REVD. DR. JOHN C. POLKINGHORNE'S ACTIVITIES IN SCIENCE AND RELIGION A PERSONAL PERSPECTIVE

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Abstract

The Reverend Dr. John C. Polkinghorne (FRS 1974), an English theoretical particle physicist, theologian and Anglican priest, died on 9 March 2021 in Cambridge, UK. Polkinghorne's most famous scientific contribution was the deep inelastic scattering models, which he formulated towards the end of his career in Theoretical physics. However, Polkinghorne then moved into another field of endeavour entirely. He made a move from Physics research to become an ordained minister in the Church of England and then became prominent in the promotion of the dialogue between Science and religion nationwide and worldwide. Some selective overviews are attempted with regard to his activities in Science and religion during his stays at the Department of Applied Mathematics and Theoretical Physics and at Queens' College, the University of Cambridge, UK. Polkinghorne's inspirations for young college students, young scientists and Christians are briefly reviewed along with the present author's connection with Polkinghorne and of Polkinghorne's relationship with his fellow Templeton Prize laureates (the Templeton Prize is regarded by many as the Nobel Prize in religion).

Keywords: priest, dialogue, science, religion, truth

1. Introduction

"The life of a great man, in a great period of the world's history, is a subject to command the attention of every thoughtful mind." [1]

The primary objective of the present article is to attempt to fill in some 'gaps' which may exist in previous articles on our common friend and mentor Revd. Dr. John C. Polkinghorne and to thereby present a useful new 'memorial' on his life and work. The present author met Polkinghorne four times in Cambridge, UK, and also had the pleasure of calling upon him at his home in 2012 and 2019. In the present author's view, Polkinghorne was one of the great men in a great period of interdisciplinary studies in the field of Science and religion. Before his passing, it is fortunate indeed that Polkinghorne was

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interviewed by Professor Alan D.J. MacFarlane FBA FRHistS at King's College, Cambridge, UK, on 4 November 2008. The transcripts of this interview were published in [2]. After his passing, two short obituaries were published [D. Wilkinson, *Obituary: The Revd Professor John Polkinghorne*, Church Times, Friday, 14 May 2021; 3] and his biographical memoir was published by the Royal Society of London [4].

A short biography of Polkinghorne is given in Section 2. Section 3 selectively reviews Polkinghorne's role and activity during his stay at the Department of Applied Mathematics and Theoretical Physics, the University of Cambridge, UK from 1959 to 1979. Section 4 gives a selective overview of Polkinghorne's activity in Science and religion at Queens' College from 1989 to 1996 and afterwards. Section 5 gives a short account of the present author's connection with Polkinghorne. Section 6 presents a couple of examples showing Polkinghorne's inspirations for young Christians. Section 7 gives a brief review of Polkinghorne's relationship with other Templeton Prize laureates. Discussion is made in Section 8 and some preliminary conclusions are presented in Section 9. Appendix is given in Section 10.

2. Polkinghorne's short biography

Details of Polkinghorne's life up to 1995 can be found in the Appendix. The present section provides a short biography of Polkinghorne as an introduction to his life and work. Some overlaps with Professor MacFarlane's interview with Polkinghorne [2] and the Royal Society's biographical memoir of Polkinghorne [4] are inevitable but have been minimized as much as possible.

John C. Polkinghorne was born on 16 October 1930 at Weston-super-Mare, England, UK. Polkinghorne entered the Quaker School in Street in 1937 and the Elmhurst Grammar School in Street in 1941. He attended Perse School in Cambridge where he excelled in Mathematics and Physics in 1945. He won a Major Scholarship to Trinity College, Cambridge in 1948. After undertaking one year of National Service, he read Mathematics at Trinity College from 1949 to 1952. In his own words, Polkinghorne was taught Applied mathematics principally by Kemmer at Trinity College.

"The quarter-century period starting in the mid-1950s is sometimes referred to as a 'renaissance of General relativity and Cosmology'." [5, p. 403] It was during this 'renaissance' that Polkinghorne did his Ph.D. under the supervision of Nicholas Kemmer (1911-1998) (FRS 1956) in his first year and then Abdus Salam (1926-1996) (FRS 1959) within the group led by Paul A.M. Dirac (1902-1984) (FRS 1930) at the Cavendish Laboratory, Cambridge, UK. He completed his Ph.D. thesis on *Contributions to Quantum Field Theory* in 1955.

As the recipient of a Commonwealth Fellowship (known as Harkness Fellowships as of 1960), from 1955 to 1956, Polkinghorne went to the California Institute of Technology and worked with Murray Gell-Mann (1929-2019).

As a historical note, "After seven years of intensive teaching at Cambridge, Kemmer moved to Edinburgh in 1953 to succeed Max Born (1882-1970) (FRS 1939) as Tait Professor of Natural Philosophy" [6, p. 196]. From 1956 to 1958, Polkinghorne worked as a Lecturer at the (then) Tait Institute of Mathematical Physics, the University of Edinburgh, UK, where Kemmer was Chair of Natural Philosophy.

Polkinghorne became a Lecturer of the University of Cambridge from 1958 to 1965, a Reader from 1965 to 1968, and a Professor of Mathematical Physics from 1968 to 1979.

Polkinghorne studied Theology at Westcott House, Cambridge from 1979 to 1981. He was ordained Deacon in 1981 and Priest in 1982. He became a curate at Cambridge (St. Andrews, Chesterton) from 1981 to 1982 and at Bristol (St. Michael and All Angels, Bedminster) from 1982 to 1984. He became a Vicar of Blean, Kent from 1984 to 1986. He was made an Honorary Professor of Physics, University of Kent in 1984. He became Canon Theologian of Liverpool Cathedral in 1994 and Six Preacher of Canterbury Cathedral from 1996 to 2007. Polkinghorne was knighted by Queen Elizabeth II in 1997.

Polkinghorne married Ruth Isobel Martin (1930-2006) on 26 March 1955. They had three children, Peter, Isobel and Michael.

3. Polkinghorne at the Department of Applied Mathematics and Theoretical Physics from 1959 to 1979 - a selective overview

"…when we are all coming to realize that truth is One, whatever its source, and that any apparent conflict between the truth of God revealed in nature, and the truth of God revealed in Christ, is of our own making, and results solely from the insufficiency of our knowledge, on the one hand, or on the other." [7]

3.1. Prologue

On December 15, 1986, Polkinghorne expressed his following views with the readers of *The Scientists*…: "No doubt there is also a role for those of us who belong to the army of honest toilers, providing the background of expectation and exploitation, but the big ideas come from the big men. The first big man of Theoretical physics that I knew was Paul Dirac, whose intellectually elegant lectures initiated me into the mysteries of Quantum mechanics. However, Dirac was too austerely remote a figure to have any direct influence on my own attempts at research. I had Kemmer and Salam as my successive Ph.D. supervisors, my most influential working relationship with a great man came when I went to Caltech as a postdoc and met Murray Gell-Mann. My work always remained mathematically based, but Gell-Mann opened my eyes to the experimentally led side of Theoretical physics and its excitements." [https://www.the-scientist.com/news/gell-mann-opened-my-eyes-64150]

3.2. Polkinghorne's inspiration and care for young college students and his own research students

Polkinghorne inspired young College students in various ways. As an interesting anecdote, Chris Garrett (FRS 1993), an English/Canadian mathematician and physical oceanographer, kindly shared his experience at Trinity College, Cambridge with the present author in an e-mail dated on 25 October 2018. In the Cambridge tradition, undergraduates have 'supervisions' from graduate students or more senior people to go over problem sets. One year Garrett was supervised in quantum theory, along with his good friend Partha Dasgupta (now Sir Partha and a famous economist), by Polkinghorne. Garrett remembered Polkinghorne saying to them "I'm not at the top, but I'm close enough to the top to understand what the really smart people are doing". Garrett felt that he himself had borne this in mind as he had enjoyed reading, or hearing about, the research accomplishments of some of his much smarter physical oceanographic colleagues.

