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A Spiritual Theory of Everything? Sir Arthur Eddington's Quest to Unite Knowledge of the Universe

Sir Arthur Eddington (1882-1944) was a prominent Quaker astrophysicist at Cambridge University who made an extraordinary impact on inter-war physics, helping to communicate relativity, cosmology and quantum physics to a popular audience. He was also a prolific science communicator whose philosophical reflections on the meaning of the new physics captivated global audiences. His quest for a theory of everything, though unsuccessful, came from his conviction that the nature of ultimate reality was spiritual, and is underappreciated for its historical impact. Much can be learned from his legacy of trying to harmonize science and faith to a larger audience searching for meaning. Eddington's ambitious attempt at a Christian theory of everything deserves further examination and can still teach us much about our approach to science and religion.

Keywords: Eddington, Theory of Everything, Mysticism, Quaker, Astrophysics, Relativity, Quantum Physics, Einstein.

Introduction

The question as to the nature of ultimate reality was never in greater scrutiny than during the inter-war period due to the overthrowing of our understanding caused by the discoveries of Einstein and others. The extraordinary generation of this physics revolution saw a transformation of the grounds of Newtonian science into the mysterious realms of relativity and quantum physics. The world previously known had changed beyond recognition, causing many in physics to venture into philosophy, during the infancy of philosophy of science as a discipline.

The public faced massive confusion over what the substance and meaning of these discoveries were. Into this void stepped Sir Arthur Eddington whose popular writings on the new world were bought in volumes previously unheard of for a scientist.¹ These works, including *The Nature of the Physical World*, *The Philosophy of Physical Science*, and *New Pathways In Science*, complemented his writings of Relativity, Cosmology and Quantum Physics which were the first on the topics in the English language. He became a household name in the inter-

¹ Rupke, N. A., *Eminent Lives in Twentieth Century Science and Religion*, Frankfurt am Main: Peter Lang (2nd ed., 2009), p.137.

war period.²

Eddington's Quaker faith stood him apart from the conventional natural theology of the 19th and early 20th century. His unusual approach brought him success in his scientific endeavors, problem solving, and innovation. However, they also brought him fierce criticism from theists and atheists alike.³ With his reputation cemented, he joined Einstein, Hilbert and others in seeking to unify relativity and quantum physics.

Eddington's very attempt at a Fundamental Theory was built upon his spiritual search for a unifying explanation of ultimate reality, that ultimately failed in trying to synthesize his Quaker vision of the world with his interpretation of the implications of both relativity and quantum physics. Ritchie, in one of the earliest Arthur Eddington Memorial Lectures, noted that Eddington had 'devoted himself, especially in the later years of his life, to the task of interpreting that change in terms of a philosophical system, trying to see the whole range of man's experience in a coherent and ordered picture.'⁴ The theory itself was a logical outworking of Eddington's epistemology which had a spiritual underpinning. Quakers are famous for rejecting dogmatism, being open to outside sources of knowledge, trusting one's inward intuitions, and placing special emphasis on the 'Inner Light' (which Eddington references frequently in *The Nature of the Physical World*). Eddington brought this perspective into his approaches to problem solving, with remarkable success in stellar physics in the 1910s-1920s. Once he felt that relativity had undermined materialism, it was inevitable that he would seek to synthesize mind into his efforts towards a Fundamental Theory.

Eddington's Search for Ultimate Reality

The final decade of Eddington's life was dominated by this quest for a theory of everything. Referred to as his 'Fundamental Theory', a closer inspection of his methodology shows it to be driven by epistemology.

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2 Stanley, M. *Practical Mystic: Religion, Science and A. S. Eddington* Chicago: University of Chicago Press (2007), p.194.

