

John C. Polkinghorne and Chen Ning Yang on the Dialogue between Science and Religion

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Abstract: John C. Polkinghorne (1930–2021) (FRS 1974) was an English theoretical particle physicist, theologian, and Anglican priest. Professor Chen Ning Yang (ForMemRS 1992) is a theoretical physicist. Polkinghorne visited the Hong Kong Baptist University in November 2006. The present article gives an account of his visit, in particular his public lecture, a dialogue with Yang, and their responses to questions from the audience. Polkinghorne’s trip to Hong Kong introduced the interdisciplinary field of science and religion to the people of Hong Kong and mainland China, and opened an East-West dialogue on this topic. Polkinghorne’s view that “Science and religion are basically friends and not foes because they are both concerned with the search for the truth” is an inspiration for many. The same goes for Yang’s point that “Science and religion belong to one family from the beginning.”

Keywords: Chen Ning Yang; dialogue; John C. Polkinghorne; religion; science

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“There was a man sent from God, whose name was John” (John 1:6)

Polkinghorne was one of the greatest scholars of the interdisciplinary field of science and religion. The above quote from the Gospel of John captures well the spirit of his contributions, serving as a metaphorical introduction to the dialogue between Polkinghorne and Yang.

The primary objective of this paper is to present perspectives on science and religion, with special reference to Polkinghorne’s public lecture, his dialogue with Yang on East-West perspectives on science and religion, and their responses to questions from the audience at a forum at Hong Kong Baptist University in November 2006. In so doing, this paper supplies further information about Polkinghorne’s groundbreaking visit to Hong Kong.¹ The novelty of the conversation he initiated is confirmed by the comments of the audience, addressed below, which indicates a public unaccustomed to this topic.

Sino-British Cultural Relations: A Selective Overview

As a background for Polkinghorne’s visit to Hong Kong, it is useful to consider aspects pertaining to the general context of Sino-British cultural relations.

The Notion of God in the Ancient Chinese Classics

In Xi Ci I of I Ching, one of the ancient Chinese classics, likely composed in the eighth century BC, includes the following line: “Seeing their spirit-like intimations and understanding them depended on their

1 R. Bêteille (ed.), *Science and Religion: Edwin Ernest Salpeter, Owen Gingerich, John Polkinghorne*, ed. Radha Bêteille et al., Creative Lives and Works (London: Routledge, 2021); J. Z. Shi, “Revd Dr John C. Polkinghorne’s Activities in Science and Religion: A Personal Perspective,” *European Journal of Science and Theology* 20:3 (2024): 1–33; J. C. Taylor and D. A. Wilkinson, “John Charlton Polkinghorne KBE: 16 October 1930 – 9 March 2021,” *Biographical Memoirs of the Fellows of the Royal Society* 72 (2022): 293–309, <https://doi.org/10.1098/rsbm.2021.0044>.

being virtuous people” (*Xi Ci I*).² The phrase “spirit-like” means God. Jao Tsung-I, also known as Rao Zongyi, a Hong Kong sinologist and historian, thought that it was extraordinary that ancient Chinese were talking about God.³

Legge argued that the “Lord on High” (*Shangdi*) mentioned in the earliest parts of two Ruist canonical works, the *Book of Historical Documents* (*Shujing*; fourth century BC) and the *Book of Poetry* (*Shijing*; dating from the beginning of the Western Zhou period, 1046–771 BC, to the mid-Spring and Autumn period, ca 771–476 BC), is equivalent to the concept of “God” in monotheistic traditions.⁴ As such, the monotheistic idea in China preceded the arrival of Christianity, it being generally thought that Christianity was first introduced to Changan, China, by a Persian monk, Aluoben, in the year 635, during the Tang Dynasty.⁵ Figure 1 shows what is possibly the earliest documented encounter between Christianity (*Jingjiao*) and ancient China.⁶

To speak of a traditional Chinese monotheism is no simple matter. Confucianism has been influencing the Chinese mind for over 2,000 years. While the ancient classics spoke of *Shang-ti* (*Shangdi* or Lord on High), the Supreme Ruler, to whom was attributed everything that belongs to God alone, Confucius replaced this term by “heaven.” However, he gave no clear account of what it meant—nor did he define people’s duties towards it.⁷

2 Available at <https://ctext.org/book-of-changes/xi-ci-shang/ens> (accessed 12 March 2024).

3 Y. T. Sze, *Literature and God: Interview and Dialogue with Prof. Jao Tsung-I: Elevation from Poetry to Philosophy* (SDX Joint Publishing Company, 2011; in Chinese).

4 J. Legge, *The Notions of the Chinese Concerning God and Spirits* (Hong Kong Register, 1852). See L. F. Pfister, “The Legacy of James Legge,” *International Bulletin of Missionary Research* 22:2 (1998): 77–82.

5 K. Barat, “Aluoben, a Nestorian Missionary in 7th-Century China,” *Journal of Asian History* 36:2 (2002): 184–198.

6 J. C. Feng, “Christianity’s Earliest Encounter with the Ancient Techno-Scientific China: Critical Lessons from *Jingjiao*’s Approach,” *Christian Perspectives on Science and Technology* 2 (2023): 80–103.

7 A. H. Smith, *The Uplift of China* (London: Young People’s Missionary Movement, 1908).

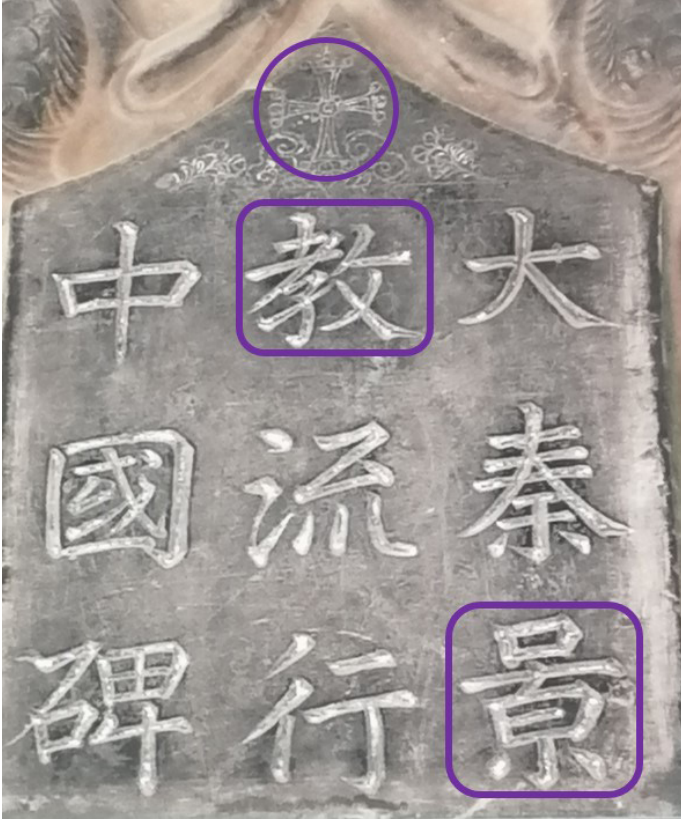


Figure 1. The famous Nestorian stone monument of Xi'an. A Christian cross, highlighted in the purple circle, is at the top of the monument; *jing* (bottom, right) and *jiao* (top of the middle column), highlighted in purple, refer to Christianity. Photo by John Z. Shi.

Confucianism, as a humanistic philosophy, downplays the importance of divine revelation and the supernatural; therefore, it does not provide a suitable framework for understanding the concept of God in Chinese culture. This realisation led scholars, such as Jao Tsung-I and Legge, to doubt the presence of monotheism among the Chinese people, but things are perhaps not quite so clearcut. Their understanding does not reflect accurately the original intent or meaning of the

ancient, pre-Confucian texts. Closer to the spirit of those texts is Feng's recent analysis, referenced above, which brings to light both ancient monotheistic ideas and the contributions of medieval Christians in emphasising divine authority and revelation.

What I am proposing, here, is that the audience's questions during Polkinghorne's visit to Hong Kong stemmed from an awareness of the ancient Chinese classics, including the contributions of the *Jing-jiao*. It is this awareness that explains why the audience was able to grasp the Christian concepts of God and divine revelation. In this light, Polkinghorne's visit to the Hong Kong Baptist University occasioned a return to the ancient sources of Chinese theology. That said, Polkinghorne was not the first modern Christian to visit China.

British Missionaries to China

To place Polkinghorne's connection with China within the general context of Sino-British cultural relations, a brief overview of British missionaries to China is given here. Those missionaries include Robert Morrison (1782–1834), James Legge (1815–1897), and James Hudson Taylor (1832–1905), among others.

Legge (top left in Figure 2), as the first example, translated all Chinese classics into English with the assistance of his three Chinese students. He was able to write Chinese in calligraphy (top right in Figure 2). In turn, Taylor spent much of his life in China.

The Society of the China Inland Mission, which he founded, helped to establish 125 schools in China. The positives of British missionary work, such as the numerous schools established on mainland China, should not be ignored. They are an important part of Sino-British cultural relations.

Equally important was the activity of the Cambridge Seven (bottom in Figure 2), who, according to Pollock, were “seven Cambridge students [who] volunteered to leave behind cosy lives of wealth and privilege to serve God in whatever way they were led.