Sir Partha Dagupta, Emeritus Processor, Frank Ramsey Professor Emeritus of Economics, University of Cambridge, reminisced: "I also attended Polkinghorne's lectures on Quantum mechanism in 1964-1965. More importantly, he mentored and advised me from my entry into the Mathematical Tripos, in 1962, right through to the point when I moved, in October 1965, to pursue a PhD in economics under Professor James Mirrlees, also of Trinity. Polkinghorne in that period was at the height of his influence in Theoretical physics at DAMTP. He had a bounce in his steps, he spoke rapidly and with conviction, and was the most charismatic among what was then a somewhat sombre group of mathematicians and physicists at Cambridge. His lectures and supervisions were dazzling; he could make you see an electron spin; he was that good. I would not say he was a warm person; it was his academic interest in his students that I remember mostly. Once I moved to economics I saw little of him, of course, and saw nothing of him once I moved away from Cambridge following my PhD. But he wrote to me to congratulate me every time he thought I had achieved something he approved of. For example, I received a congratulatory card from him in 1978 when I was promoted to a professorship in economics at the London School of Economics. How he got to learn of it, I know not. The last time I met him, at a party at Trinity, a few months after I had returned to Cambridge as professor of Economics (1985), he introduced me to his wife by saying that I was transforming Economics. That was an exaggeration of course, but it suggested he had kept track of me and my research interest, and was (possibly) proud of me. Then again, when I was elected to the Royal Society (2004), he wrote to say that, as I was already a Fellow of the British Academy, I had achieved a lot more than even a 'double first' - a rather typical Cambridge point of view. It seems to me that kind of interest in an old student who had moved far afield is rare. I have much to be grateful to him." (Personal Communication with Sir Partha Dasgupta, 13 June 2023)

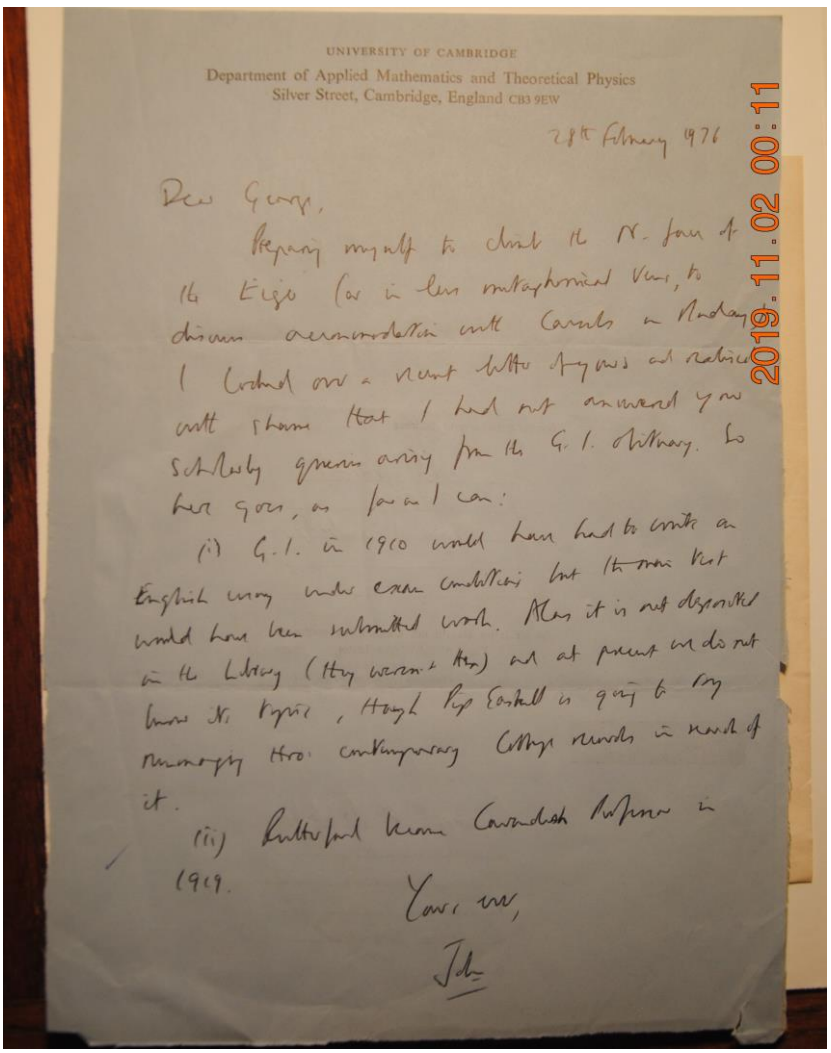
Polkinghorne had many research students, among them, e.g. Peter V. Landshoff and Peter Goddard. According to Professor Landshoff's talk at Polkinghorne's memorial service held at the University Church, Great St. Mary's, Cambridge, on Friday, 10th June 2022, Polkinghorne always paid a lot of attention to keeping his students happy, and gave them to believe that he cared about each of them. When research is going well it is a marvellous experience, but it is easy to get demoralised when one gets stuck on a problem, and Polkinghorne was very good at maintaining the students optimism that in the end they would be successful. His students all knew that their professor was religious, but he never talked about it to them and they never suspected he intended to give up Physics.

3.3. Polkinghorne's role and his connection with the late Professor G.K. Batchelor

Polkinghorne returned to Cambridge from Edinburgh in 1958. The Department of Applied Mathematics and Theoretical Physics (DAMTP), the University of Cambridge, UK, was founded by the late Professor G.K. Batchelor (1920-2020) (FRS 1957) on 1 October 1959. The foundation of DAMTP by the late Professor Batchelor was partially due to Dirac [8]. Polkinghorne was a faculty member of the DAMTP from 1959 to 1979. At that time, DAMTP was initially housed in the Phoenix Wing at the top of the Cavendish Laboratory in Free School Lane [5], and relocated in Silver Street in 1964 (Figure 1). It was removed to Wilberforce Road in December 2002. It is believed that Polkinghorne had stayed at both sites and had spent most of his time in Silver Street.

Figure 1. A photo showing the Old Cambridge University Press premises in Silver Street, where DAMTP was located from 1964 to 2002. Photo by John Z. Shi on 21 September 2019.

The present author had fortunately spent the two Michaelmas terms at the G.K. Batchelor Laboratory, DAMTP, the University of Cambridge, UK, in 2012 and 2019, respectively [8]. Professor Lord Julian C.R. Hunt's (FRS 1989) recommendation gained the present author an invitation by Professor Paul F. Linden (FRS 2007) to spend the Michaelmas term in 2012 there. Professor Stuart B. Dalziel, Director of the G.K. Batchelor Laboratory, had kindly hosted the present author in the Michaelmas of 2019. The present author's links to DAMTP, Cambridge, is in a way one of his motivations for the writing up of this article.



UNIVERSITY OF CAMBRIDGE
Department of Applied Mathematics and Theoretical Physics
Silver Street, Cambridge, England CB3 9EW

28th February 1976

Dear George,

Preparing myself to check the proofs of the Elegy (or is there metaphorical virus, to discuss accommodation with Cavells on Monday. I looked over a recent letter of yours and realised with shame that I had not answered your scholarly queries arising from the G.I. obituary. So here goes, as far as I can:

(i) G.I. in 1910 would have had to write an English essay under exam conditions but the essay that would have been submitted would have been submitted work. Alas it is not deposited in the Library (they weren't then) and at present we do not know Mr Pyrie, though Pye Eastall is going to try manuscripts from contemporary College records in search of it.

(ii) Rutherford became Cavendish Professor in 1919.

Yours ever,

John

Figure 2. A photograph of Polkinghorne's hand-written letter to the late Professor G.K. Batchelor dated 28 February 1976. Source: The Batchelor Archive, the Wren Library, Trinity College, Cambridge, UK, with permission.

Fluid dynamics, led by Batchelor, and High-energy physics, led by Polkinghorne, were the two biggest groups within DAMTP [4]. "He [Batchelor] was an extraordinarily effective Head of the Department of Applied Mathematics and Theoretical Physics from its foundation in 1959 until his retirement in 1983". [9] "Polkinghorne admired Batchelor as an effective, congenial leader." [10] "Batchelor was an efficient administrator and effective operator." [11, p. 10]

At the late Professor Batchelor's Archive, the Wren Library, Trinity College, Cambridge, the present author unexpectedly happened upon a dozen of Polkinghorne's hand-written letters to Batchelor. As an example shown in Figure 2, Polkinghorne answered Batchelor's scholarly question arising about the G.I. Taylor obituary [12]. Polkinghorne wrote Batchelor that Rutherford became Cavendish Professor in 1919, which was included in Taylor's biographical memoir [12]. Below is the full text of Polkinghorne's letter: "28th February 1976. Dear George, preparing myself to climb the N. [North] face of the Eiger (or in less metaphorical voice to discuss accommodation with Cavendish on Tuesday). I looked over a recent letter of yours and realized with shame that I had not answered your scholarly question arising from the G.I. [Taylor] Obituary. So here goes, as far as I can: (i) G.I. [Taylor] in 1910 would have had to write an English essay under exam conditions but the main part would have been submitted work. Alas it is not deposited in the library (they were not there) and at present we do not know its topic, though Pip Gaskell is going to try rummaging through contemporary College records in search of it. (ii) Rutherford became Cavendish Professor in 1919. Yours, John."

As a historical note, according to Professor H. Keith Moffatt, Polkinghorne was meant to have succeeded Batchelor as Head of the DAMTP. However, Polkinghorne's resignation from Professor of Mathematical Physics led Professor Moffatt to have succeeded Batchelor as Head of the DAMTP instead in 1983.

3.4. Polkinghorne's scientific contribution

Polkinghorne's possibly incomplete bibliography can be found in Appendix II. A brief account of his scientific research and career can be found in Taylor and Wilkinson [4]. However, to make the present article complete, the following citation for his FRS certificate is quoted below: "Distinguished for his work on the analytic properties of scattering amplitudes, fundamental to the use of relativistic Quantum mechanics in subnuclear refraction theory. He has contributed substantially to the study of the singularities of Feynman integrals, giving an early demonstration of the existence of Regge poles in relativistic Quantum mechanics and making a series of important contributions to the theory of Regge cuts. He has also made many contributions to S-matrix theory, including the first derivation of the Landau equations in that context and a complete analysis of physical region singularity structure. In the last three years his work has been concerned with the construction of general covariant models

corresponding to the parton picture of hadronic structure, together with the development of a quantitative theory based on more detailed dynamical assumptions. This has resulted in a model giving good agreement with experiment in the recent extremely important fields of deep inelastic lepton scattering and of hadronic processes at large transverse momentum." [https://catalogues.royalsociety.org/CalmView/Record.aspx?src=CalmView.Catalog&id=EC%2f1974%2f23]

3.5. Why did Polkinghorne decide to resign from DAMTP and to become an Anglican priest?

Before we proceed to Polkinghorne's second career as an Anglican priest, a brief discussion is made about the scientist's struggle against aging and the anguish of not being able to continue to be creative.