3 Yolton, J.W. *The Philosophy of Science of A. S. Eddington*, The Hague, Netherlands: Martinus Nijhoff (1960), p. 90

4 Ritchie, A. D. *Reflections on the Philosophy of Sir Arthur Eddington*, Cambridge: Cambridge University Press (1948), pp. vii-viii

preting that change in terms of a philosophical system, trying to see the whole range of man's experience in a coherent and ordered picture.⁵ The theory itself was a logical outworking of Eddington's epistemology which had a spiritual underpinning. Quakers are famous for rejecting dogmatism, being open to outside sources of knowledge, trusting one's inward intuitions, and placing special emphasis on the "Inner Light" (which Eddington references frequently in *The Nature of the Physical World*). Eddington brought this perspective into his approaches to problem solving, with remarkable success in stellar physics in the 1910s-1920s. Once he felt that relativity had undermined materialism, it was inevitable that he would seek to synthesize mind into his efforts towards a Fundamental Theory.

Through a blend of his Quaker mysticism and methodology, he came to see certain numbers as holding special significance in the underlying fabric of the universe. This was mockingly referred to as numerology long after his death ('137 and all that'⁶ was a typical summation of the attitude to it as stated by Maurice Wilkins, by which he refers to Eddington's obsession with the significance of the fine structure constant) where his public, religious assessment of science and religion was misunderstood and often ridiculed by Bertrand Russell⁷ and Chapman Cohen⁸ among others. His unconventional approach to both astrophysics and philosophy left him often misunderstood, with several criticisms revealing more of a failure on the part of the critic to understand rather than Eddington himself. Writing after Eddington's death, John Yolton summarized the problem this way:

There are confusions and ambiguities and even misguided speculations in all of Eddington's works. These make for tedious reading and easy condemnation. But when placed in their historical perspective, many of the confusions can be clarified and given their proper place in the context of dualistic theories of knowledge and reality.⁹

However, Eddington's *Fundamental Theory*, his popular philosophy, his Quaker mysticism, and his incorrect approaches to quantum physics all stemmed from the same place. According to his biography by Vilbert Douglas, 'He continued to hold these views because he could see no other logical explanation for certain facts of human experience.'¹⁰ What Bertrand Russell saw as

5 *ibid.*, pp. vii-viii

6 Wilkins, M. *Science and the divine. A historical approach to problems of science and the world today*, unpublished, accessed from Kings College London archives, March 2022 (1978), p. 2.

7 Russell, B. *The Scientific Outlook*, London: Routledge Press (2009)

8 Cohen, C. *God and the Universe: Eddington, Jeans, Huxley and Einstein*, London: Pioneer Press, (2nd edition, 1931)

9 *op.cit.*, Yolton, p. XII

10 Douglas, A. V. *The Life of Arthur Stanley Eddington*, London: Thomas Nelson and Sons Ltd

a misguided attempt to preserve free will through a scientific basis in quantum physics,¹¹ (which was almost certainly a misunderstanding of Russell's)¹² turned into a more extravagant attempt to explain ultimate reality in a more comprehensive synthesis. Ironically, the less dogmatic approach to problem-solving that found its roots in Quakerism were relegated as a consequence of his dogmatism in solving a Fundamental Theory.

Matthew Stanley places the falling of Eddington into obscurity on the combination of his critics, his failed theory of everything, as well as his Quaker spirituality and philosophy.¹³ Only now in rediscovering his works are many coming to see new value with a fresh approach to his work.¹⁴ As Dean Rickles explains, 'Eddington...had very little contemporary engagement with his theories. In some ways, this was because Eddington was simply well ahead of his time.'¹⁵ Whilst his Fundamental Theory has not regained traction, his more successful and unconventional approaches to problem solving in science have.