Figure 2. Top left: James Legge. Photo Credit: the Legge Family Collection. Top right: Legge's hand-written Chinese in calligraphy and English translations dated 22 March 1879. Bottom: The Cambridge Seven. Source: <https://tinyurl.com/4bpp98tm> (accessed 12 March 2024).

These seven inspired thousands of others to think seriously of missionary service.”⁸ As shown in Figure 2, the Cambridge Seven wore Chinese-style clothes, namely, Mandarin garb, thus showing their cross-cultural adaptability. The Cambridge Seven were: M. Beauchamp, W. W. Cassels, D. E. Hoste, A. T. Polhill-Turner, C. H. Polhill-Turner, S. P. Smith, and C. T. Studd. Their efforts paid off. According to Chinese academics, China is currently home to at least 45 million Christians, the majority of whom are Protestant. However, Western researchers consider the number closer to 90 million.⁹

Before I turn to Polkinghorne’s visit, a point is in order, regarding the possible objection to the positive appraisal of missionaries’ impact. Were missionaries, coming as they were from privileged backgrounds, and bearing imperialist ideas, able to understand or empathise truly with the experiences of the communities they sought to convert? The freedoms granted to missionaries might have been a byproduct of imperialist agendas, rather than originating in a genuine respect for religious freedom. In this vein, I should point out that the British schools were not solely motivated by altruism, instead being used as a means of cultural indoctrination. This background history should be borne in mind when considering the attitude of Chinese people to religion, especially the Christian faith.

Polkinghorne’s Visit to the Hong Kong Baptist University in 2006

I begin by pointing out that the first time I had come across the name of John C. Polkinghorne KBE FRS was through Chen Ning Yang’s *Collected Essays*,¹⁰ where one essay referred to Yang’s dialogue with Polkinghorne at Hong Kong Baptist University in November 2006. There, Yang

8 J. Pollock, *The Cambridge Seven: The True Story of Ordinary Men Used in No Ordinary Way* (Christian Focus, 2006).

9 S. Schafer, “Onward, Christian Soldiers,” *Newsweek* (May 10, 2004): 24–28.

10 Chen Ning Yang’s *Collected Essays* (*Shuguang Ji*; in Chinese), ed. Weng Fan (SDX Joint Publishing Company, 2008).

(ForMemRS 1992; Nobel Prize Laureate in physics in 1957) pointed out that his famous physicist friend, Polkinghorne, believed in God and was a priest. Polkinghorne met Yang at the Institute for Advanced Study, Princeton University, USA, in the 1960s. As a Chinese who grew up in mainland China and trained in the United Kingdom, I am still surprised by Polkinghorne's two different careers.

Polkinghorne's visit was occasioned as part of the celebration of the Hong Kong Baptist University's fiftieth anniversary, a significant event called "Brilliance of Civilisation: In Celebration of the Hong Kong Baptist University Honorary Doctorate Recipients 2006." Held on 13 November 2006, the forum was organised by the Center for Sino-Christian Studies and was cosponsored by the Department of Religion and Philosophy. The Master of the Ceremony was Professor Lo Ping-cheung, Research Coordinator of the Centre for Sino-Christian Studies and a faculty member of the Department of Religion and Philosophy.

Prior to this event and to Polkinghorne's visit, it is noteworthy that, in March 2003, Dr Kang Phee Seng (alias Jiang Pisheng), Head of the Department of Philosophy and Religion, Hong Kong Baptist University, nominated Polkinghorne for an Honorary Doctorate of the said university. The university approved the nomination with the conferring of an Honorary Doctorate on Polkinghorne on 14 November 2006. On that visit, at the invitation of Yang, Polkinghorne presented a public lecture entitled "The Dialogue between Science and Religion and Its Significance for Academia." and was followed by an "East-West Dialogue on Science and Religion" with Chen Ning Yang. In what follows, I present the addresses given during the event—in English for the first time.

Opening Remarks by Council Chairman of Hong Kong Baptist University

Before Polkinghorne's public lecture and his dialogue with Yang, Mr Moses Mo-Chi Cheng LL.B., LL.D., GBM, GBS, OBE, JP, Council Chairman, Hong Kong Baptist University, delivered a short welcoming address. Here are his remarks (slightly edited):

We are very honoured to have both bishops of Hong Kong here, Archbishop Kong ... and Bishop Zen. Welcome to Hong Kong Baptist University! ...

This is indeed a very happy and special occasion for all of us here at Hong Kong Baptist University. As most of you know, we are celebrating our fiftieth anniversary. This forum is indeed a very important part of our year-long celebrations. This afternoon, Hong Kong Baptist University is very privileged to have two outstanding scholars as speakers. They are none other than the Revd Dr John Polkinghorne, who will speak on “The Dialogue between Science and Religion and Its Significance for Academia,” and Professor Yang Cheng Ning, Nobel Laureate in Physics, who will engage in East-West dialogue with Revd Dr Polkinghorne on science and religion ... Professor Yang is our honoured alumnus. An Honorary Doctorate of Science was conferred on him in 1999. Revd Dr Polkinghorne will become an Honorary Doctor of Humanities of this University tomorrow ...

The dialogue between science and religion, I am given to understand, has been one of the fastest growing interdisciplinary fields in the West, involving many top scientists and religious study scholars. However, this important interdisciplinary study is relatively new to academia in Hong Kong and mainland China. This is therefore a very special occasion during which we can benefit from two of the most creative thinkers of our time. The Hong Kong Baptist University is indeed honoured to host this lecture and the dialogue.

Ladies and gentlemen, Albert Einstein once said, I quote, “Religion without science is blind, science without religion is lame.”¹¹ This afternoon, we are here together to be illuminated on the relationship between science and religion and its significance for academia. I am sure our speakers will shed new light on these issues. At the end of this forum, we all will be able to see better and run faster in the race of life and in academia in particular.

11 See the context in A. Calaprice, *The Expanded Quotable Einstein* (Princeton University Press, 2000).

Opening Remarks by the Director of the Center for Sino-Christian Studies

The next speaker was Professor Kang Phee Seng, a founding member of the International Society for Science and Religion. Kang introduced the two speakers. Here are his remarks:

Hong Kong is the place where East meets West. Today, on this special occasion, we are witnessing its new role as the place where science meets religion ...

I cannot think of better scholars to initiate this conversation between science and religion at the highest academic level in Hong Kong, than the Revd Dr John Polkinghorne and Professor Yang Cheng Ning. This public lecture and dialogue involving internationally acclaimed scientists from East and West is the first of its kind in China and in East Asia. The University is honoured to host this historic event today.

The Revd Dr John Polkinghorne will first deliver his lecture on the dialogue between science and religion and its significance for academia. As an eminent scientist, he was elected Fellow of the Royal Society, joining the ranks of Isaac Newton, Charles Darwin, James Clerk Maxwell, and Stephen Hawking. Then, as an outstanding scientist and theologian, he was awarded the Templeton Prize, considered the Nobel Prize in religion. Within a short span of twenty years, he has produced more than twenty books on science and religion, many of which have been published by prestigious university presses. He has helped in no small measure to establish the new and reputable interdisciplinary field of science and religion. No wonder Harvard University has recently announced the creation of an Endowed Watson Professorship in science and religion, thus joining Princeton, Cambridge, Oxford, Berkeley, and others in affirming the discipline as a legitimate academic field. I am sure the audience cannot wait to hear Dr Polkinghorne tell us why the science-religion dialogue is significant for leading academic institutions.



Figure 3. Moses Cheng Mo-chi (left) presenting a souvenir to Polkinghorne (right). Credit: Centre for Sino-Christian Studies, Hong Kong Baptist University.

After the lecture, Professor Yang Cheng Ning will engage in a dialogue on this theme with Dr Polkinghorne. Professor Yang is a Nobel Laureate in Physics, a US National Medal for Science Laureate, and a member of the Chinese Academy of Sciences. He needs no further introduction. If I may, I would mention only that Professor Yang's doctoral supervisor, the famous Enrico Fermi, once advised him, "as a young man, work on practical problems. Do not worry about things of fundamental importance." For all his admiration of Fermi, Professor Yang did not seem to take this piece of advice too seriously. In fact, it is precisely his doing away with a fundamental parity conservation law which physicists before him took to be too important to deserve scrutiny that won him the Nobel Prize in Physics in 1957. Perhaps, in recent years, the still young at heart Professor Yang has been ignoring the same advice again. He has expressed his keen interest in something of even more fundamental importance, namely, religion. In very recent lectures, at Penang and Hong Kong University, for instance, Professor Yang has spoken about his interest in the relation between science and religion. It has been said that, as a

young theoretical physicist, Professor Yang experienced difficulties with applied physics. His fellow students used to say “where there’s a bang, there’s Yang.” In that vein, now they would have to say “where there is a discussion of God and the Big Bang, there is Yang.”

John Polkinghorne and Professor Yang are old friends. Their friendship began more than forty years ago during their Princeton days. This afternoon, we have a direct East and West dialogue on science and religion or rather a warm conversation between two old friends on things of fundamental importance.



Figure 4. From left to right: Moses Cheng Mo-chi, Ng Ching-fai, Polkinghorne, Yang, and Kang. Credit: Centre for Sino-Christian Studies, Hong Kong Baptist University.



Figure 5. Group photo (Polkinghorne at the centre of the front row). Credit: Centre for Sino-Christian Studies, Hong Kong Baptist University.