Sir Isaac Newton (1643-1727) (FRS 1672) gave up Mathematics after a 'certain age'. As a related historical anecdote, on 25 February 1842, James MacCullagh (1809-1847) (FRS 1843), an Irish mathematical physicist, wrote his English friend Charles Babbage (1792-1871): "I have grown very stupid of late, and regularly fail in everything I attempt. What the reason may be I cannot tell. But I begin to be of Newton's opinion, that after a *certain* age, a man may as well give up Mathematics. Perhaps it would be better - at least for one's own happiness - to have some occupation or profession which should connect one immediately with his fellow men, and to make the pursuit of science a collateral object, rather than a direct one." [13, p. 84]

As described in Batchelor [14], every scientist would likely have the struggle against aging and the anguish of not being able to continue to be creative, for example, the pure English mathematician Godfrey Harold Hardy (1877-1947) (FRS 1910) even attempted suicide. James MacCullagh's suicide in 1847 may be another example given what he wrote above. Likewise, Polkinghorne also had his struggle against aging and the anguish of not being able to continue to be creative.

In his own words, Polkinghorne enjoyed being a theoretical particle physicist and regarded it as being a Christian vocation. However, why did Polkinghorne decide to become an Anglican priest? When Polkinghorne recalled the process by which he came to do that, i.e. to retrain in a career unrelated to Physics, there seem to be three major reasons: firstly, in the mathematically based subjects, he found that you do not get better as you get older. What counts is mental flexibility rather than accumulated experience. Secondly, the subject was very much changing its character. All the time he had worked in Particle physics there had been clever theorists around but it had been essentially experimentally driven. In the second half of the 1970s, the so-called standard model, which is the quark structure of matter, was discovered. Then the input from experiment began to dry up. String theory began to come into existence. Thirdly, string theory involved new types of Mathematics which he would have to learn. However, he felt that he was losing mental flexibility and he was not

congenially disposed to do so. He thought the time had come to do something different. For further details, please see the transcripts in Béteille [2, p. 94, 95].

Kemmer, who was an important teacher and mentor of Polkinghorne's at Trinity College, was wise enough to be aware that in 1960 he had come to the end of his career as a research scientist and found another line of work in teaching [6]. In the present author's view, Kemmer's decision might have influenced Polkinghorne also. Newton, MacCullagh, Hardy, and Kemmer had strategies against aging. Polkinghorne's strategy was to become an Anglican priest.

As an interesting historical note, Polkinghorne asked his student, Landshoff, to write a reference for him to the Advisory Council for the Church's Ministry, so that he could become a full-time Theology student. It was a complete surprise to Landshoff. Polkinghorne told Landsoff and other students it was because he had reached the age when it was easier to give an hour's Physics lecture than to sit through one.

As another historical note, Dirac resigned from DAMTP in 1969 and moved to Tallahassee in Florida [10, p. 387, 390]. Polkinghorne resigned from DAMTP in 1979 and became a priest.

4. Polkinghorne at Queens' College from 1989 to 1996 and afterwards - a selective overview

Polkinghorne was installed as the 38th President of Queens' College, Cambridge, UK, on 7th July 1989. Even during his Presidency at Queens' College, Cambridge, he continued to express his views on the relationship between Science and religion to the public and society. Below are a few selected examples.

The Big Bang theory seems to have been the prevailing cosmological model explaining the existence of the Universe. Further evidence for the Big Bang theory was discovered in the 1990s. This might have challenged Christian faith. In his response to the discovery, he commented on it by saying: "The Creation story is happening today as it happened 15 billion years ago. But scientifically, if it is correct, it is quite interesting. It fills a gap in our understanding of Nature. There is quite a subtle relationship between Science and Theology. Neither of them determines the other. But we do talk about Creation differently now than before Darwin. Over the last 200 years, Science has had an antiseptic role, cleansing Theology. It has liberated Theology to do its proper role. The literal reading of the Creation account in Genesis was a development of late medieval times. Saint Augustine certainly didn't read the Bible like that." [A. Brown, *Big Bang evidence leaves Christian faith unmoved*, Independent, 25 April 1992]

In his reply to the question, i.e. "why popular science writers insist on invoking the name of God in their books", by Lee Elliot Major, Polkinghorne suggests that there is another reason why scientists allude to God: "The physical scientists are very struck with the rational order and beauty of the world. It is a

world that is, in some sense, shot through with signs of mind. The fact that beautiful Mathematics lies behind the fundamental Physics is a very remarkable fact about the world. The fact that the world is so very special, in a way that is necessary for its fruitful development is striking. So physical scientists think there's something going on here. There are signs of mind in the world. They use the mind-of-God type of language partly as a tacit acknowledgment of that. The biologists always talk as if Evolution were enough to produce complex life. It isn't. You have to have the right ground rules as well. Biologists are struck by the chanciness of the world; the role of contingency and evolutionary history…I think in some sense Physics is 200 years ahead of Biology. There was a great wave of atheism in the 18th century among physicists, and the biologists are the same today. The physicists got through that and they saw that the world wasn't just mechanical, there was something more subtle and interesting about it. Biologists will find the same - they will discover signs of mind in due course. They haven't quite got there yet. I think also there are a lot of people in the academic world who are sort of wistful travellers with religion; they cannot throw God away, but equally they fear some more developed form of religious belief would involve intellectual suicide. I believe this is totally mistaken. Faith is not a question of shutting your eyes, gritting your teeth and believing in impossible things because the Bible or the Pope or some other authority tells you so. It is the search for motivated belief, just as Science is the search for motivated belief. It would be foolish to try to talk about God without taking into account the great record of human religious experience, and religious tradition. And that's what a lot of these scientists who invoke God are trying to do. They are not taking that area of insight and experience seriously, and I think that's a mistake on their part. Everybody has to do that. It is as much true of the atheists as it is of the theists." [L.E. Major, *Written in His Image*, The Times Higher, July 22 1994]

Polkinghorne retired from his Presidency of Queens' College in September 1996. He was interviewed by Christian Tyler in January 1997. In Tyler's view, "Polkinghorne is a person in whom God and the Big Bang, Theology and Cosmology, religion and Cosmology, religion and Science are closely - and comfortably - combined". "God provides the best explanatory hypothesis. Science and religion reflect two aspects of a single reality. Together they provide a more satisfying account of the world than either on its own. They represent a real openness in the way the world works. Perhaps it should be open, not just to allow God to do things. The nexus of material causality can't be drawn so tight as to exclude some other form of causality. This is a very - heh, heh - conjectural area. God isn't there just to light the blue touch-paper of the Big Bang. Saint Augustine was right and Einstein saw he was right: there is no Before. And I'm against a God of the gaps, a sort of Cheshire Cat who gradually fades away. The biologists are offering just a whole series of Just-So Stories which even on their own basis are not very forcible. That's not a bad analogy [God as real as quarks]. Nobody will ever see a quark. You never pull them out because they're sort of stuck inside matter. But they make sense of a great