Uniting Mind and Matter through Mathematics

At his Gifford Lecture in the mid-1930s, Eddington claimed that 'the nature of all reality is spiritual, not material nor a dualism of matter and spirit.'¹⁶ Eddington saw reality as shadowy and symbolic,¹⁷ which could now be properly justified in terms of relativity and quantum physics. Furthermore, the certainty of the previous era had been spectacularly overturned and reality was now far more complex. A significant conclusion that Eddington was sure about was that 'Materialism is dead.'¹⁸ Together with Edward Arthur Milne and Sir James Jeans, the rational side of science was given renewed emphasis in place of materialism, bending instead towards a popular idealism.¹⁹

Eddington viewed the very task of philosophy of science as uniting mind and matter through epistemology.²⁰ Epistemology itself was now an unavoidable

(1957), p. 142

11 Russell, B. *Religion and Science*, Oxford: Oxford University Press (1997), p. 161

12 Spencer, N. *Magisteria*, London: Oneworld Publications (2024), p. 342

13 *op.cit.*, Stanley, pp. 122-3

14 Durham, I.T, and Rickles, D. *Information and Interaction: Eddington, Wheeler and the Limits of Knowledge*, Switzerland: Springer International Publishing (2017), Kindle, Location 124

15 *op.cit.*, Durham, Location 140

16 Eddington, A. *New Pathways in Science*, Cambridge: Cambridge University Press (1935), p. 408

17 *op.cit.*, Yolton, p. 59

18 Eddington, A. *Science and the Unseen World*, London: George Allen & Unwin Ltd (1930), pp. 31, 34.

19 *op.cit.*, Yolton, p. 89

20 *op.cit.*, Yolton, p. 67

task for the physicist, which he personally developed through his 'selective subjectivism' summarised by Durham and Rickles as 'objective reality exists but our knowledge of it is subjective.'²¹

A further consideration is Eddington's perspective on the special place of mathematics. It is unsurprising that a man such as Eddington would regard divine properties in mathematics. The return to a rationalist conception of nature brought on by Eddington, Jeans and Milne concurred with few philosophers, but was no longer casually dismissed due to the new physics. Eddington, one of the finest mathematicians of the century, was confident he could convey the ideas numerically. A complete theory would need to account for consciousness, give place for free will, as well as unifying relativity and quantum physics.

What is ultimate reality?

Eddington felt fully vindicated in his assault on materialism by the new physics. Peter Bowler explains his place in the environment in saying that

Science deals only with what can be measured, yet has come to be seen as the source of a totally self-consistent system ruling out the significance of non-metrical things, such as human values. In fact, this decision to exclude values is a decision of the mind, which seeks to order the world in terms of those aspects of it that do not change – and Eddington recognized that natural selection may have forced us to think in this way because our survival depends on functioning in the material world. But not only are values thus left out; so, too, is a sense of "becoming," which is absent from the four-dimensional world of space-time constructed by the modern physicist...mind can now be seen as a real agent in our descriptions of the world.²²

With the conclusion that the universe is fundamentally 'mind stuff',²³ the challenge came to describing this universe of idealism in mathematical terms. Eddington's more popular writings give more away than the complicated mathematics, but he summarises the challenge in saying 'It is a commonplace reflection that we understand very little about our own minds, but it is here if anywhere that all knowledge begins.'²⁴ It was outrageous to Russell and others for a scientist of Eddington's calibre to write that 'I do not think that with any

21 *op.cit.*, Durham, Location 185

22 Bowler, P. J. *Reconciling Science and Religion: The Debate in Early Twentieth-Century Britain*, Chicago: University of Chicago Press (2001), p. 105

23 Eddington, A. S. *The Nature of the Physical World*, London: Everyman's Library (1935), p. 267. See also, Armour, L. 'The Things that Fill the World' in MacEwan, P. (ed) *Idealist Alternatives to Materialist Philosophies of Science*, Leiden: Brill (2020), p. 31.

24 Eddington, A. *New Pathways in Science*, Cambridge: Cambridge University Press (1935), p. 412

legitimate usage of the word it can be said that the external world of physics is the only world that really exists.’²⁵ This ran at odds with the Logical Positivists, including those colleagues of his at Cambridge.