Figure 6. Polkinghorne giving the public lecture (13 November 2006). Credit: Hong Kong Baptist University.

Polkinghorne's Public Lecture at Hong Kong Baptist University

After the above introductions, Polkinghorne gave a public lecture on “The Dialogue between Science and Religion and Its Significance for Academia,” on 13 November 2006 at Hong Kong Baptist University. The session was chaired by Professor Lo. Here is the transcript of the lecture (slightly edited):¹²

I hope you will excuse me if I sit down to speak, I am having back problems. Although I lose in authority for not standing, I gain in comfort.

It is a very great pleasure for me to be in Hong Kong and a great privilege to have a chance of speaking this afternoon. It is a special pleasure and a special privilege to do so in the presence of Profes-

12 The major part of Polkinghorne's public lecture and the dialogue with Yang was translated into Chinese and published in *Dialogues between Science and Religion in China*, ed P. S. Kang *et al.*, *Dialogues between Science and Religion in China* (China Social Science Press, 2008).

sor Yang, who is such an outstanding insightful leader of the community of particle physicists in which I worked as a humble toiler for twenty-five years. It is very good to see him again.

In my own country, and throughout the world, the twentieth century saw a vast expansion of access to university education. Governments were willing, largely for what they saw as practical reasons, to provide financial resources needed for that expansion. Politicians understood that graduates are needed to enable the development of a prosperous nation. Now, while that is true and is certainly to be welcomed, I think it would be a bad mistake to think that the principal role of academia is to facilitate an increase in the gross national product. A different purpose, in my view, the most important purpose, of academia is the discovery and the propagation of knowledge. Many other good outcomes will follow and will fulfil its main objective. Their continuation depends in the long run on not losing sight of this central aim and justification for a life of academia.

So, I want to state from the outset of this lecture my strong belief in the value of knowledge for knowledge's own sake. I want also to state my strong belief that ultimately knowledge is one. Academic life today is subject to many severe pressures in the direction of intense specialisation. Now I am quite happy to recognise that engaging in depth with a specific topic teaches one something valuable about knowledge, something that cannot be learnt in any other way. But the insight that is gained then has to be set in a wider context. There is a real danger that the modern academy will be made up of people who simply know more and more about less and less. A true university is much more than a loose assembly of specialised research institutes, occasionally on the same campus merely for reasons of administrative and logistical convenience. There has to be a genuine intellectual exchange between all parts of academia—a form of interdisciplinary discourse by means of which all will be enriched. For this reason, I believe that the dialogue between science and religion has an important part to play or, speaking more precisely, the dialogue between science and theology is important, since the latter's intellectual reflec-

tion on the religious experience parallels science's reflection on the physical world. If the true university is to be an institutional expression of the unity of knowledge, it must include theology or religious studies among its faculties. So much for the general premise on which this lecture is based.

Let me start my more detailed discussion with that part of academia that I know the best, namely the faculty of science. Scientific research is hard work. Like any other worthwhile activity, there is a good deal of wearisome routine to be endured. Occasionally there is frustration. What seemed to be a good idea in the morning evaporates under close scrutiny in the colder light of the afternoon. So, why do we do it? The answer is because scientists want to understand the world. The rewards for their labour are those moments of discovery in which some new insight into the wonderful structure of the Universe and its remarkable and fruitful history is gained. At least, that is how the scientists understand what is happening. They believe that they are engaged in the search for true knowledge concerning the nature of the physical world, in which we are alone.

However, different parts of academia provide different perspectives. Sometimes, things may not appear to be the same, at least at first glance or when viewed from a different angle. In the twentieth century, a number of philosophers felt that they needed to disabuse the scientists of what they considered to be a naïve belief. These philosophers offered a variety of alternative suggestions about what was actually happening in scientific research. The positivists suggested that science is simply about correlating the results of experimental measurements. It was not at all clear why this rather banal task was to be considered worth much effort. It is one thing to work hard. If there really are quarks and gluons, one can learn about their properties. But it is quite another thing if the actual characters in the scientific story are simply marks on photographic plates or scale readings on instruments. Why should one bother about them? It seems to me that the positivists totally fail to give an account of science that is at all adequate to explain why many people devote their lives to its pursuit. A some-

what more exciting account is offered by instrumentalists. They too do not believe science could tell what this world is actually like. But they do at least recognise it enables you to get things done. According to them, there might not really be electrons, but at least there are electron microscopes. In their view, science is about pragmatic success rather than about gaining a true understanding of nature. Yet, instrumentalism fails to explain how it is that those microscopes work so well. Surely, the obvious reason is that there actually are electrons with the properties that are being assumed in the design of the device. Once again, an explanation was offered that fell short of what the scientists actually experience in the pursuit of their subject. The fact is, of course, that scientists are not simply concerned with getting things done. This is technology. They want to understand the nature of things and how things work.

The way that science achieves the prize of understanding is subtle. People sometimes think that the scientific method for finding truth depends simply on checking whether the inescapable predictions of theory fit exactly with the clear results of experiments. But in actual fact the matter is more complex than that. Theory and experiment intertwine in delicate ways. There are no scientific facts that are not already interpreted facts. Appeal has to be made to theory in order to understand what it is the instruments are actually measuring and, in turn, theories have to be adjusted and corrected in the light of experimental findings. This interrelationship between theory and experiment involves an irreducible degree of circularity into the scientific procedure. Nevertheless, scientists have a good reason to believe that this circularity is benign rather than vicious.

Two particular kinds of experience strongly reinforce the belief that science is not just about making up a story about the world but about truly discovering what the world is like.

One is the continuing element of surprise that pertains to scientific investigations. Prior expectations of what might be found often need to be subject to a radical revision as a consequence of

the way things are actually found to be. Nature often runs contrary to our expectations. An outstanding example of this was when Professor Yang together with Professor Lee showed us that there is an intrinsic handedness in nature, a preference of the left hand over the right—something people have previously supposed to be impossible. This scientific experience of surprising novelty also implies corollaries of wider significance than for science itself. First of all, science shows us that there is no universal epistemology, no universal way of knowing everything. Things can only be known in accordance with their actual nature and so different identities must be known in different ways. The everyday world can be known in the clear and determinate ways that Newtonian thinking had presumed. But the cloudy and fitful quantum world can only be known in its Heisenbergian uncertainty. Secondly, there is no simple characterisation of rational expectation. No one expected handedness to be present in nature. Consequently, the natural question for scientists to ask, not only about science but about things in general, is not “is it reasonable?” as if we had prior knowledge of the necessary shape of reason. Rather, the instinctive scientific question is “what makes you think that might be the case?” You see, the latter question is, on the one hand, open to new possibilities but it is also ... requiring evidence for what is being asserted. These two insights—of no universal epistemology and an openness to the unexpected in rational thinking—are important in the science and religion discussion. They offer theology both an opportunity and a challenge to which, I believe, it should be happy to respond. I will say more about that in a minute.

The second experience that confirms the realist interpretation of science ... [refers to its capacity for fertile, long-term explanations of] other phenomena, of a quite different kind. My great scientific hero is Paul Dirac, one of the founding figures of quantum theory. He discovered his famous equation of the electron by considering how to combine quantum theory and relativity theory in a consistent fashion. He then immediately found it to be a new theory explaining the known—but until then inexplicable—anomaly in the magnetic property of electrons. Later on, he recognised the equation also implied the existence of antimatter, a previously unknown possibility. This long-term fertile explanatory power

is very persuasive in regard to [establishing] the truthfulness of [science]. Because of the subtle circularity of the interweaving of theory and experiment, science cannot assert that it possesses absolute proof beyond the logical necessity of its conclusions. Yet it can and should lay claim to the attainment of well-motivated convictions, even if those convictions will never amount to a total grasp of all truth about the physical world. There is always a possibility of some new phenomenon awaiting discovery around the next experimental corner, which will then cause physicists to revise and to deepen their understanding. The true achievement that science can claim is verisimilitude, the making of reliable maps of physical reality fully adequate on a specified scale but not exact on every scale. As a partial account of physical reality, science often has to speak in terms of unseen realities, entities whose existence is inferred in the explanatory power they convey in relation to more directly visible and accessible phenomena. For example, the current candidates for the role of basic constituents of matter are the celebrated quarks and gluons of elementary particle physics.

Not only have these not been observed individually, but it is believed they never will be since the forces bonding them together to make protons and electrons and so on are thought to be too strong to allow the necessary decomposition, a property that we call quark confinement. Nevertheless, particle physicists are totally convinced that quarks really exist. The basis for this belief is that it explains in an elegantly concise way the properties of the nuclear particles that are directly accessible through experimental investigation. In other words, belief in the unseen reality of quarks and gluons derives from a deep intelligibility this assumption affords. Here again, I think, we see the possibility of a close relationship between science and religion.

Theology seeks to speak of the unseen reality of God. It too can base its case on the claim that theistic belief makes sense of great swathes of human experience. This will include not only the widely-testified experience of encounter with the sacred but also, interestingly enough, they include the experience of doing

science when that experience is set in a deeper context of intelligibility. In fact, I think, those who are imbued with thirst for understanding—the thirst that so powerfully motivates scientists—will find it cannot be quenched by science alone. The truth of the matter is that the sciences have achieved their very great success essentially by the modesty of their ambitions. They only consider a certain impersonal kind of encounter with the world around us, namely, the encounter which treats reality objectively and, one might say, as available to be manipulated, to put to the test as we may choose. This restriction gives science a secret weapon—the method of experimental investigation from which so much of its success derives.