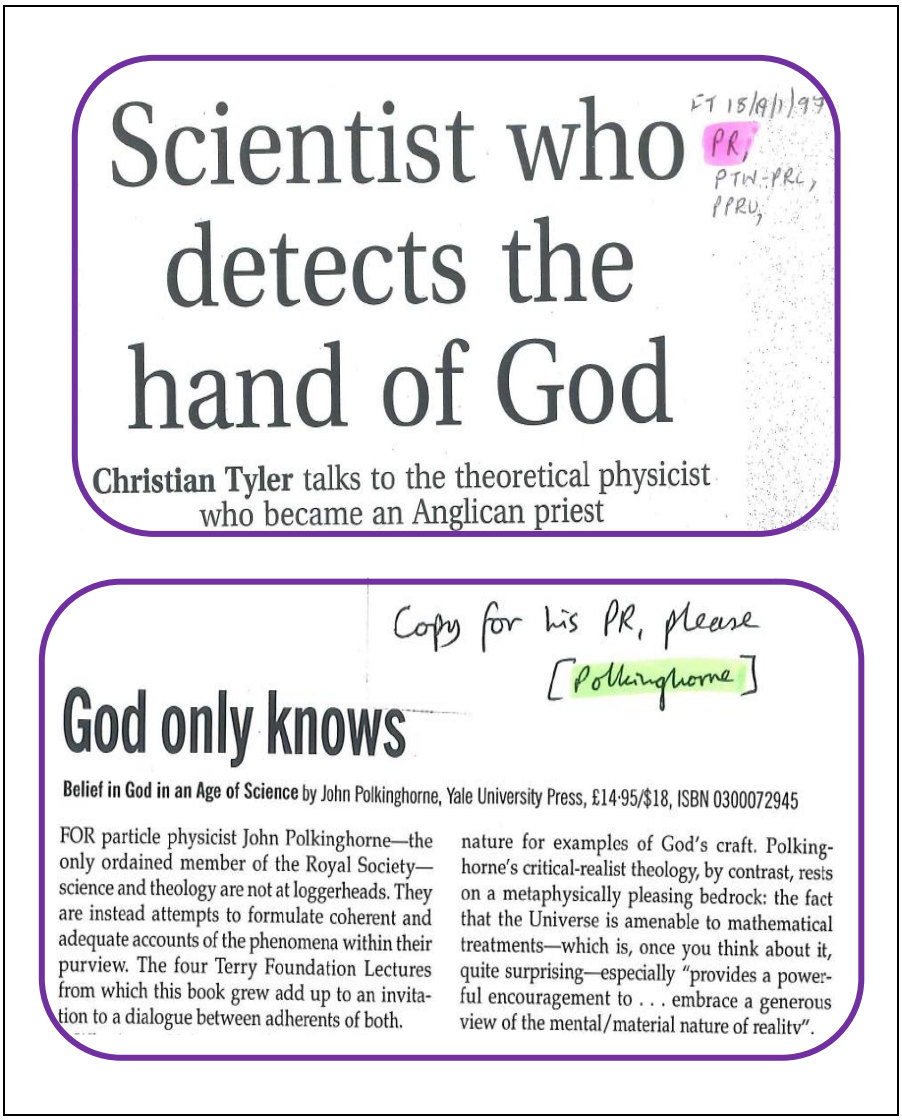
swathe of physical experience, of experiment. I believe in God for a rather similar reason. A useful meta-scientific concept. The reason that Science is possible is that the world is a creation. Of course, within Science itself I am methodologically an atheist. That is right. But I am by no means disposed to think that only scientifically useful concepts have meaning, value or truth about them. The concept of a Creator ties together a whole series of significant facts of our experience of the world. It would be foolish to think that every explanatory hypothesis had the character of a scientific hypothesis - like requiring that every item of food was made of meat. In some sense, I think it's been easy for me. It sometimes seems to me that Christianity is all too good to be true - heh, heh - you know. Then I say to myself: Deny it. I know I can never do that. The majority are not dismissive of religion in the way that the Dawkinses of this world are, but equally I think are wistful about it. They feel somehow or other it can't be embraced without committing some form of intellectual suicide. What I tend to say these days is not that Theology is the queen of the sciences but that Theology is the real Theory of Everything." [C. Tyler, *Scientist who detects the hand of God*, The Financial Times of London, 18-19 January 1997]

It is also interesting to note that Polkinghorne made copies of those articles containing his views during the interviews or the review of his book soon after they were published. He then sent them with his hand-written notes to his personal archive of the Royal Society of London (Figure 3). The abbreviated letters 'PR' may refer to the President of the Royal Society. If so, Polkinghorne not just tried to disseminate his views as widely as possible but also took his views very seriously.

Polkinghorne loved writing and this was one of his favourite occupations. During his stay at Queens' College, he completed his brief autobiographical notes. On 10th October 1995, Polkinghorne sent the notes to Mrs. Sheila Edwards, the Librarian, and suggested they could be put in his personal archive at the Royal Society of London (Figure 4).

To ensure that genetic tests were supplied safely and used ethically, John Horam, Parliamentary Secretary for Health, announced plans to establish an Advisory Committee on Genetic Testing, which was thought to be the first committee of its type in the world. He was particularly pleased that the Revd. Dr. Polkinghorne, President of Queens' College, Cambridge, had agreed to chair the Advisory Committee (*the UK DEPARTMENT OF HEALTH Press release*, 10 January 1996).

It appears that Polkinghorne had numerous interactions with scientists of Christian faith even after his Presidency of Queent's College. As a selected example, Dr. Stephen C.Y. Liu was the late Professor of Microbiology and Molecular Biology at the Michigan State University, USA. Polkinghorne met Liu During Liu's visit to Cambridge in 2001 (Figure 5). Liu worked as a biologist for more then 30 years and was a disciple of Jesus for more than 50 years. He felt that his Christian faith was his eternal hope for his life. As Christian and a scientist, Liu wrote a Chinese book entitled *Science and Christian Faith: Their Relationship in the Past, Present and Future* [15].



Scientist who detects the hand of God

FT 15/9/1/99 PR, PTW-PRC, PPRU,

Christian Tyler talks to the theoretical physicist who became an Anglican priest

Copy for his PR, please [Polkinghorne]

God only knows

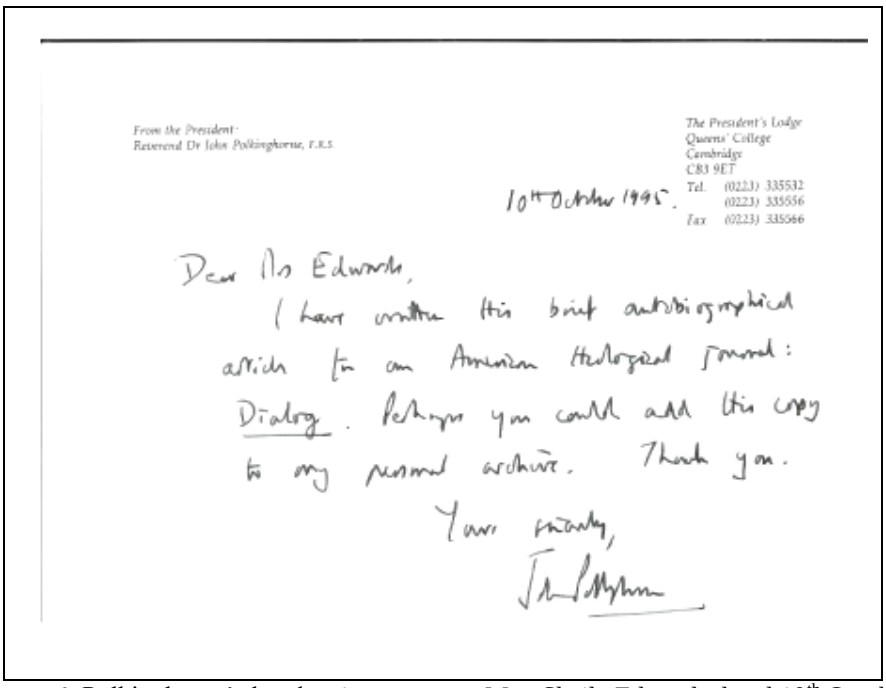
Belief in God in an Age of Science by John Polkinghorne, Yale University Press, £14·95/$18, ISBN 0300072945

FOR particle physicist John Polkinghorne—the only ordained member of the Royal Society—science and theology are not at loggerheads. They are instead attempts to formulate coherent and adequate accounts of the phenomena within their purview. The four Terry Foundation Lectures from which this book grew add up to an invitation to a dialogue between adherents of both.

nature for examples of God's craft. Polkinghorne's critical-realist theology, by contrast, rests on a metaphysically pleasing bedrock: the fact that the Universe is amenable to mathematical treatments—which is, once you think about it, quite surprising—especially "provides a powerful encouragement to . . . embrace a generous view of the mental/material nature of reality".

Figure 3. Upper: a portion of Christian Tyler's article in *The Financial Times of London* containing Polkinghorne's views on Science and religion with Polkinghorne's hand-written notes on the top-right. Lower: a portion of book review of Polkinghorne's book *Belief in God in an Age of Science* in *New Scientist* 4 July 1998, page 46.

Even after his retirement, as a leading scientist and theologian, Polkinghorne was still very concerned with society and humanity. For example, in a strong response to Dr. Panayiotis Zavo's reports of the first human cloning, Polkinghorne hit out, claiming his colleagues on the ethical fringes are "imposing their own genetic will on other people" [The Church of England Newspaper, 22 January 2004]. In Polkinghorne's view, no person should undertake such activity, regarding the Cyprian-born scientist's actions as reckless and unethical.



From the President
Reverend Dr John Polkinghorne, F.R.S.

The President's Lodge
Queens' College
Cambridge
CB3 9ET
Tel. (0223) 335532
(0223) 335556
Fax (0223) 335566

10th October 1995.

Dear Mrs Edwards,

I have written this brief autobiographical article for an American theological journal: Dialog. Perhaps you could add this copy to my personal archive. Thank you.

Yours sincerely,

John Polkinghorne

Figure 4. Polkinghorne's hand-written notes to Mrs. Sheila Edwards dated 10th October 1995 regarding his brief autobiographical article.

Figure 5. Polkinghorne with Stephen C.Y. Liu in 2001 in Cambridge, UK. Photo credit: Stephen C.Y. Liu.

Polkinghorne wished other countries would follow the UK's example where reproductive cloning is illegal. Polkinghorne thought cloning to be widely considered to be ethically unjustified. There would always be scientists prepared to disrespect ethics in the name of progress, but the majority of scientists want to act ethically. It is a widely held principle. If also underwritten by Christian beliefs, then life is an end not a means. Even if the risks involved in cloning were to be removed and it became as straightforward as IVF (in vitro fertilisation), you would still be determining genetic make-up and imposing your own genetic will. Polkinghorne thought no person can undertake this.