However, the influence of Alfred North Whitehead amongst others is clear in his scientific epistemology, and consciousness as the nature of the universe’s fabric was in keeping with the British philosophers such as George Berkley that Eddington would occasionally reference. His difficulty lay in not only uniting relativity and quantum physics, but in finding within the equations a clue to expressing consciousness:

All through the physical world runs that unknown content, which must surely be the stuff of our consciousness. Here is a hint of aspects deep within the world of physics, and yet unattainable by the method of physics. And, moreover, we have found that where science has progressed the farthest, the mind has but regained from nature that which the mind has put into nature. We have found a strange footprint on the shores of the unknown. We have devised profound theories, one after another, to account for its origin. At last, we have succeeded in reconstructing the creature that made the footprint. And Lo! It is our own.²⁶

If reality was not ultimately physical, perhaps its mystical nature could still be expressed mathematically. In the nearly two decades that he was working exclusively on his Fundamental Theory, he would candidly update the public by expressing analogy to the problem of describing reality:

We are haunted by the word reality. I have already tried to deal with the questions which arise as to the meaning of reality; but it presses on us so persistently that, at the risk of repetition, I must consider it once more from the standpoint of religion. A compromise of illusion and reality may be all very well in our attitude towards physical surroundings; but to admit such a compromise into religion would seem to be trifling with sacred things. Reality seems to concern religious beliefs much more than any others. No one bothers as to whether there is reality behind humour. The artist who tries to bring out the soul in his picture does not really care whether and in what sense the soul can be said to exist.²⁷

In hindsight, given that many consider a theory of everything unreachable,²⁸

25 *ibid.*, Eddington, A, p. 43

26 Eddington, A. S. *Space, Time and Gravitation: An Outline of the General Relativity Theory*, Cambridge: Cambridge University Press (1920), pp. 200-1

27 Eddington, A S. *The Nature of the Physical World*. Shizu Bito (2014), Kindle, location 4683

28 See, for example, my own summary in *The Conversation* at <https://theconversation.com/theory-of-everything-how-a-fear-of-failure-is-hampering-physicists-quest-for-the-ultimate-answer-230715>

Eddington was adding layers of complexity in attempting to explain consciousness. The only outcome for him to explain matter in a world of mind stuff was through ascribing power to numbers themselves in a quasi-numerology. His epistemology ensured that fundamentally, knowledge be expressed mathematically as the language of God and provide a foundation of data to work with:

Let us now consider the common root from which scientific and all other knowledge must arise. The only subject presented to me for study is the content of my consciousness. According to the usual description, this is a heterogenous collection of sensations, emotions, conceptions, memories, etc. the raw materials of knowledge and the manufactured products of intellectual activity exist side by side in this collection. We wish to pick out the raw material – the primitive data, unspoiled by the intervention of habitual forms of thought. It must, I think, be recognised that this is an unattainable ideal. Our faculty of sensory perception is modified by training; and it is impossible to conceive it divested altogether of the training forced on it by the conditions of life and adaptation to the environment. I do not think that sensation, as we know it, could exist without any activity of mind which concentrates, compares, and distinguishes. What we call a sensation can never be purely sensory. But that is a question better left to psychologists. In any case the practical difficulty exists.²⁹

He struggled immensely, as anyone would, with time and entropy. These were the essence of the shadow in his symbolic world.³⁰ He gave glimpses of his progress during his earlier work, *Relativity Theory of Protons and Electrons*, which is regarded by Lord Martin Rees and those at the Institute of Astronomy at Cambridge (where Eddington lived for most of his life) as entirely useless and of no further scientific value. Indeed, it has been extremely hard to obtain an intact, physical copy of it today despite Eddington's fame in contrast to his other books. He gave lectures on his Fundamental Theory in 1942 in Ireland, but these public addresses drew confusion rather than excitement. Eddington's death during the war undoubtedly contributed to the lack of fanfare, but after 1945 attempts were made to honour him. Edmund Whittaker was given the difficult duty of interpreting the mathematics of Eddington's almost completed *Fundamental Theory*, which was published posthumously. Whittaker had studied at Trinity College, Cambridge where he had been one of Eddington's teachers, but spent most of his time as Professor of Mathematics at Edinburgh, after six years as Professor of Astronomy in Dublin. They were close friends by the time of Eddington's death.