As we all know, there are other equally valid ways of engaging with reality, in which the encounter is personal, a meeting with a *thou* rather than an *it*, one might say. In that personal world of human experience, testing has to give way to trusting.

Another way of characterising the self-limitation of science is to recognise that it

confines itself to asking a particular kind of question, essentially the “how” question, by what process things happen. Of course, this is a valuable kind of inquiry to pursue but it is not the only issue relevant to gaining understanding. There is also the “why” question, of whether there is meaning and purpose present in what is happening. Science brackets out this kind of inquiry, as we know perfectly well. But one may ask how and why about the same event. Indeed, we need to do so if we are to understand it fully. The kettle boils both because burning gas heats the water and because I want to make a cup of tea. A degree of consonance must be assessed before the answer is given to these two questions. The person who asserts the intention of making a cup of tea by putting the kettle into the refrigerator is suspect.

The search for consonance between insights offered by science and by religion is extremely significant, and an important part of the dialogue between them. Academia offers many resources

for assessing questions of consonance. So, my argument so far is that the impersonal insights of science need to be complemented by the personal insights of other kinds of human search for truth and understanding, which are proper concerns of other parts of academia.

I would like to explore what a faculty of theology or religious studies can offer in this respect. The first insight it can offer, I think, is to explain why science is possible at all ... Of course, we can all see that the evolutionary necessity for survival can explain why human beings are able to make rough and ready sense of everyday phenomena. Yet it is difficult to believe that our ability to understand the subatomic world of quantum physics and the cosmic realm of curved spacetime is at hand for all; understanding of them requires highly counterintuitive modes of thinking. It is difficult to believe that understanding quantum theory and relativity theory is simply a happy spinoff from our ancestors having had to dodge sabre-tooth tigers.

Not only is the world deeply and rationally transparent to scientific enquiry, it is also rationally beautiful, time and again affording scientists the reward of wonder as a recompense for the labour of their research. Fundamental physics is a proven technique of discovery to seek theories whose expression is in terms of equations possessing the unmistakable character of mathematical beauty. It has been found time and again that only such theories will turn out to have the long-term fruitfulness that persuades us of their verisimilitude.

I have already spoken of Paul Dirac. I think he is the greatest physicist whom I have known personally. He once said, "it is more important to have beauty in your equations than to have them fit your experiment." Now, of course, Dirac did not mean empirical adequacy could be dispensed with. No physicist could possibly think that. What he did mean was this: if at first sight your equations do not seem to fit your experimental facts, that is, of course, disappointing, but it is not absolutely and necessarily fatal. Perhaps you did not make the right approximations in trying

to solve the equation ... Perhaps the experiment went wrong. We have known that to happen more than once in physics. At least, there is some sort of residual hope. But, you see, if your equations are ugly, there is no hope. They could not possibly be right. The whole history of modern physics is against you.

Dirac made his great discoveries by a lifelong, highly successful quest for mathematical beauty. He once said, ironically, ... “it was a very profitable religion to hold.” Now, why deep science is possible and why its success ultimately involves the apparently abstract discipline of mathematics as a prime means to unlocking the secret of the universe, are significant questions about the nature of the world in which we live. Dirac’s brother-in-law, Eugene Wigner, who also won the Nobel Prize for physics, once asked, “why is mathematics so unreasonably effective?” Why did this abstract subject prove the key for unlocking the secrets of the physical world? Science itself is unable to offer an explanation of this profound character of the laws of nature. It has to treat them simply as givens on an unexplained basis that it has to assume for its explanation of the details of processes. Theoretical physicists rejoice that mathematics is unreasonably effective, but theoretical physics does not explain in a fundamental sense why that is so.

It seems intellectually very unsatisfactory, lazy in fact, to leave the matter there, as if the possibilities of science were simply a happy accident. I believe that a religious understanding renders the intelligibility of the Universe itself intelligible, which says that the world as explored by science is shot through with rational beauty precisely because the mind of its Creator lies behind its wonderful order.

I am both a scientist and a Christian believer, a physicist and a priest. When they are told this, people sometimes look at me with a kind of surprise ... and suspicion, as if I said I was a vegetarian butcher. Behind that attitude there lies the belief that there is some sort of incompatibility between science and religion, as if they are supposed to be at war with each other, as if we ought to decide clearly which side of the battle line we are going to take.

I think this conflict picture of the relationship between science and religion is a very bad mistake. I believe they are friends basically, not foes. I think the fundamental reason for their friendship is that both of them are engaged in the search for truth. Both believe there is a truth to be found, though their concerns are with very different aspects of the truth. Science's impersonal truths, as I have already suggested, are written with truths about persons and about the transpersonal reality of God. I also believe science and religion are both seeking the truth through the quest for motivated belief. In the case of science, that might not seem a very contentious claim to make. But what about religion? Is it not based on faith? Is not faith a question of shutting your mind and believing what you're told, in submission to some unquestionable religious authority?

I answer "yes" to the first of these questions. I think religion is based on faith. But I think that the nature of faith is a commitment to what we have good reason to believe is true. So, I emphatically answer "no" to the second question. I do not at all think that you have to commit intellectual suicide to be a religious believer. In fact, I could not be a religious believer if I thought that was required of me. If a religious belief turns out to be nothing but irrational fetishism, then of course theology or indeed religious studies would have no proper place in the truth-seeking community of academia. But I say that faith too is based on motivated belief.

In my speaking, my writing, and my thinking I explore with utmost scrupulosity motivations for my Christian belief. It is only in that way faith can truly be part of the search for the truth. In fact, I particularly reject the claim sometimes made that science is concerned with facts while religion is simply concerned with opinions—public facts versus private opinions. We have already seen that scientific facts are already interpreted facts; they intertwine experiment and theory, facts and informed opinion.

Religious beliefs are not merely theistic assertions; they are motivated experience. The foundational events of a religious tradi-

tion—in the case of Christianity, the life, death, and resurrection of Jesus Christ—and a continuing engagement with sacred reality conveyed by a life of prayer, worship, and obedience. Understood in this way, religious revelation is not a matter of infallible propositional truth conveyed in some holy and mysterious manner, but it is a record of those events and persons to which the sacred reality of God has been most clearly and accessibly conveyed. Scripture is not a divine textbook in which are written all the answers and which examines questions of life that have to be memorised. Scripture is a laboratory notebook, one might say, giving the details of those critical experiments in which God has been encountered and known.

Now, if science and religion are friends and partners in the search for truth and understanding in the way I have suggested, then they will have things to say to each other in a fruitful dialogue. I want to describe some of these exchanges. For its part, science can tell religion what the natural world is like, what its past history has been. Religious people need to listen carefully and respectfully to what science has to say in this respect, and to welcome the insight it offers. If they are truly seeking to serve the God of truth, they should welcome truth from whatever source it comes.

Some truths, not of course all truth, but some truths certainly come from science. One of its most important discoveries, I think, has been that the Universe has a history, a discovery of deep time, as people sometimes say. The world looked very different in the past from the way it looks today. The Universe as we know it originated in the fiery singularity of the Big Bang, some 13.7 billion years ago. Notice that 13.7! Cosmologists are getting really very accurate or believe they are, and I think they are probably right. It all started very simply. The early Universe was just an almost uniform expanding ball of energy. But today that same Universe is richly structured and complex. The human brain is in fact the most complicated system encountered so far in the scientific explanation of the world. The fact that that initial ball of energy was eventually able to give rise to beings who are aware of their cosmic home and able to discover many of its secrets is an aston-

ishing story of unfolding fertility—certainly compatible with the theistic belief that a divine purpose lies behind the history of the world. I think the most extraordinary events in cosmic history of which we have knowledge anyway have been the appearance of persons here on planet Earth—people aware of themselves, aware of the world, and able to understand it. It is in human beings that the Universe becomes aware of itself and, of course, science becomes a possibility. You may recall that Pascal, the great French thinker, said, “Human beings are tiny beings on the enormous scales of the world. They are just reeds, frail reeds. But they are thinking reeds.”

Because of that, we are more than all the stars. We know them and ourselves, and the stars know nothing. I think that’s right. It turned out that this is only possible because the laws of nature, or rather the laws of nuclear physics, were just right to produce an enhancement effect, a resonance as we say in the trade, in having just the right energy to produce carbon. If nuclear physics had been a little different, there would have been no carbon; no you and me. There are many such fine-tuning exacting requirements of the laws of nature we recognise as having been indispensable for the development of the Universe in the fruitful way that it actually happened. The most exacting requirement for what has been called anthropic potentiality relates to the recently discovered dark energy associated with space itself, which drives the Universe’s expansion. The magnitude of this dark energy is at least fifty-four orders of magnitude, as a factor (10 to 54) smaller than what would have been expected on general grounds. This is a vital fine-tuning, since anything larger would have blown the universe apart so rapidly as to destroy the possibility of its forming any complex structures ... Such a remarkable set of facts surely calls for some explanation. Science by itself, in my view, can’t offer it since it has to take the laws of nature as it finds them. Theistic belief, however, offers such an explanation, for its concept of the divine purpose lying behind the history of the world enables it to interpret the built-in fruitfulness of the Universe. It allows for the development of carbon dioxide as being the endowment of fertility bestowed on the cosmos by its Creator.