When interviewed by Jonathan Margolis, Polkinghorne expresses the following views: "Faith isn't a question of shutting your eyes, gritting your teeth and believing six impossible things before breakfast because some unquestionable authority has told you to. It's a search for truth. Science is great, but it's not the whole story. It deals with repeatable experience, but we all know that in our personal lives, experiences aren't repeatable. And you simply couldn't demonstrate how someone is your friend, or what music is. I believe God reveals his nature in many ways. They're not demonstrations that knock you down, but they are very striking things about the world that are best understood as the work of God. The wonderful order of the world, which we scientists investigate, is a sign that there is a divine mind behind that order." [J. Margolis, *For Christmas week, we asked some eminent scientists if it's possible to reconcile reason with religious faith*, Mail Online, 20 December 2008]

In his short article about religion and Science for an 800th Anniversary Portrait, Polkinghorne reiterates that The University of Isaac Newton is an institution in which one would expect there to be serious intellectual discussion concerning how the scientific and religious world views relate to each other, although by no means all Cambridge scientists have been sympathetic to religious belief [16].

Surely, there has been a mixed record about the relationship between Christianity and Science. In a review of *Some Lessons from History*, for the Galileo case, Polkinghorne gave us his view: "With hindsight we can see clearly that in the Galileo case the Church made some bad mistakes, but these should serve as warnings of the need for future carefulness rather than discrediting the possibility of positive interaction between Science and Theology" [17].

The present author agrees with his views.

5. The present author's connection with Polkinghorne

5.1. Inspirations from the great geniuses

"…a man's religion is an essentially private matter, and one concerning himself alone." [18]

In the present author's view, Charles Darwin's view also implies that Charles Darwin might be religious as well. The present author partially agrees with Darwin but does feel that we should talk about and discuss religion since it

is essentially home or hope of man's soul, and it can shape man's mind. One may wonder 'What on Earth am I here for?' The present author feels that sharing this private matter with others may help them in one way or another.

However, what is religion? The present author feels shamed since he did not really understand the meaning of this word until Professor Alain Pumir explained it to him in an e-mail dated on 4 October 2021. The word *religion* in English originated from The Latin *re-ligio*, which means to re-link, to re-connect, and to restore our personal/spiritual relationship with God. Generally, the word *religion* connects with *religare*, to bind.

As a scientist, the present author has been pleased to know about the Christian faiths by the writings of those Western geniuses and scientists quoted earlier in the present document. As noted in Turnor [19] and Keynes [20], according to MSS. Conduitt, Sir Isaac said a little before his death: "I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

From Newton's entire life, we may interpret that the great ocean of truth mentioned by Newton might be twofold: half of it is the scientific one while half of it the religious one. Similar speculation is also presented in Pelikan [21].

"And he [Maxwell] said rightly, for true science is not, and cannot be, at variance with religion." [P.G. Tait, *Religion and Science*, The Scots Observer, December 8, 1888; 22]

In his book entitled *Encounter with Mathematics*, Lars Gårding (1919-2014), a Swedish mathematician, outlines the general model of the Christian confession of faith as follows: "The Christian confession of faith is a concise description of a model of the Universe ruled by an almighty god who created it and governs over all life on Earth, who punishes and rewards. A god of this kind is the answer given by many religions to man's wish to know his place in the Universe and the purpose of his life." [23]

When the present author was learning of Mathematics, he was greatly inspired and motivated by those geniuses that had their great thoughts of Mathematics' relation with God. Below are some selected examples: "The chief aim of all investigations of the external world should be to discover the rational order and harmony which has been imposed on it by God and which He revealed to us in the language of Mathematics" (Johannes Kepler (1571-1630)) [24]. "God created the natural numbers; everything else is man's handwork." (Leopold Kronecker (1823-1891) [25] "An equation for me has no meaning unless it expresses a thought of God." (Srinivasa Ramanujan (1887-1920)) [26]

Being inspired by Kepler, Kronecker, Ramanujan, Dirac, and others, the present author has already been fully convinced that God is a mathematician of a very high order. This has become a primary motivation of the present author's learning of Mathematics.

The present author confesses that Christian faith gradually became the home or hope of his soul and also greatly shaped his mind, in what to think and how to think. As an example, when the present author became interested in turbulence, he realized that it is closely related to God. Below are similar views by British scientists. "Lamb remarked 'I am an old man now, and when I die and go to Heaven there are two matters on which I hope for enlightenment. One is quantum electrodynamics, and the other is the turbulent motion of fluids. And about the former I am really rather optimistic.'" [27] "…he (Keith Stewartson (1925-1983)) regarded the whole phenomenon of turbulence as being unrigorous and probably invented by the Devil on the seventh day of Creation (when the Good Lord wasn't looking);…" [28] "It seems that Nature has a nice sense of irony. On the one hand we have a physical quantity, **u**, which behaves in a random fashion, yet is governed by a simple, deterministic equation. On the other hand the statistical properties of **u** appear to be well behaved and reproducible, yet we know of no closed set of equations which describes them!" [29]

There have been other interesting views, e.g. Dame Jane Morris Goodall said in September 2010: "I don't have any idea of who or what God is. But I do believe in some great spiritual power. I feel it particularly when I'm out in nature. It's just something that's bigger and stronger than what I am or what anybody is. I feel it. And it's enough for me." [*Jane Goodall's Questions & Answers*, Readers Digest, 128, September 2010]

5.2. How is it possible to be both Chinese and a Christian?

"…on the Gentiles also was poured out the gift of the Holy Ghost" (The Acts 10.45)

When the present author contacted Professor MacFarlane regarding his view about the writing up of this article about Polkinghorne, he kindly encouraged the present author to write it up and perhaps to write something on how it is possible to be both Chinese (where traditionally there was no God, the family was paramount over belief, there were no absolutes, etc.) with being a Christian. It may not be easy to answer his question. However, his question is indeed interesting. MacFarlane's question is perhaps more relevant to the first Chinese to encounter Christianity than to the present day where much of Chinese and world thinking are the same. As briefly presented in subsection 1 of section 5, ancient Chinese did have the concept of God. Other Chinese may also argue that Jesus Christ was not Chinese at all and thus they cannot or do not believe in non-Chinese. It is obviously not true for the arts, Science, engineering and not even for religion since many Chinese are Buddists, a 'religion' which originated in India.

"Having made known unto us the mystery of His will, according to His good pleasure which He hath purposed in Himself; that in the dispensation of the fullness of times He might gather together in one all things in Christ, both which are in Heaven, and which are on Earth; even in Him." (Ephesians 1.9-10)

Can we find any clues or answers to Professor MacFarlane's query? We now take a close look at the Holy Bible. "And they of the circumcision which believed were astonished, as many as came with Peter, because that on the Gentiles also was poured out the gift of the Holy Ghost." (The Acts 10.45). 'the Gentiles' may not include Chinese, however, we can infer with certainty from Ephesians 1.9-10 and other parts of the Bible that all nations or nationalities on Earth, e.g. Chinese, should be inclusive in 'all things' and thus 'the mystery of his [God's] will' as well.

Scripture states "…as it is now revealed unto his holy apostles and prophets by the Spirit: That the Gentiles should be fellow heirs, and of the same body, and partakes of his promise in Christ by the Gospel" (Ephesians 3.5-6). The Gentiles should include other nations including Chinese. In Mark 6.15 Jesus says: "Go ye into all the world, and preach the Gospel to every creature". Clearly, 'all the world' and 'every creature' should include Chinese. Scripture states, "To whom God would make known what is the riches of the glory of this mystery among the Gentiles; which is Christ in you, the hope of glory" (Colossians 1.27); 'the Gentiles' here can include Chinese. The present author has been generally satisfied with the inspirations or wisdoms hidden in these lines in Scripture, which have fully convinced the present author, even as a non-Jewish but Chinese, to have his Christian faith.

As a historical anecdote, Xu Guangqi or Paul Hsü Kuang-ch'i (1562-1633), a Chinese agronomist, astronomer, mathematician, politician and writer in the Ming Dynasty, was asked by the Emperor, "There were so many religions and Gods in our own Chinese history, why do you believe in a non-Chinese God, Jesus?" Xu or Hsü replied by saying that such ideas, "*Love your enemies* (Matthew 5.44), "…*Inasmuch as ye have done it unto one of the least of these my brethren, ye have done it unto me*" (Matthew 25.40), must be from a real God [who he could trust in]. The present author is also greatly inspired by Xu's or Hsü's understanding in one way or other. The present author cannot claim any deep historical Chinese classics expertise but can confirm that there is no concept of "*Love your enemies*" in any Chinese classics at all. In the present author's view, "*Love your enemies*" is indeed a wisdom for all nations or human beings. It was when we were still God's enemies (Colossians 1.21 and Romans 5.10) that He [God] demonstrated His love for us. Through Jesus (Romans 5.8) God's love brought salvation to us.

As discussed before, in the Preface to his book *The Notions of the Chinese Concerning God and Spirits*, Legge interpreted from the Chinese classics that the knowledge of Himself [God] [was already] possessed by "*a large portion of His[God's] human family, and the terms by which His servants may best express His own name, and the second [third] person in His triune nature, in translating His revealed word*!" [30] Clearly, in Legge's view, Chinese are "*a large portion of His [God's] human family*".

5.3. The present author's connection with Polkinghorne

"Test everything; hold for what it is good." (1 Thessalonians 5.21)

Polkinghorne did not use the e-mail much for his communication. In his own words, he does not use email much to the irritation of his friends. However, he seemed to have left Nicholas Beale's e-mail or a phone number for any correspondences. The present author gathered from a web page that he was able to contact Polkinghorne through Beale. In 2012, just before the present author went to Cambridge, he reached out to Beale by an e-mail. After a while, Beale replied to the present author that Polkinghorne agreed to see him in Cambridge. The present author was delighted.