Sir James Jeans in his small work *The Astronomical Horizon* explains how any possibility of it being correct was immediately erased by the newest post-

29 Eddington, A. *The Philosophy of Physical Science*, New York: The MacMillan Company (1939), p. 195

30 *op.cit.*, Eddington, A.S. *The Nature of the Physical World*, Kindle, location 1804

war discoveries in the subatomic world.³¹ *Fundamental Theory* itself was met with some excitement, followed immediately by derision. Confusion at the elements of numerology were almost shameful to a once-great astrophysicist who seemed to misunderstand quantum mechanics. In every conceivable manner, *Fundamental Theory* was an extraordinary failure.

Today, if one visits the archives at Trinity College in Cambridge, there exist many boxes of Eddington's preserved notes over this period of immense exertion in pursuit of the Fundamental Theory. Great care has been taken in preserving this effort as that of a master mind. Eddington used great symbolic notation giving the appearance of hieroglyphics and Whittaker estimated that there were perhaps seven people alive that would be able to interpret his equations. The preservation is out of respect as well as historical interest, but nothing more.

Legacy

Eddington's reputation as an astronomer remained strong for many years past his death. Firstly, his work in establishing Einstein's General Theory of Relativity by the eclipse expedition of 1919 to Principe Island off the coast of Africa assured him a place in the history of science. This was clearly not a one-man effort but his leading role not only in the expedition itself but also in explaining it to the reading public was crucial. While some have queried his objectivity in measuring the light deflection on the photographic plates from Principe, others have argued that the process was sound.³²

Secondly, his book *The Internal Constitution of the Stars*³³ was for many years the standard textbook on stellar structure. Evans, a former student and a clear admirer of Eddington, writing in 1998 says:

The most glorious of all Eddington's achievements are his contributions to the theory of stellar structure, epitomised by his great work *The Internal Constitution of the Stars*, first published by the Cambridge University Press in 1926. Although seven decades have passed, this book is still worth reading ... Eddington had a wonderful physical intuition and relied on it, not only in his descriptive writings, but also in leaps of argument in his researches.³⁴

Sir Arthur Eddington was also, along with Jeans, a leading writer in the inter-

31 Jeans, J. *The Astronomical Horizon*, London: Oxford University Press (1945), p. 20.

32 Collins, H. and Pinch, T. *The Golem: What you should know about science*, Cambridge: Cambridge University Press (2nd ed. 1998), Chapter Two *passim*. For a discussion of this issue see Rampelt, J.M. 'Arthur Stanley Eddington: Relativity and Dogma' in Nicolaas A Rupke (ed.), *Eminent Lives in Twentieth Century Science and Religion*, Frankfurt am Main: Peter Lang (2nd ed. 2009), p. 146.

33 Eddington, A. *The Internal Constitution of the Stars*, Cambridge: University Press (1926).

34 Evans, D. *The Eddington Enigma: A Personal Memoir*, Princeton: Xlibris (1998), p. 95.

war years of popular and semi-popular Christian apologetics. The influence of both of them declined in the post-war world, surpassed by C S Lewis who was influenced by both. John Habgood³⁵ puts Eddington's decline down to L. Susan Stebbing's *Philosophy and the Physicists*³⁶ of 1937. But the book sale figures do not bear this thesis out. Eddington's poor use of philosophical idealism was no doubt a factor in his decline as an apologist as was a desire for a new approach to apologetics.

*Fundamental Theory*³⁷ undoubtedly tarnished Eddington's legacy. This was the least successful of Eddington's works: a judgement, with which even his supporters such as Evans³⁸ and Kilmister³⁹ would not wholly disagree. Barrow and Tipler are franker in their disapproval.⁴⁰ It is interesting to speculate on whether Eddington's reputation would not have been higher if his sister had, on his death, burnt not only many of his personal papers, but also the unfinished manuscript of *Fundamental Theory*. This book did more to damage Eddington's intellectual reputation than the work of Bertrand Russell, Joseph McCabe, Stebbing or any other of his critics.