The second thing science tells us about the cosmic story is that the process which has been at work throughout its history is the lawful regularity of nature, and the particular and exploratory character of individual happenings. Evolution is sometimes described as resulting from a combined operation of chance and necessity. Here chance does not stand for capriciousness. It stands simply for the contingency of much of what has actually happened. So vast is the range of possibilities that in 13.7 billion years of cosmic history only a small fraction of what might have happened has in fact happened. Necessity stands for the reliable regularity present in nature, which provides the context of these contingent events. It is this evolutionary dialectic between necessity and chance which has been the source from which novelty emerged in cosmic history, whether it was in the formation of the first stars and galaxies, in the beginnings of terrestrial life, the development of terrestrial life, or the coming into being of self-conscious humanity.

It is a deep insight of contemporary science that the realms in which true novelty can emerge are always held in regimes which may be described as being at the edge of chaos—a mixture of order and disorder—regimes in which chance and necessity inextricably intertwine. A regime which is all necessity would be too rigid for anything really new to happen. If there were no genetic mutations, there will be no new forms of life. A regime that was all chance will be too haphazard for anything new to persist. If genetic mutations were prolific and happened all the time, no species will be established on which natural selection could operate.

People sometimes think that evolution is the issue on which science and religion can never find agreement. There is a caricature account which sees the publication in 1859 of Darwin's great book *The Origin of Species* as being the final parting of the ways between science and religion. This picture is ignorant and far from the truth. From the start, some religious people were wise enough to see that the theory of evolution does not conflict with creation but rather tells us something about the way the Creator has chosen to work. A clergyman friend of Darwin's, Charles Kingsley, said that God could no doubt have produced a ready-made

world but, it turns out, the Creator has done something cleverer than that in making a world that makes possible the evolutionary exploration of potentiality with which creatures have been endowed. Creatures could make themselves. That is a phrase that encapsulates the theological understanding of the evolutionary process, the process by which creatures are allowed to make themselves.

It turns out that not only has science given religion new and deep insight in the ways of creation, but it also offers religion some assistance with the latter's greatest problem. What's that great problem? Surely, it is the problem of the evil or suffering of persons in the world. If God is good and all powerful, as religious people claim, how does it come about that disease and disaster are so widespread in a world asserted to be a divine creation? This problem, I believe, holds many people back from religious belief and troubles those who are religious believers. It does not have a simple one-line solution.

Some help arises from recognising that a world in which creatures are given freedom to be themselves and to make themselves, that kind of world is a great good. It also has the shadowy side of a necessary cost. Evolutionary processes produce remarkable fruitfulness for the emergence of new kinds of life but inescapably there will also be ragged edges and blind alleys. We tend to think it would surely have been easy for God to separate the good and the bad processes of the world—to keep the former and throw away the latter—but science helps us see how delicately intertwined and subtly interconnected are the natural processes. So, the simple division between this kind of good and bad is not coherently possible. Take a simple example, the engine that has driven the remarkable three or four billion years history of life on earth has of course been genetic mutation, which has continually produced new kinds of life to be sifted and preserved through natural selection in a reliable environment. If germ cells are to be able to mutate and produce new biological possibilities, then it must also be the case that some somatic cells, body cells, can mutate. Sometimes this will result in malignancy. You cannot have one and not the other. The ancient fact of cancer in the world

is not gratuitous. It is a shadowy side of fertility, a necessary cost of a world in which creatures are able to make themselves.

Science does not remove all religion's perplexities about the ills of the world. It does offer it some assistance in wrestling with them. So, there are real gifts which scientific understanding gives to religious people for a religious understanding. In the dialogue between science and religion, what gift could religion offer to science by way of return? Certainly not to seek to answer science's questions for it. We have every reason to believe that scientifically possible questions will receive scientifically testable answers even if these answers may at times be very hard to find. However, as we have already seen, there is very good reason to believe that there are many meaningful and necessary questions to ask, which are not scientific in character—which lie beyond science's self-limited power to address and respond. Hence the need for those seeking understanding to look to additional sources of insight, beyond those science can provide.

Of particular interest this afternoon are what one might call meta-questions, queries that relate to issues out of the experience of doing science, which take us beyond (that's the meaning of *meta*) the legitimate domain of scientific explanation. The gift which theology offers to science in their mutual dialogue within academia is a deeper and wider intelligibility that I believe a theistic metaphysics can offer.

Science has revealed a world whose rational order, rational transparency, and rational beauty is shot through with science in mind. I have already suggested that this fact should be understood as representing an invitation to encounter the mind of the Creator. The pursuit of science requires of the scientist the faith commitment that the Universe is endowed with a deep structure to which the human mind has access. Without that assumption, whether implicit or explicit, fundamental science seems a hopeless enterprise. In turn, a religious belief that the world is indeed a cosmos because it is also a creation underwrites this basic and necessary scientific conviction. Let's put the matter another way, through

the word that is frequently used by scientists in their informal conversations but never, of course, in their formal papers submitted to learned journals; that word is “wonder.” The experience of wonder at the rational beauty of the Universe affords scientists a recompense for all the labour and frustration inevitably involved in doing research. I believe that whether the scientists involved know it or not, the religious person will rightly interpret this basic scientific experience of wonder as being an impressive act of worship of the Creator.

The exchange of gifts between science and religion has been briefly sketched. One sees how these two quests for truth and understanding are not competitive rivals between which we have to choose. They complement each other as partners in the great human quest for understanding. If we are truly to understand the world, I believe we shall need to look at the Universe with both the eye of science and with the eye of religion. This binocular vision will enable us to see and comprehend much more than we can ever manage with either eye on its own. The fundamental reason why the dialogue between science and religion must rightly find a place in academia is that the richness of reality is such that it demands that all its diverse dimensions—scientific, aesthetic, cultural, ethical, and religious—find their proper place and recognition by being represented in that truth-seeking community. Certainly, science by itself could never be enough. It trawls experience with a coarse grain net. Many things of the utmost significance and importance slip through its wide meshes. Ask a scientist—as a scientist—to tell you all that he or she can about music. They all say it is your neural response to the impact of sound waves on the ear drum. Of course, that is true and it is in its own way worth knowing. But ask the same scientist—as a person—to tell you all they can about music and they will surely have much more to say about the deep mystery of how a temporal succession of bursts of vibrating air can convey to us a profound and true experience of timeless beauty. The university exists to bring together the insight of all truth-seeking investigations. Within that broad and deep embrace, there is an indispensable place for the dialogue between science and religion. Thank you very much.

An East-West Dialogue between Polkinghorne and Yang

It seems to be one of the fundamental features of nature that fundamental physical laws are described in terms of a mathematical theory of great beauty and power, needing quite a high standard of mathematics for one to understand it. You may wonder: Why is nature constructed along these lines? One can only answer that our present knowledge seems to show that nature is so constructed. We simply have to accept it. One could perhaps describe the situation by saying that God is a mathematician of a very high order, and He used very advanced mathematics in constructing the Universe. Our feeble attempts at mathematics enable us to understand a bit of the Universe and, as we proceed to develop higher and higher mathematics, we can hope to understand the Universe better.¹³

Polkinghorne's public lecture was followed by an East-West dialogue between Polkinghorne and Yang (Figures 7 and 8), chaired by Dr Leo Kam-Ching Cheung.¹⁴ As we shall soon see, throughout their dialogue the views of Polkinghorne and Yang complemented each other. Both reached the conclusion that science and religion are not foes but friends, and that a dialogue between science and religion is required.

Polkinghorne: I thought Professor Yang was going to make a sort of introduction, a few remarks to set out our position? Or do you want to go straight into conversation? The latter, is it? OK. Well, can I ask you? I am suggesting that the laws of nature—in their very wonderful order and in their amazing fruitful consequences—have a character about them that means that it cannot be satisfactory to treat them as given brute facts. They seem to point beyond themselves and beyond science. Of course, you wouldn't know about the laws of nature without science, which

13 P. A. M. Dirac, "The Evolution of Physicist's Picture of Nature," *Scientific American* 208:5 (1963): 45–53.

14 From this point of the event on, the audio recording includes indistinct parts where the words could not be made out. Hence the more numerous ellipsis signs.

points beyond them, to some further explanation. What I mean is a theistic explanation. But would you agree that there is more to be told than science on its own could say?



Figure 7. Polkinghorne and Yang engaged in an East-West dialogue on science and religion. Credit: Centre for Sino-Christian Studies, Hong Kong Baptist University.

Yang: I am not sure I know how to answer your question. My personal relationship with religion is undergoing a transformation as I grow older. I think, perhaps, I could share with you some matters ... Throughout my career, I was a teacher and a research physicist. You started your career also as a research physicist. When one understands as a researcher some secret of nature, that is a very humbling experience. The Revd Polkinghorne has mentioned Paul Dirac, one of the greatest physicists of the twentieth century. He was particularly famous for the second equation on this screen [Figure 8], which is now called the Dirac equation: $[\alpha \cdot pc + \beta mc^2] \psi = E \psi$

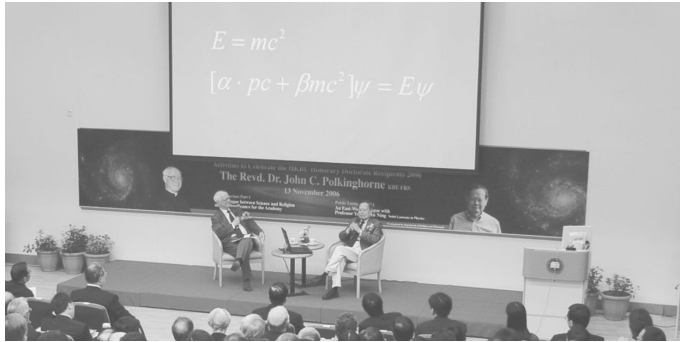


Figure 8. Polkinghorne and Yang engaged in an East-West dialogue on science and religion. Einstein's and Dirac's equations appear on the projected screen. Credit: Centre for Sino-Christian Studies, Hong Kong Baptist University.