On the present author's arrival in Cambridge in September 2012, Dr. Abraham Karpas, an international known haematologist, the present author's landlord in Cambridge, kindly gave him a Cambridge tour and highly recommended him the Canteen of the University Centre for his future lunch. On Sunday 23 September 2012, the present author went there for a lunch. What a happy coincidence, Polkinghorne was having a lunch with his grandchildren. The present author met Polkinghorne for the first time. He kindly agreed to have a photo with the present author (Figure 6). On this occasion, Polkinghorne gave his home address to the present author and made an appointment for the present author's visit to him on Sunday 18 November 2012.

Figure 6. Polkinghorne with the present author at the Canteen of the University Centre, Cambridge, UK on Sunday 23 September 2012. Photo Credit: John Z. Shi.

On Sunday afternoon of 18 November 2012, the present author went to see Polkinghorne at his home (Figure 7) to meet him a second time. Polkinghorne said to the present author that "When you look back, you will be able to feel that there was a God on the way". Polkinghorne was as generous in

spending time with the present author as he was with other visitors. The present author in recalling this visit feels that the chance to chat with Polkinghorne was a privilege and a bonus.

Figure 7. Polkinghorne's house in Cambridge. Photo by John Z. Shi in 2012.

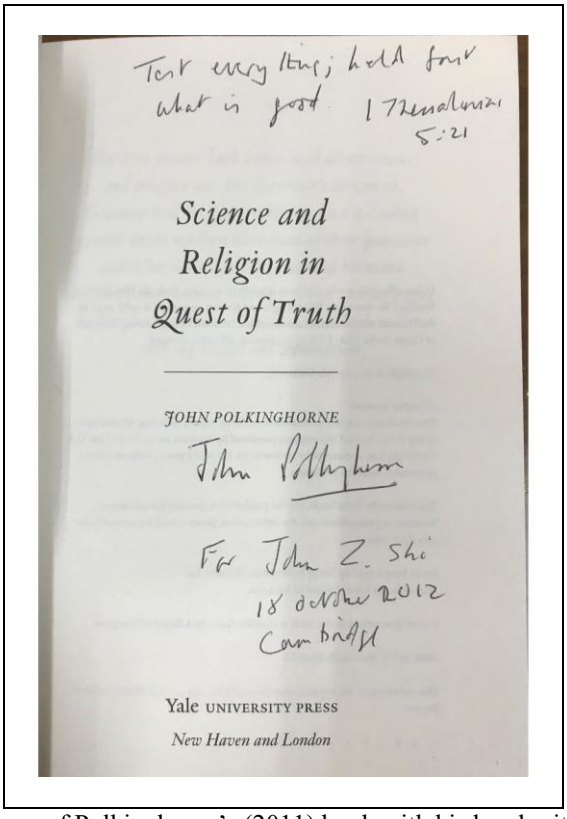


Figure 8. Front page of Polkinghorne's (2011) book with his handwritten biblical notes (1 Thessalonians 5.21) to the present author on Sunday 18 November 2012.

During the present author's visit, Polkinghorne presented him a new book entitled *Science and Religion in Quest of Truth*, and wrote some biblical notes (1 Thessalonians 5.21) on the front page (Figure 8).

The present author spent the Michaelmas Term of 2019 at the Emmanuel College, Cambridge, UK. During this stay, after consulting with Professor H. Keith Moffatt, the present author went to see Polkinghorne on Sunday 15 December 2019 at his home in Cambridge and met him a fourth and last time. Because of his aging, Polkinghorne required a full-time career. The covid-19 later made Polkinghorne move into a nursing home.

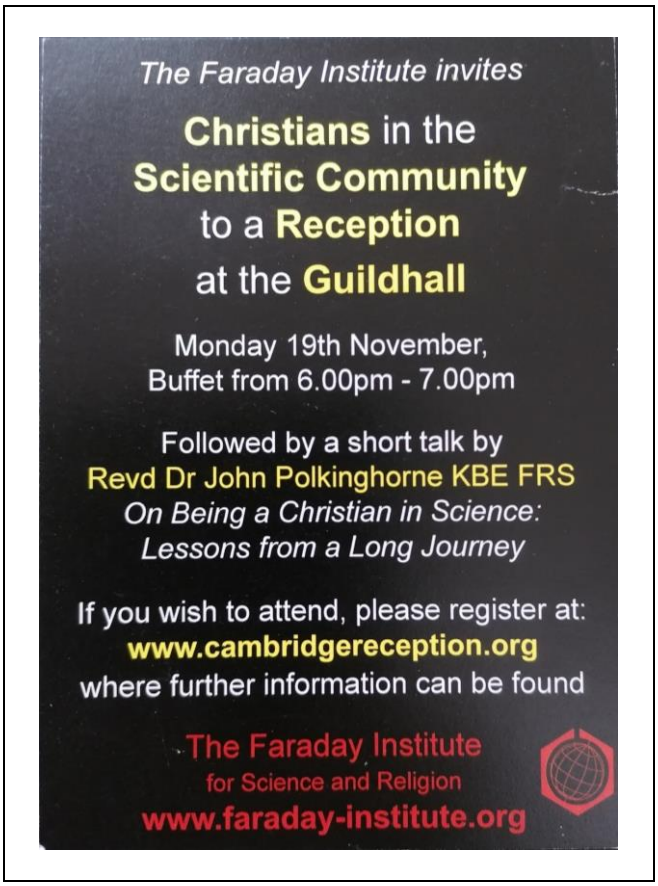


Figure 9. A poster showing information about a short talk by Polkinghorne entitled *On Being a Christian in Science: Lessons from a Long Journey* at the Guildhall, Cambridge, UK, held on Monday evening 19 November 2012.

6. Polkinghorne's inspirations for young Christians in the scientific community

Polkinghorne had also inspired young Christians in the scientific community. The Faraday Institute for Science and Religion was found in 2006 and based at St. Edmund's College, Cambridge, UK. At the beginning of the

Michaelmas Term each year, the Cambridge Inter-Collegiate Christian Union (CICCU) together with the Faraday Institute for Science and Religion, organize a Reception at the Guildhall, Cambridge, UK. As shown in Figure 9, Polkinghorne was invited to give the Young Christians a short talk *On Being a Christian in Science: Lessons from a Long Journey* on Monday evening 19th November 2012. The present author, as a senior scientist, turned up there, and met Polkinghorne a third time. It was a bit unfortunate that the present author did not clearly hear Polkinghorne's address. However, the present author could feel the warmth of Polkinghorne's presence.

7. Polkinghorne's relationship with other Templeton Prize laureates

"All of Nature reveals something of the Creator. And God is revealing himself more and more to human inquiry, not always through prophetic visions or Scriptures but through the astonishing productive research of modern scientists." (Sir John Marks Templeton (1912-2008)) [https://www.templeton.org/about/sir-john]

The Templeton Prize, which was established in 1972, honours individuals whose exemplary achievements advance Sir John Templeton's philanthropic vision: harnessing the power of the sciences to explore the deepest questions of the Universe and humankind's place and purpose within it [https://www.templetonprize.org/templeton-prize-history/].

Figure 10. Polkinghorne with three other Templeton laureates in 2005: Ian Barbour (1999 laureate), Holmes Rolston (2003 laureate), John Polkinghorne (2002 laureate) and George Ellis (2004 laureate). Photo Credit: Judith Marchand, https://mountainscholar.org/handle/ 10217/67437?show=full, Colorado State University Libraries, Archives & Special Collections, with permission.

Polkinghorne received the Templeton Prize in 2002. His expressed the following views at his receipt of the Templeton Prize: "I want to take Science and religion with great and equal seriousness. I see them as complementary to each other and not as rivals. The most important thing that they have in common is that both believe that there is a truth to be sought and found, a truth whose attainment comes through the pursuit of well-motivated belief. Of course, the two forms of enquiry view reality from different perspectives, Science studying the processes of the world, while religion is concerned with the deeper issue of whether there is a divine meaning and purpose behind what is going on. I believe that I need the binocular approach of Science and religion, if I am to do any sort of justice to the deep and rich reality of the world in which we live. I think of myself, and of some of my colleagues in this task, as being 'two-eyed' scientists-theologians." [https://www.templetonprize.org/laureate/john-c-polkinghorne/]

This shows explicitly the interesting way in Polkinghorne's life that he combined Science and religion.

Figure 11. Polkinghorne with six other Templeton Prize laureates in 2012 (from left to right): Charles Taylor (2007 laureate), Freeman Dyson (2000 laureate), John Polkinghorne (2002 laureate), John D. Barrow (2006 laureate), Ian Barbour (1999 laureate), Holmes Rolston (2003 laureate) and Lord Martin J. Rees (2011 laureate). Photo Credit: Clifford Shirley, https://mountainscholar.org/handle/10217/67441, Colorado State University Libraries, Archives & Special Collections, with permission.

Figures 10 and 11 show Polkinghorne with other Templeton Prize laureates. As an interesting example, one of them, Lord Martin J. Rees (FRS 1979) (right in Figure 11), a student and friend of Polkinghorne's, describes himself as "a practising but non-believing Christian" [31].

8. A brief discussion

"With the utmost freedom of thought we are bound to reach the conclusion that Science is not antagonistic to religion, but that it is a help to religion." (Lord Kelvin) [7]

Throughout the British history of Science, the present author has found that numerous giants had their Christian faith. As an example, Lord Kelvin remained a devout believer in Christianity throughout his life. He saw his Christian faith as supporting and informing his scientific work.