Michael Polanyi could be viewed as a successor of Eddington in acknowledging the personal element in science, theology and philosophy. Two points may be drawn from this consideration. Firstly, Eddington's belief in the validity of intuition as a source of knowledge was influenced by his Quaker understanding of the importance of seeking and the Inner Light. Secondly, it proved a successful technique for Eddington in some of his work, such as on the internal constitution of the stars and on the spiral nebulae, but not in others, such as on what is now called the Chandrasekhar Limit. That intuition may sometimes help in the move towards truth that was part of Eddington's Quaker belief; clearly in his science it was not always a sufficient guide to the truth.

Kilmister sees Eddington's success as a popular writer as one of the reasons behind the poor reception of *Fundamental Theory* (which he abbreviates to FT):

The essence of popular writing is to tell less than the whole truth. The good writers like Eddington, are those who contrive to do this without making actually false statements... Eddington's acquisition of this skill to a high degree is

35 Habgood, J. *Varieties of Unbelief*, London: Darton, Longman and Todd (2000), p.17.

36 Stebbing, S. L. *Philosophy and the Physicists*, London: Methuen (1937).

37 Eddington, A. *Fundamental Theory*, Whittaker. E.T., Cambridge: Cambridge University Press (1946)

38 *op.cit.*, Evans, *The Eddington Enigma*, chapter 12 *passim*.

39 Kilmister, C W. *Eddington's Search for a Fundamental Theory*, Cambridge: Cambridge University Press (1994) *passim*.

40 Barrow, J.D., and Tipler, F.J. *The Anthropic Cosmological Principle*, Oxford: Oxford University Press (1986), pp. 227-228.

one cause of the obscurities of FT.⁴¹

Eddington strove to discover the nature of ultimate reality, but *Fundamental Theory* did not convince those working in the field of theoretical physics who saw its faults. Stanley points out there are no significant traces of Eddington's belief in *Fundamental Theory*. Whilst we have argued that Eddington's quaker mysticism, idealism, and religious epistemology influenced his approach to *Fundamental Theory*, Stanley is correct that much unlike his previous books, Eddington does not mention spiritual or philosophical matters explicitly. Also, unlike the seeking approach of his stellar work, *Fundamental Theory* is relentlessly deductive.

Posthumous accolades tended towards ignoring the stranger elements of Eddington's final two decades, such as Chandrasekhar's generous praise in his biography of Eddington,⁴² or to embrace the interdisciplinary nature of Eddington's life, as is seen in the memorial lectureship instated in his honour by Cambridge University and the Royal Astronomical Society. This lectureship initially focused on the interplay between science, philosophy and religion and made no attempt to hide what was characterized as a praiseworthy attempt in undertaking such a challenge as *Fundamental Theory*. This immense collection of lectures, published for many years by Cambridge University Press, is a treasure of prize winners exploring some aspects of how science and religion dialogue. It would include Nobel laureates such as Maurice Wilkins, Roger Penrose, François Jacob, Max Perutz, and Amartya Sen, as well as important religious philosophers such as John Hick and Michael Polanyi. Since 2009, the Eddington Lecture has narrowed its scope to simply astronomy, with no mention of Eddington's philosophy or religion.

With renewed emphasis on the role of consciousness, and the popular rise of panpsychism, there may yet be place in the future for considering the mind in developing a theory of everything, but at present Eddington stands as a cautionary tale for those seeking a spiritual element within the mathematical framework of uniting relativity and quantum mechanics.

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41 *op.cit.*, Kilmister, C W. *Eddington's Search for a Fundamental Theory*, p. 83

42 Chandrasekhar, S. *Eddington: The Most Distinguished Astrophysicist of our Time*, Cambridge: Cambridge University Press (1983)