The first equation on the screen is $E = mc^2$. It is familiar to everyone in the audience. It had a tremendous impact on the future of mankind. When that equation was written down in 1905 by Einstein, Dirac was three years old. Twenty-three years later, he wrote down the second equation, which incorporates the elements of Einstein's equation, E and mc^2 . Dirac added α and β , which are very simple mathematical structures, and it resulted in a miracle. It is a miracle because, given this ingenious idea, Dirac could predict that the fundamental particle electron—each of us have billions and billions of them in our bodies—are tops, spinning tops. And more than that. He could calculate from that simple equation how fast each of these electrons is spinning and how much magnetic field is created by that movement. Through subsequent development, that calculation resulted in a precise number for the magnetic strength of each electron, a result supported by subsequent experiments in laboratories all over the world. That calculation was confirmed to the accuracy of at least eleven decimal points. To appreciate the meaning of this, to appreciate how accurate it is, let us imagine that this hall is filled with marbles and you are required to count these marbles one by one. And there will be something like several hundred billion marbles. You are required to count them one by one, and tell us the precise

number down to the last marble—a twelve-digit number, and you have to be correct for every digit. That is the degree of accuracy which that simple-looking Dirac equation was able to create. The beauty, the elegance, the grandeur of this deep penetration of the secrets of nature! For any scientist that deals with it it is an absolutely awe-inspiring experience. Science students, in learning about the Dirac equation, have this experience. But in my old age I understand more. I understand that feeling of awe-inspiring experience in seeing something that perhaps is a secret which should not be seen by a mortal man. I understand it as a deeply religious experience.

A second aspect of my transformation came about because of the following thoughts. As I reflected on human history, I found that agriculture in early human civilisation is about 10,000 years old. That is one hundred centuries. Over the first ninety-nine of these centuries, progress in every sphere of human activity had been gradual and slow. Then, in the last of these one hundred centuries, the twentieth century, progress has exploded: While in the year 1900, the fastest way of traveling was on horseback, at perhaps 8 kms/hr, today we fly at 800 kms/hr. While in the year 1900 the telephone was a new toy, today several hundred million cell phones are in use all over the world. While in the year 1900 the best computational aid was the abacus, today we have supercomputers performing trillions of operations per second. While in the year 1900 diabetes, the dreaded disease, was incurable, today we have insulin, antibiotics, magnetic resonance imaging, organ transplants, etc., etc., more than doubling the human lifespan. While in the year 1900 humans were earthbound, today we walk on the moon. While in the year 1900 TNT bombs weighed 500 pounds, today the explosive power of a hydrogen bomb is equivalent to 20 billion pounds of TNT.

All of these miracles, good or bad, are consequences of the unprecedented development of science and technology in one century, the twentieth. So, I often reflect, it is as if humankind is on a fast train, propelled onwards by science and technology, rushing on, exploring and accelerating. Could the train crash? Of course, nobody can answer that question. But the question gener-

ates uncertainty and anxiety, especially for me in my old age. Reflecting on it, I suggest that anxiety must be one of the fundamental reasons for the deep faith of a religiously devout person. I therefore agree with Dr Polkinghorne, that there is an urgent need for increased dialogue between science and religion. Thank you.

Polkinghorne: Well, thank you very much. I would like to just tell you something that you perhaps do not know. If you go into Westminster Abbey when you are next in London, look for the memorial slab for Paul Dirac [Figure 9]. You will find the Dirac equation inscribed upon that slab. I don't know what most tourists make of the inscription. You and I will be pleased, except it is written not in Dirac's notation you rightly used up there, α and β , but with a γ notation ($i\gamma\cdot\partial\psi=m\psi$). There was a big debate about that. I told the Dean of Westminster to write in Dirac's form but he did not accept the advice.

I think you made a very important point about the extraordinary acceleration of science and technology. Science gives knowledge. Technology comes along and turns that knowledge into power. I think that knowledge is always a good gift. It is better to know than to be ignorant. But power is an ambiguous gift. Not everything that can be done should be done. I think you put your finger, if I may say so, on a very important aspect of the dialogue and indeed the interaction between science and religion. Religious people are not the only people to have insights into ethics and what should be done, but they have a long tradition of thinking about those questions. They should be able to contribute to the dialogue. You pointed out to us very remarkable and striking ways in which the world has changed in the twentieth century. But, of course, human nature does not seem to have changed very much. And in fact, the twentieth century has shown us terrible ways in which human nature can be corrupted and distorted, and the dreadful deeds that flow from that. We do need, absolutely, to address those problems that, I think, focus on human nature. One of the difficulties many scientists have is that they are very used to thinking about things in general. That is the power of science.



Figure 9. Dirac's equation is engraved on his memorial slab in the Westminster Abbey. Source: <https://tinyurl.com/23t9v4cy> (accessed 12 March 2024).

Dirac's equation describes all the trillions, trillions of electrons in the Universe—an enormously powerful generality. But, of course, the character of a person is always unique. We are unique people. We have unique experiences and religious traditions, faith traditions that focus on unique founding figures and events ... I wonder how you, a scientist, respond to a religious appeal to unique events and unique people, I mean, are you happy with that?

Yang: You know I do not know how to answer that question. As I said, science has made amazing progress, especially in the last couple of centuries. And as science has made progress, it has become more powerful. Humankind can today manipulate things in nature in ways which were unimaginable even, let us

say, a hundred years ago. But, at the same time, while its power increases, the same goes for the humble feeling when understanding new deep matters. As you mentioned before, there is the question: Is there a grand design? Is there a purpose? And what is going to happen? As I said, when required to fill in a form with the item "Religious Affiliation," I had always filled it saying I am an atheist. That said, when you understand something really subtle, really deep, the question necessarily comes up, how come? If you ask me whether an increased dialogue between science and religion could answer such a question, I would have to say that I am not sure. However, that does not mean that such conversations would be useless and should not take place. In fact, I like very much a sentence in a speech made by our friend Freeman Dyson. When he accepted the Templeton Prize, he said: "God is when the mind has reached its limit."

Polkinghorne: Yes, and I think we can only find out the degree of fruitfulness of the dialogue between science and religion by pursuing it. In science, you investigate a regime. You do not know what is going to turn up but you won't find anything if you do not go to look for it. I very much doubt there is a sort of natural cosmic religiosity, one might say, that goes with the science. This is a feeling of awe and so on that you expressed so well, which Einstein frequently talked about. I remember one of his papers, where he says that "when he made great discoveries he felt like a child in the presence of the elders." This wonderful order of the world is something that transcends finite human thinking. That is a gift the practice of science gives to scientists. But there is another experience of science which is more ambiguous and relates to the ethical question you raised and that is very exciting ... In the twenty-first century, I think, the most important developments in terms of scientific understanding and technological possibility are going to be in the biological sciences rather than the physical sciences. The amazing advances taking place in genetics offer great opportunities for healing, also for manipulation of human life in ways that are ethically dangerous. It is very easy to be carried away with the excitement of research, to respond to a sort of technological imperative ... We have done this. We have done that. Come on, let us do the next thing. But the next

thing might not be the thing which should be done. I wonder what you think about whether we need a dialogue between the expert scientist and the general public—a religious public, or a nonreligious one, but an ethically concerned public, so that researchers are not carried away with excitement ... I am sure you read lots of the memoirs of people who worked at Los Alamos during the war, great scientists were there, perhaps the greatest concentration of scientists ever assembled to carry out a single purpose. Most of them, it seems, did not really ask themselves what they were doing till they saw the first test explosion. Then they felt differently about it. Oppenheimer said, didn't he, "the scientist is very sweet, easy to be carried away." It would be interesting to know what you think about that.

Yang: You mentioned that there is a common perception of many people that science and religion are contradictory. This is certainly not true. Science and religion have the same origin. The origin is the human desire to understand. Science and religion take different methods, different approaches, but the ultimate aim is really the same. If you look at what Newton wrote, you realise that of the thousands and thousands of pages of manuscripts that people have collected of his works, only a small fraction of them are about science. Most of them are about religion. I remember that once I was visiting Wutaishan in Shanxi. I went to one of the temples, and the monk there asked me to write something in their visitors' book. So, I thought about it. What I wrote in Chinese was as follows: "Science and religion belong to one family from the beginning."¹⁵ The monk was very pleased.

