been unable to establish the doubtlessness of each step on the journey back home until arrival, must have found it so difficult to forge paths to their destinations and many must have gotten lost on the way.

But some were guided back home by knowledge of the position of the stars in relation to the direction at night and knowledge of the landmarks that point towards the same direction during the day. And in the same vein, empirical philosopher-scientists who believe, in the manner of the ancients, that “pure thought is competent to comprehend the real” [2] will not only achieve the philosophical immersion that is necessary for the emergence of the creative principle but also the empirical immersion which must be achieved before experience points the steps of the pure thought they conduct in non-mathematical language towards the direction of knowledge of reality.

But forging a path to knowledge of reality in the universal non-mathematical language of pure thought before translation gives empirical philosopher-scientists the opportunity to become so fluent in this language that they become able to communicate such knowledge effectively with colleagues and philosophers of science who may not be fluent in the language of mathematics as well as with the mathematicians who will translate the non-mathematical language of pure thought into its mathematical equivalents or develop new mathematics for the purpose of such translation if they do not already exist. Indeed, General Relativity was misunderstood in its early days when only a few scientists were familiar with the mathematical language of non-Euclidean geometry and the confusion which has been attributed to defects which were not inherent in the theory but rather in its exposition [22] would not have occurred if Einstein had first conducted pure thought in the universal non-mathematical language and had become fluent in this language before translating it into its geometrical equivalent because he would have been able to communicate the theory effectively even with the majority who were not familiar with this language.

Such models which will be digital twins of real-life processes that are sought by mathematical scientists in biology [23] and other sciences will not be obtained by interpreting data with new mathematics but rather by translating the universal non-mathematical language of pure thought into the necessary mathematical equivalents. And when paths have been forged to the empirical alternatives of all logically-deduced theories in each field of science, the result will be the disappearance of the deep-seated incompatibilities in our system of concepts [15] and the unification of knowledge which was not only Einstein's dream but also that of Herbert Spencer, the scientist who was commemorated with "On the method of theoretical physics" at Oxford in 1933 [2].

For instance, by conducting pure thought in the universal language, empirical philosopher-physicists will be able to forge a path to the quantum theory of Einstein's dreams [2] which, upon the translation of that non-mathematical language into its mathematical equivalent, will unite freely with General Relativity. And when science has empirical theories that unify knowledge and not only logically deduced theories that are useful, we will witness an acceleration of scientific progress that we cannot imagine at this time.

Declaration of Competing Interest

I declare that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

I am grateful to Priscillia for her assistance throughout the process of preparing this manuscript.

References

1. Newton I. The Mathematical principles of natural philosophy, trans. Andrew Motte. London: 1729.

2. Einstein A. On the method of theoretical physics. Philosophy of Science. 1934;1:163-169.

3. Spencer Q. Do Newton's rules of reasoning guarantee truth … must they? Stud Hist Philos Sci. 2004; 35(4): 759–782. doi: 10.1016/j.shpsa.2004.02.001

4. Longair M. Bending space-time: a commentary on Dyson, Eddington and Davidson (1920) 'A determination of the deflection of light by the Sun's gravitational field'. Philos Trans A Math Phys Eng Sci. 2015 Apr 13;373(2039):20140287. doi: 10.1098/rsta.2014.0287.

5. Giné J. On the origin of the anomalous precession of Mercury's perihelion, Chaos, Solitons & Fractals, 2008;38(4):1004-1010. https://doi.org/10.1016/j.chaos.2007.02.010

6. Shaw AK. Diverse perspectives from diverse scholars are vital for theoretical biology. Theor Ecol 2022;15:143–146. https://doi.org/10.1007/s12080-022-00533-1

7. Enderling H, Wolkenhauer O. Are all models wrong? Comput Syst Oncol. 2020 Dec;1(1):e1008. doi: 10.1002/cso2.1008.

8. Box G. Science and stastistics. J American Stat Assoc. 1976;71(356):791–799.

9. Field E.H. All Models Are Wrong, but Some Are Useful. Seismological Research Letters. 2015;86 (2A): 291–293. doi: https://doi.org/10.1785/02201401213

10. Will CM. The Confrontation between General Relativity and Experiment. Living Rev Relativ. 2006; 9(1): 3. doi: 10.12942/lrr-2006-3

11. Popper, Karl (2004). The logic of scientific discovery (reprint ed.). London & New York: Routledge Classics. ISBN 978-0-415-27844-7First published 1959 by Hutchinson & Co.

12. Debono I, Smoot GF. General Relativity and Cosmology: Unsolved Questions and Future Directions. Universe 2016;2(4):23. https://doi.org/10.3390/universe2040023

13. Kennefick D. Testing relativity from the 1919 eclipse—a question of bias. Physics Today 2009;62(3):37. https://doi.org/10.1063/1.3099578

14. Slavov, Matias. “Empiricism and Relationism Intertwined: Hume and Einstein’s Special Theory of Relativity.” Theoria: An International Journal for Theory, History and Foundations of Science, vol. 31, no. 2, 2016, pp. 247–63. JSTOR, http://www.jstor.org/stable/43799840. Accessed 20 Feb. 2023.

15. Einstein A. Physics and Reality. Jean Piccard, trans. Journal of the Franklin Institute. 1936; 221: 348–382.

16. Schilpp A. Albert Einstein: Philosopher-Scientist, The Library of Living Philosophers, Evanston, IL (1949), p. 684.

17. Brenner S. Nature’s gift to science (Nobel lecture). Chembiochem. 2003 Aug 4;4(8):683-7. doi:10.1002/cbic.200300625.

18. Cohen JE. Mathematics is biology's next microscope, only better; biology is mathematics' next physics, only better. PLoS Biol. 2004 Dec;2(12):e439. doi: 10.1371/journal.pbio.0020439

19. Darwin, C.R. On the origin of species by means of natural selection, 1st ed. London: John Murray. 1859.

20. Krakauer DC, Collins JP, Erwin D, Flack JC, Fontana W, Laubichler MD, Prohaska SJ, West GB, Stadler PF. The challenges and scope of theoretical biology. J Theor Biol. 2011 May 7;276(1):269-76. doi: 10.1016/j.jtbi.2011.01.051.

21. Lehmkuhl D. Why Einstein did not believe that general relativity geometrizes gravity. Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics. 2014;46(B): 316-326. https://doi.org/10.1016/j.shpsb.2013.08.002

22. Darrigol O. Mesh and measure in early general relativity. Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics. 2015;52 (B): 163-187. https://doi.org/10.1016/j.shpsb.2015.07.001.

23. Eftimie R. Grand challenges in mathematical biology: Integrating multi-scale modeling and data. Front. Appl. Math. Stat. 2022;8. https://doi.org/10.3389/fams.2022.1010622