What is Polkinghorne's role within the general context of the British history of Science and religion? From a historical perspective, following up Francis Bacon (1561-1626), Robert Boyle (1627-1691), Isaac Newton (1642-1727), Michael Faraday (1791-1867), George Gabriel Stokes (1819-1903), Lord Kelvin (1824-1907), James Clerk Maxwell (1831-1879), Peter Guthrie Tait (1831-1901) and William Bragg (1862-1942), Polkinghorne had continued to inspire many in the study of the dialogue between Science and religion.

Stokes, a great mathematician and fluid dynamicist, made a significant contribution to the debate on the relationship between Science and religion in Victorian Britain [32]. In the present author's view, following up Stokes, Polkinghorne had indeed continued to inspire many in the study of the dialogue between Science and religion in his time.

9. Conclusions

The key message of forgiveness is that God has forgiven me.

When the present author attended a part of the service in the Jesus College Chapel, Cambridge, UK, on Sunday 20 October 2019, The Revd. Lesley Belinda shared her sermon topic above with the present author. This is on the present author's own experiences in becoming Christian.

It is generally difficult for the present author to decide what to choose for Conclusions of this article, but the following particular observations are made:

(1) From Polkinghorne's expressed views on his search for truth using a binocular vision of both Science and religion, and that Science and religion are complementary to each other, i.e. they are friends, not foes or rivals, we may think hat it is neither odd, nor disingenuous, for Polkinghorne to be both a physicist and a priest.

(2) The present author feels that one should be cautious about his/her relationship with a religious faith: (i) if this relationship is conducted properly and well, a religious faith can engender wisdom and a better way of life; (ii) if not conducted with due reverence, thought, and humility, a religious faith can lead to foolishness, arrogance or cruelty.

(3) The geographical separation of home countries makes it impossible for the present author to claim to know Polkinghorne well, or even at second hand, but it is hoped that a unique and useful personal perspective has been provided in this article which does credit to Polkinghorne and to his beliefs

that Science and religion are not in opposition but can be used in tandem to further an improved understanding of the Cosmos and man's place in it.

10. Appendix - John C. Polkinghorne's brief autobiographical notes: From Physicist to Priest

I grew up in the country and in a Christian home. My parents were regular worshippers at our local Anglican parish church and, since I was a well-behaved child, I accompanied them willingly from an early age. No particular provisions were made for children but we had a vicar who was a skilful preacher, able to make biblical passages come alive, and I used to enjoy listening to him. I absorbed Christianity through my pores. Religion was obviously important to Mother and Father but they were people who did not naturally talk much about it and I received little in the way of formal religious instruction at home. When I was about eight an aunt of mine let me have a little book of private prayers that I had found lying around in her home and I used these regularly and somewhat secretly.

I am, therefore, a cradle Christian. I cannot remember a time when I was not in some way a member of the worshipping and believing community of the Church. The figure of Jesus has always been central for me and no view of reality would begin to be adequate which did not fully take the phenomenon of Christ into account. I have not been given the gift of an untroubled faith - I sometimes think that Christianity might be too good to be true - but when that mood is on me I say to myself 'Well then, deny it' and I know that I could never do that. Christ's side is one on which I have to take my stand.

When I was fourteen we moved from Somerset to Ely and I went to school in nearby Cambridge. The Perse School, which I attended, was small and very academic and for the first time I encountered clever boys who did not believe in God. We used to argue, but my faith survived that and a subsequent spell of national service in the Army before coming up to Cambridge in October 1949 to study Mathematics at Trinity College.

In my first week as an undergraduate I was taken to a Freshers' Sermon preached on behalf of the Christian Union. The preacher used the story of Zacchaeus's meeting with Jesus as He passed through Jericho on His way to His death at Jerusalem, as the basis of a challenge to respond to Christ right now, to take this unique opportunity. I was strongly moved and went forward at the end among a crowd of those who wished to make a decision for Christ. For some years afterwards I would have spoken of this as my 'conversion', but I now understand it as a moment of deeper Christian commitment along a pilgrimage path that I was already treading.

There followed a number of years of close involvement with the Christian Union. I have mixed feelings about that time. The conservative evangelical Christianity which I embraced so wholeheartedly gave me certain gifts which I continue to value and seed to retain: the importance of a personal commitment to Christ and a love of Scripture. Yet it also promoted a narrow view, both of the

varieties of Christian experience and of the relevance of general culture. There was a kind of defensiveness, even fearfulness, in the face of sources of truth not guaranteed as 'sound'. Nowhere was this more apparent than in its treatment of the Bible. I have found it immensely enhancing for my own use of Scripture to be able to recognize its human and cultural character. Whilst still discerning its inspired and normative status. The Church of England is such a broad comprehensive Church that its members are always being invited to identify themselves as adherents of one particular party or another. Today I find it difficult to choose a label for myself, but 'catholic' would certainly be part of it. I value greatly the sacramental life and the accumulated insights of the Christian tradition. I feel most spiritually at home on the occasional visits I am able to make to a small community of Anglican nuns (the Society of the Sacred Cross) living a Benedictine life in the Welsh countryside.

My undergraduate studies at Cambridge were in Mathematics. I had chosen the subject because I was good at it and liked getting things right, and also because my mathematical imagination had been kindled at school by an outstanding master who taught me. At the university I got interested in how one could use Mathematics to understand the deep structure of the physical world so that I embarked on a PhD in 1952 it was in the area of theoretical elementary Particle physics. This was the beginning of a long career as a physicist, which lasted till 1979. It was an exceptionally interesting period in the development of my subject since it spanned the long struggle, by means of experimental discovery and theoretical insight, which eventually uncovered the quark level in the structure of matter. My own work was very much on the mathematical side of this great collaborative enterprise and I attained a modest degree of professional success, becoming Professor of Mathematical Physics at Cambridge University in 1968 and being elected a Fellow of the Royal Society in 1974.

Nevertheless, I had long thought that I would not remain in Particle physics all my life. The subject was always changing in response to new ideas and new discoveries. When one was young, this state of intellectual flux was exciting; it became somewhat more tiring as one grew older. In mathematical thinking, most of us loose in middle age the flexibility of mind that is a characteristic of youth. We can still do the old tricks but it becomes harder to learn or to invent new ones. I had seen many senior colleagues get somewhat miserable as the subject moved away from them. I resolved I would leave Physics before Physics left me. I felt I owed this, not only to myself, but also to the young workers in the large research group I was privileged to lead. As my fiftieth birthday approached, and as a particular era in Particle physics came to a close with the establishment of what is called the Standard Model, I realized that the time had come for me to go. I was not leaving Physics because I had in any way become disillusioned with it, but I had done my little bit for the subject and now it was time to do something else.

I like being with people. I value the Eucharistic life. I had some experience of being a Lay Reader (an unordained local preacher). These considerations encouraged in my mind the idea of a possible vocation to the

Anglican priesthood. Fortunately, my wife Ruth concurred - it was necessarily a joint decision. The next step was to have my vocation tested and considered by a selection committee, a collection of wise and experienced people appointed by the Church for that purpose. They too concurred, and I was subsequently grateful, not only for that decision but also for the care with which I felt it had been taken.

So October 1979, just before my forty-ninth birthday, saw me a beginning student at Westcourt House, a small Anglican seminary in Cambridge in the liberal Catholic tradition. I was the oldest person in the House, older that the Principal even! It was very odd becoming a student again - I found out how much more difficult it is to listen to a lecture for an hour than to give one - but I had a lot to learn during my two-year course. Perhaps the most important lesson of all I learned was to value the Daily Office, the round of morning and evening prayer and praise, psalmody and Scripture, which it is the obligation of an Anglican priest to recite faithfully. It provides the spiritual framework for my life today.

Just before I went to Westcott, a theologically knowledgeable friend of mine suggested to me that I should read Jurgen Moltman's The Crucified God[1]. I had done a little desultory theological reading on and off over the years, but this was perhaps the first substantial theological work which I read with serious attention. I was deeply affected by it and Moltman has been one of the major theological influence on me ever since. I can understand the criticisms which some make of the occasionally rather uncontrolled exuberance of his writing, but for me he is a person of exciting theological ideas which span the two horizons of the biblical witness and the demands of the century of the Holocaust.

I cared for Physics, and I continue to do so, but I have come to realise that Theology grips me much more profoundly than Science ever did. Yet the personal paradox is that I shall never be able to become a professional theologian. I do not have the time or opportunity to recapitulate that long apprenticeship and involvement with a world-wide academic community which is the indispensable requirement of becoming a fully-fledged practitioner. I do not think this means that I have nothing to contribute to theological thinking, but I am aware of my limitations. I cannot claim to be more than a scientist with serious theological interests. I have to say that I wish I met a few more theologians who have serious scientific interests. The interdisciplinary field of encounter between the scientific and theological world-views, which has been my predominant intellectual interest over the last fifteen or so years, calls from all its participants for a certain acceptance of risk and a certain charity towards the efforts of others with different backgrounds.