Polkinghorne: I am sure I would be pleased if I understood what you had written. You were thinking along the same lines though, this quest for understanding, this quest for truth being a fundamental human activity. It is interesting, is it not? The big sort of founding figures of modern science in the seventeenth century and the early eighteenth century were nearly all people whose religion was also important. They may have had their difficulties with orthodox religious belief, as Newton certainly did. They may

15 Translated by me.

have had difficulty with the religious authorities, as Galileo notoriously did. Others were lucky in that respect, Robert Boyle, Kepler, and so on. They were all people who clearly said we should read two books, the book of nature and the book of Scripture. I think we should remember that. I mean, one of the reasons why science and religion should be friends is that religious belief helped as a sort of midwife to bring modern science to birth. But I would like to ask you another question, which you may think is a tangent. I am very interested in what you say to it. I will explain why afterwards. What do you think about mathematics? What is the nature of mathematics? Is it a discovery or is it an invention? Did mathematicians invent mathematics or did they find it? Did Mandelbrot invent the Mandelbrot set or did he discover it? What do you think about that? Sorry, a tangent question, but very interesting.

Yang: You always raise questions with me and you know I cannot answer them. But it is important to raise such questions.

Polkinghorne: Thank you.

Yang: The dialectic of science and religion entails the questions of what religion can learn from science and what science can learn from religion. I thought about this last night. I would say that Galileo's was a very good example of what religion could learn from science.

Polkinghorne: Absolutely.

Yang: If there were more dialogues between religion and science, there would not have been that affair about Galileo several centuries ago. Religion has acknowledged that. But what can religion teach science? What immediately comes to mind is that religion could teach scientists to be less arrogant. As science produces more and more powerful results, there is a tendency for scientists to become arrogant, which, I am sure, everybody would agree is not appropriate. Furthermore, the power that is created by scientific progress, as I tried to show earlier, can lead to disastrous

consequences. That is where more thoughtfulness should come in. That is where religion can play an important role.

Polkinghorne: Thank you. The reason I asked you a question about mathematics is because I believe mathematics is a discovery. Most mathematicians believe that mathematics is a discovery, whether they are religious people or not, and I think that is right. It is a very interesting thing. There is a dimension of reality, a world of mathematical entities to which we have access given the unreasonable effectiveness of mathematics, a world which is clearly different from the material world though related to it. This belief, I think, enhances our understanding of the richness of the reality in which we live. We are, of course, material beings. But we are also, as Pascal said, thinking reeds. We have access to this world, this amazing world, a world of mathematics and human thought. Do you think we should find out what they (the audience) think out there?

Questions and Answers

The audience were people from various backgrounds. Their comments below brought to light the significance of the broader context of science and faith, in particular questions pertaining to the nature of science, theology and Chinese culture, tradition and thought. That said, at their core, the comments and questions were theological and philosophical issues of science and religion, in response to Polkinghorne's lecture. The concerns these questions illustrate point, however, beyond the confines of the Chinese world, to matters of general relevance for humankind in our age.

Chair (Dr Leo K. C. Cheung): It is now the time to invite questions and comments from the floor. To allow more questions, will you please keep your question short, within one minute? And when you are asking your questions, would you please introduce yourself by giving your name and affiliation?

Question 1 (from a young student): I am from mainland China, having a master's degree in communications. I have two questions. Do you think science and religion have the same origin, in a Marxist sense? There are many persons and outstanding scientists in mainland China who do not believe in religion. The government's policy discourages it anyway ... Do you think they need to believe in a religion?

Polkinghorne: Can I make a quick response to that? I make an empirical response. Of course, obviously, I do not share Marxism's understanding of the nature of religion. I think there is some empirical evidence that suggests Marxism is not a total explanation of history or of human nature. This is one thing I want to say. The other thing is, of course, you do not need to be a religious person to do science. I know great scientists who are convinced atheists, sometimes very militant atheists ... You do not need to be religious to do science. But this does not mean there may not be a hidden undergirding of the order of the world which originates in the mind of God.

Yang: I am not a student of Marxism. Of course, I know some things as a layman. Marxism was considered a deeply economic theory, I understand. Some people believe Marx should have won a Nobel Prize in Economics. As to Marxism as a philosophy, I am not qualified to make any statements. You mentioned the question of religion and the policy of the Chinese government. That is a very sensitive and a very important subject. It is my belief that that is a question the Chinese government is very anxious to find solutions to. I am sure that is also a question that the Vatican is paying a lot of attention to.

Question 2 (anonymous member of the audience): Dr Polkinghorne, you mentioned the unseen reality. Perhaps I can see some kind of unseen reality. I would like to introduce myself. I am from Hong Kong and I am not very educated. What I can see is that the birth of any newborn baby brings with it parents, gender, date and place of birth, mother tongue, ethnic race, colour of skin. All of these are given to anyone, everyone. No one can choose, change,

reject these [and the person is not asked to consent to any of this]
... Is this legal or illegal without the consent of the person?

Polkinghorne: Well, I share the Kantian view. Each human being is an end and not a means, and is entitled to a deep ethical respect ... I have a certain amount of amateur engagement with medical ethics issues in the United Kingdom, having been on various government committees and things. That has been a common denominator among the people wrestling with these problems, whether they came from religious backgrounds or not ... Certainly people are entitled to individual liberty. That does not mean there are not restrictions societies can rightly place on people's activity ...

Question 3 (Professor Lauren Pfister): I have a question to follow from Dr Polkinghorne's quotation of Blaise Pascal. Your quotation says that humans think and the Universe does not; that humans will die and know they will die, but the Universe does not know anything about it. So, Pascal goes on to say, "the question is not only to think, but to think well." I want to ask both of you. How do we face death in the light of science and religion? How do we think well about it? Because, I believe, Professor Yang is talking about anxiety and uncertainty [and] is thinking about death, and knows we will die. And that we need to know how to think well.

Polkinghorne: Can I kick off? Thank you very much for extending Pascal's quotation. I did not know that. I have forgotten it. I do think the question itself is a very serious question. And one that I think everybody thinks about. Some people think about it every day. Other people are able to dismiss it. But I think it is a question facing all of us. Every story that science tells, every *horizontal* story, you might say, of the scientific understanding of the world, ends in death of one form or another. The Universe is going to die but on a very much longer timescale than you and I. So, in the end, if the scientific story is the only story to tell, the Universe ends in futility. That is why another common friend of ours, the distinguished Nobel Prize-winning physicist, Steven Weinberg, stated that the more he understood the Universe, the more it

seemed pointless; in the end it's just going to end in futility. But I believe, of course, there is another story to be told. The *vertical* story of religion and theology tells us the story of God's faithfulness. I think the only ground for hope in a destiny beyond death lies in the faithfulness of God. That is exactly the point that Jesus had during an argument about this, he said "God is the God of Abraham, the God of Isaac, and the God of Jacob; not of the dead but of the living." In other words, the patriarchs matter to God ... People are not going to be thrown away. They will have some sort of destiny. I believe we have. Our destiny links with the resurrection of Jesus Christ ... If we do not have some transcendent story to tell beyond the horizontal story of science, then it is the end.

Question 4 (a business lady): My name is Huang. I come from the business community. I think it has been clearly demonstrated even today that you can see the glory of God in all the equations that describe the physical world. Personally, it is Schrödinger's equation that I admire. But this only says to us that there is a magnificent Creator. The equation and its underlying mathematics tell the magnificence of the Creator. My question then is, how do you get from this large-scale picture to something as specific as the resurrection?

Polkinghorne: You cannot learn everything from [mathematics]. In particular, the picture of God that it will give you will not be more than a picture of God the great mathematician or a cosmic architect or something like that. This is not to be despised but I think there's more about knowing God than that ... If there is some truth ... about God as in some sense personal, I mean, as far as we can use human language, ... [it is more appropriate] to call God a person than to call God a force. Then we will have to take the risk of entering into a personal experience and of evaluating that experience with the ambiguities and also the enhanced eventualities that it brings. The reasons for my Christian faith lie ... in the way I encounter the figure of Jesus Christ in the Scriptures, in the church, and in the sacraments. That is why for me individual experience is an indispensable component of possibly everybody's worldview but certainly of the Christian worldview.

Question 5 (an orchestra conductor): I am a conductor. I really appreciated your comments about music ... You evoked the idea of verisimilitude, really wonderfully ... Do you feel that verisimilitude can become perhaps [a way of furthering the dialogue of science and religion]? Given the contention between the two sides regarding the methods they use and the types of dialogue they choose to engage in, ... is there a fundamental disagreement between the two as to what constitutes realism?

Yang: I am not sure that realism is something which either Dr Polkinghorne or I had in mind when we were talking about the necessity to have more dialogue between science and religion. Reality is a question which has been debated in academic physics in the twentieth century. In particular, it was one of the unending disputes between Einstein, Heisenberg, and Bohr. But that is another subject which may or may not have anything to do with the subject matter that we are focusing on this afternoon.

Polkinghorne: I do not quite agree with that. To me the issue of realism is very important in science and religion. I think in some sense it is a common issue between the two. I am a critical realist in both my understanding of the nature of science and of the nature of theology. Verisimilitude, or something like it, is an indispensable concept for theology. I mean, we realise that the infinite reality of God will never be adequately caught in final human speech. Every image of God, in some sense, is an idol, it has to be broken. There is a strong tradition, I am sure you know, called apophatic theology, which says we can know what God is not, not what God is. This tradition is very strong in the eastern church but also in the western church. St Thomas Aquinas took that point of view. It does not mean we can't know anything. To paraphrase another theologian hero of mine, Augustine, talking about the Trinity: Three what? He said, "Three persons." We have to say something rather than to be silent. We know we are not getting the whole story. I think there is a concept, a very important concept, of verisimilitude in theology just as in science. Final remark about music, one of my favourite quotations is from George Steiner (he was a celebrated literary critic), who wrote a very interesting book *Real Presences*, about creativity, and somewhere in that book he

says something like “the matter of music is central to the issues of metaphysics.” Said otherwise, if your worldview does not give adequate account of the human experience of music, you have missed the point.

Question from President Ng Ching-fai: I would like to put a question to Revd Polkinghorne. You mentioned the phenomenon of circularity in science. That is, whenever a new discovery obtains from experimental results, the theory needs to be modified if it cannot explain the facts. Is there also circularity in theology? As you mentioned evolution, you are using a new interpretation of evolution, in which case circularity is also a phenomenon in theology. Is it not true?

Polkinghorne: Yes, I certainly would not wish to give you the impression that science is circulatory and theology is absolutely straight. To the point, I think all human knowledge actually is, to a degree, precarious. I think we do not have certain knowledge in the absolute sense. Gödel shows even mathematics is not logically complete. So, if that is true of mathematics, it will surely be true of science and even more so of religion. The philosopher of science I am influenced by the most is Michael Polanyi, who was a distinguished scientist and philosopher. When he wrote his great book *Personal Knowledge about Science*, he said in the preface, “I am writing this book to explain how I may commit myself to what I believe to be true while knowing that it might be false.” That is, I think, the human condition. That is certainly the condition of a religious person. This is why we walk by faith, and not by sight. Faith is not a rational belief but commitment to a rationally motivated form of belief. It is not an absolute certainty beyond peradventure. That is the human condition, in my view.

Discussion

Analysis of Polkinghorne's Public Lecture

Polkinghorne's public lecture could be of interest to many readers, as it proved groundbreaking for the present author's own experience. While a thorough analysis of the lecture in its entirety would be useful, in what follows I present my own perspective on selected points. This selection illustrates my learnings, as a scientist, from his lecture.

What is Polkinghorne's perspective on the primary role of academia? Polkinghorne, who spent most of his scientific life at the University of Cambridge, thinks that the most important purpose of academia is its focus on discovery and the propagation of knowledge. This view of academia works for top universities, but may not be easily accepted by, e.g., engineering or technology-oriented universities.

What is Polkinghorne's perspective on the motivations that drive the scientist to undertake research? I believe that perceiving the beauty and mystery of Nature is the best motivation driving the scientist to undertake research. Scientific research is not as easy as one might expect. Hence Polkinghorne's point that the key motivation of doing scientific research is the will to understand the world. Sometimes, scientists are rewarded by moments of elation, when they discover a part of the wonderful structure of the Universe, which pays off for their hard work.

What is Polkinghorne's view of Nature? Very often, Nature does not always oblige us with answers to our questions and expectations. This view is really interesting, and provides a good reminder for young scientists, especially when they experience disappointment, frustration, and failure in their scientific research.

What is Polkinghorne's perspective on Scripture? In Polkinghorne's view, "Scripture is not a divine textbook in which are written all the answers and which examines questions of life that have to be memorised. Scripture is a laboratory notebook, one might say, giving the details of those critical experiments in which God has been encountered and known." I believe that David Martyn Lloyd-Jones (1899-1981),

a Welsh Protestant minister, would not fully agree with Polkinghorne. Lloyd-Jones believed that the Gospel is concerned with everything that pertains to human experience, to the whole history, and to the world as a whole, insights which are very profound. The Bible is not just another ancient book. In one of his sermons, titled “The Message of the Bible,” Lloyd-Jones shares views about the unique nature of Scripture as the very word and revelation of God. Their views differ. But perhaps Polkinghorne’s metaphor of Scripture as “a laboratory notebook” is not diametrically opposite to Lloyd-Jones’ more traditional view of Scripture.

What is Polkinghorne’s idea of the relationship between science and religion? For him, the true achievement of science is verisimilitude, the making of reliable maps of physical reality, which are fully adequate on a specified scale but not exact on every scale. In turn, theology speaks of the unseen reality of God. Based on his own career as a physicist and a theologian, Polkinghorne reiterates that science and religion are friends; they both are engaged in the search for truth through motivated belief. This common denominator is indispensable for the dialogue of science and religion.

What is Polkinghorne’s idea of how to examine the Universe? He is convinced that, if we are truly to understand the world, we need to look at the Universe with both eyes, those of science and those of religion.

Analysis of Yang’s Short Presentation

Yang is an outstanding leader of the community of particle physicists. Although he is not a religious person, given his scientific reputation the transformation of his ideas about religion should be of interest to many. First, he has recognised that the awe-inspiring moments scientists experience on discovering a secret of Nature may actually be deeply religious ones. Second, he recognises that the unprecedented development of science and technology in a single century can cause

anxiety, which might be one of the fundamental reasons for embracing deep faith.

From my viewpoint, that first recognition of his is of utmost relevance here. Are the moments of awe religious experiences? Although Yang may not have stated it explicitly, it seems to me that he intimated that the laws of Nature were established by the Creator, whether or not this overlaps with the religious concept of God. Why is this perspective significant? Again, although Yang did not make this connection explicit, it is possible that his view of the awe-inspiring experiences of top scientists is not unrelated to the scriptural wisdom that proclaims, “The fear of the Lord is the beginning of knowledge” (Proverbs 1:7). He might have hinted at this connection when he pointed out that scientists should be humble in their research, regardless of its outcomes.

Yang’s second point implies that people should always seek to acknowledge the Creator, or God, no matter how much science and technology might advance. Accordingly, a dialogue of science and theology is unavoidable. His perspective finds its best illustration in the statement that “Science and religion belong to one family from the beginning.” It is hoped that Yang’s views will continue to inspire more and more Chinese, including scientists, to explore the relation between science and religion, including the Christian religion.

My Own Experience

On a personal note, with Polkinghorne’s encouragement, I made a final decision regarding my baptism and confirmation in the Ely Cathedral, Cambridgeshire, UK, on Saturday night, 26 November 2012. Figure 10 pictures me and my sponsors in a Chinese restaurant. I continue to serve the One Who is worthy of all my efforts and trust. Before writing this article, I, both as a scientist and a Christian, had been trying to reconcile science and religion in the footsteps of Newton, Kepler, Kelvin, Stokes, etc. Now, Polkinghorne’s speech and his dialogue with Yang provide inspiration for me, in many ways.



Figure 10. Celebrating the author's conversion to Christ. From left to right: Revd Peter Hayler, Thirza Hope, John Z. Shi, and Christopher McDougall (1936-2017). Chinese restaurant, Cambridgeshire, England, 26 November 2012.

Conclusions

This paper underscores the ongoing importance of fostering a dialogue between science and religion. The insights provided by Polkinghorne and Yang offer valuable frameworks for further exploration and understanding, encouraging a holistic approach to the quest for truth.

In the light of Polkinghorne's convictions that the search for truth requires the binocular vision of both science and religion, and that science and religion complement each other, it is neither odd nor disingenuous for him to be a physicist as well as a priest. His insights into the primary role of academia as promoter of discovery and disseminator of knowledge, which relates to profound motivations for doing scientific research, are precious to many, institutionally and personally. He speaks of Nature and Scripture in almost identical terms. Thus, he draws attention to the fact that Nature often runs counter to the expectations of scientists, which invites researchers to humility. The

same goes for his point that “Scripture is not a divine textbook in which are written all the answers”; instead, as “a laboratory notebook” of sorts, Scripture invites believers and theologians to humility, to the realisation that God and the mysteries of existence remain irreducible to arrogant and superficial claims about the truth.

In turn, the considerations of Yang, as a Chinese and a top physicist, brought to the fore his profound knowledge of the East-West dialogue in regard to science and religion. He made an important point about the unprecedented development of science and technology provoking anxiety, which, according to him, prompted many people to embrace deep religious convictions. The admission regarding the transformation of his later views on religion, which led him to state that “science and religion belong to one family from the beginning” will surely continue to inspire more and more Chinese, including scientists, to explore the relation between science and religion.

It can be cautiously inferred from their dialogue that for Polkinghorne and Yang there is no conflict between science and religion, which are two complementary ways of seeking the truth. It was encouraging that the Chinese audience at the event acknowledged the mutual relationship of science and faith, despite their Chinese traditional cultural background. It is this openness to the idea that led me to address, in the preliminary sections of this article, the complex backdrop of that tradition, which cannot be reduced to either Confucian humanistic ethics or modern atheism. In its most ancient sources, Chinese tradition treasured a sense of God’s mystery at work in the world which, to an extent, reverberates in at least some of the comments that were put forward. It would not be unwarranted to conclude by suggesting that Polkinghorne’s visit to Hong Kong in 2006 represented as significant a milestone in terms of science and religion as Batchelor’s visit to China, in the 1980s, was in regard to bridging the gap between Western physics and Chinese fluid dynamics.¹⁶ In this sense, indeed, the scriptural

16 J. Z. Shi, “George Keith Batchelor’s Interaction with Chinese Fluid Dynamicists and Inspirational Influence: A Historical Perspective,” *Notes and Records of the Royal Society* 75 (2021): 461–502.

words that serve as a motto to this paper—“There was a man sent from God, whose name was John” (John 1:6)—can be aptly taken to mean Polkinghorne’s own impact.

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