On ordination, an Anglican clergyman spends three years in apprenticeship to the parochial ministry. It is called serving one's title and I did mine in perfectly ordinary parishes in Cambridge and Bristol. Once licensed to go solo, I became Vicar in charge of a large village parish outside Canterbury. All in all, I did five years in this kind of work. In addition to preaching and taking services, it involved a good deal of wandering around, knocking on doors

and drinking cups of tea with people who were in some sort of trouble, such as illness or bereavement. The Church of England is a national Church with a responsibility to the whole community. Only a minority of those I visited were in any way active participants in worship.

I enjoyed this life very much, but of course there were intellectual aspects of me which were not greatly exercised in the course of it. I had thought originally that I had left the academic world for good, but I gradually came to recognize that thinking and writing about Science and religion was part of my vocation, the particular way in which I might serve the Christian community. When an unsought opportunity came in 1986 to return to Cambridge as the Dean of Trinity Hall (a job equivalent to being the parish priest of that academic 'village') I decided, after some thought, to accept it. Three years later I received an equally unexpected invitation to become the President of Queens' College, Cambridge (the Head of the College, but not its Chief Executive, rather a kind of eighteenth century constitutional monarch in its society). This essentially secular job was possible for me because Queen', like all the ancient colleges at Cambridge, has a religious basis as part of its foundation. I continue to exercise a degree of priestly ministry as I share with our Dean in celebrating the Eucharist and preaching in the College Chapel.

My main intellectual activity is writing. I love the task of composition, the search for as clear a way as possible to convey what I want to say. The late Bishop John Robinson of Honest to God fame (who ordained me priest) once said to me that he could not think without a pen in his hand. I knew at once what he meant. As one reads and thinks, ideas buzz around in one's mind. It is the act of writing which causes this flux of thought to condense into some coherent thread of argument. I write all my manuscripts in scribbled longhand because, when the structure really begins to form, I cannot type fast enough to keep up with myself.

My first book in the Science and religion area arose out of my experiences on leaving Physics. I could not quit right away, for I had obligations to my graduate students which had to be fulfilled through an orderly withdrawal. In the eighteen months it took me to wind up my scientific affairs, I had quite a few conversations with colleagues over a cup of coffee in some laboratory canteen as they asked me what on Earth I was up to? Mostly, they were probing my reasons for Christian belief. In half an hour or so I could no more do justice to that theme than I could have conveyed to an arts friend, on a similar timescale, my reasons for belief in quarks. I decided I would put down on paper what I would have said if I had had a few hours at disposal. The result was a small book with a grandiose title: *The Way the World Is*[2]. There isn't a great deal of explicit science in the book (the first publisher I approached rejected it on those grounds) but it exemplifies in a simple way a conviction that runs through much of my writing: that religious insight, like scientific insight, depends upon the search for motivated belief. The title was intended to convey that idea of rationally grounded understanding, rather than constituting a ridiculous claim to total metaphysical adequacy!

I did not have time for writing when I was a curate learning the trade but as I wandered round the streets of my working class parish in Bristol, I used to think about the similarities and differences of Science and religion and what they had to say to each other about the one world of human experience. When I came to Kent as a vicar, part of the arrangement was that I should have a chance to write and this enabled my thoughts to crystallise into *One World*[3], a survey of the scene which has proved a fairly steady seller.

I have never been able to see more than a book ahead and I did them envisage writing a trilogy of little volumes on the topic of Science and religion. However, the other two offerings followed in fairly quick succession. *Science and Creation*[4] is mainly concerned with two themes. One is the revival, as I see it, of natural theology in the modest mode of proffered insight based on the very structure of the laws of Nature themselves which seem, in their deep rational beauty and intelligibility and in their 'finely-tuned' anthropic fruitfulness, to point beyond Science to a mere profound Reality. This is an insight that is particularly appealing to someone whose scientific experience has been in fundamental Physics. Biologists see a more messy and ambiguous picture of the process of the world and the second theme I tried to address was that of an evolutionary world 'making itself' in an unfolding act of continual Creation, necessarily precarious and costly in its character. Here I was helped by the thoughts of my seniors, Ian Barbour and Arthur Peacocke, and by W.H. Vanstone's wonderfully insightful *Love's Endeavour, Love's Expense*[5], another book which I had read early in my theological studies and which has remained an abiding influence.

In chapter five of *Science and Creation*, I began the tentative exploration of a theme which has recurred in much of my subsequent writing: that we should seek to understand the relationship of mind and matter as being that of complementary poles of a single 'world stuff' in flexible and open organization. The task of a proper understanding of this metaphysical issue is far beyond my modest capacity (or that of any one today, I believe) but I have come to think that the insights of so-called chaos theory may offer a clue to a useful direction in which to wave our hands in cautious speculation. I propose that the undoubted unpredictabilities of these exquisitely sensitive physical systems should be treated, not as unfortunate signs of epistemic ignorance, but as sources of ontological opportunity. Coining the phrase '*Epistemology models Ontology*' as a slogan of scientific realism, I suggest that the ontology of deterministic equations aligns poorly with the epistemology of intrinsic unpredictabilities and that it should be replaced (as almost everyone does in the case of quantum uncertainties) by a more subtle and supple ontological account. This leads eventually to the notion of an enhanced range of causal principles in which the 'bottom-up', bits and pieces, energetic causality of physics is supplemented by the operation of 'top-down' causality of a non-energetic, patter-forming, kind that might be called 'active information'. I suggest that this is how we act in the world and that it is consistent to suppose that God interacts with Creation in this mode also.

My first sustained attempt to discuss divine action was in the third book of the trilogy, *Science and Providence*[6]. Here I also took up a theme to which I have returned in later writing, the consideration of how God relates to time. Although contemporary science affords no satisfactory account of the basic human experience of the present moment, my view is, 'so much the worse for Science!'. I reject a block Universe account[7] and assert the true temporality of the world. Since God knows things as they really are, I believe that this implies that God knows creation in its temporality. In my view, there must be a temporal pole to the divine nature in addition to an eternal pole (an idea which I accept from the process theologians whilst rejecting a number of their other proposals), and that even God does not know the unformed future.

My writing has been characterized by a succession of short books. I think and read about a topic and then reach a stage at which I have to try to set down what I think about it. This seems to result in a series of volumes of just over a hundred pages. I try to write with all the intellectual seriousness and scrupulosity I can muster but I do not write in an overtly academic style. This is a deliberate choice; I decided early on that my target audience should be two-fold: the educated unbeliever whom I am wishing to persuade of the rationally motived credibility of Christianity and the educated believer whom I am wishing to persuade to take Science seriously and to enhance Christian understanding by so doing. I do not think these aims are inconsistent with also seeking to offer some intellectual input into the interaction between Science and Theology.

After the trilogy, I found I wanted to return to some themes I had touched on earlier and discuss them in greater detail. This resulted in *Reason and Reality*[8], whose chapters seek to consolidate the consideration of how scientific and theological thinking relate to each other, the role of natural theology, and a number of other issues including more discussion of how to interpret chaos theory.

The invitation to give the Gifford Lectures in Edinburgh in 1993 encouraged me to write what is my longest book to date. Rather exasperatingly, it has different titles on the different side of the Atlantic: *Science and Christian Belief/The Faith of a Physicist*[9], but at least in has the same subtitle: 'Theological Reflections of a Bottom-up Thinker'. The idea was to weave a discussion of Christian belief around phrases selected from the Nicene Creed, using arguments based on a bottom-up movement from experience to interpretation. Scientists know that the world is strange and exciting, beyond out prior powers of anticipation, and they are open to unexpected insights provided they are based on evident to show that this is indeed the case. The lectures are an exercise in that search for motivated belief which is so central to my own thinking. In a sense they are a much more developed account of the programme I attempted with *The Way the World Is*. The final chapter discusses a theological problem which is much in my mind, of how we are truly to understand the interrelationships of the world's great faith traditions, so obviously concerned with a common spiritual realm but so obviously making clashing cognitive claims about its nature. This unresolved diversity contrasts perplexingly with the

universality of scientific understanding which has spread so readily across the globe.

After the Giffords I needed a holiday, but I love to write so I dashed off a chatty book about Science and religion which I called *Quarks, Chaos and Christianity*[10]. It is rather a favourite of mine.

My latest offering is called *Scientists as Theologians*[11]. My valued colleagues, Ian Barbour and Arthur Peacocke, have also recently given Gifford Lectures[12] and comparison of the three sets reveals both many common themes but also some interesting divergences of method and conclusion, mostly relating to the question of how great a degree of conceptual autonomy has to be claimed by Theology ad to what extent it can harmonise its thinking with scientific patterns of understanding. In attempting the delicate task of a comparison between the three of us, I have concluded that there is a spectrum, which I characterize as running from consonance to assimilation, in which Barbour is near the integrationist end, I am near the conceptual autonomy end, and Peacocke is somewhere in between us.

I think that the Science-and-technology debate is currently in an interesting phrase in which the action has to some extent moved away from the obvious border areas of natural theology and the doctrine of Creation into a closer engagement with central Christian questions such as Christology and eschatology. The bottom-up thinking that characterizes scientific thought has something to offer here, not as a uniquely effective method of doing theology but a positive source of insight, comparable with the particular insights offered, in their very different ways, by black or feminist theology.

I do a fair amount of public speaking about Science and religion. I quite often end a talk by saying that I am both a physicist and a priest and that I believe that I can hold these two aspects of me together, not only without compartmentalization or dishonesty, but also with a significant degree of mutual enhancement. It is to that task that I seek to devote my current endeavours.

Notes

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