

## **FAITH AND SCIENCE: Yoke-fellows or antagonists?**

Aidan Hart

I have long been perplexed by the embarrassment that the contemporary scientific world feels towards religious faith. This is a recent phenomenon. History is full of believing scientists. There is an equally puzzling the tendency for many religious people to view science either as a threat to faith, or, which is perhaps worse, to treat it as a completely separate realm of truth, with little relationship with faith. Certainly, the knowing of love is distinct from the knowledge of science. But since God created both the heart and the head, they must surely be correspondences.

For me personally, the study of God's world and scientific discoveries is to breathe in the fragrance of my Beloved. Knowledge of this world makes me desire and seek its Creator even more. Each piece of scientific knowledge is a footprint - not the Beloved Himself, but an imprint, and an imprint with a direction pointing towards Him.

And when we do follow the footprints and eventually meet and commune with Him who "made the stars also", our mind is expanded. This in turn makes us more able to receive further scientific insight into the splendours of His world. Life with Christ is full of surprises. Beholding Him we pass "from glory to glory". This spiritual awareness that there will always be new realms in one's spiritual life helps to keep the mind flexible and therefore also open to new paradigms of science, both to learn them from others, and even to discover new things. A healthy faith feeds scientific discovery; it does not trammel it.

So, in this article I want to explore a more mutually positive way of viewing the relationship of science and faith, one that would benefit both science and our relationship with God. I am by no means suggesting an interference of one field in the other, but when I noticed the remarkable similarities between the fundamental principles of quantum mechanics and trinitarian theology, and of relativity with other theological truths, I couldn't but help think that in future some theological principles might just suggest to scientists a fresh way of looking at a particular scientific problem – not in a dogmatic or rigid way, but as a possible avenue to explore.

So, in what ways can science help a person's faith?

### **Science and divine eros**

Science, the arts and theology are equally an exploration of God and His wonderful world. Although I majored in English literature at university, I took as many papers in mathematics and biology as the regulations allowed within an arts degree. Unfortunately, these same regulations excluded physics, but this area has been the focus of my subsequent scientific reading for the past years, and will be the focus of the scientific elements of this article.

The best way I can describe my own experience of this study is to liken it to a game of hide and seek with God. Learning of some scientific breakthrough I stand in awe. But then another, even deeper, breakthrough shows a deeper and even more strange level of reality, as though God is saying: I am in this, but not only in this; I am here, but not only here.

For example, Isaac Newton's laws of gravity, motion and time are all wonderful, and as true as need be in our day-to-day life. But when objects approach high speeds, close to the speed of light, or when they are exposed to great gravitational forces, then Newton's laws prove insufficient, and must give way to Einstein's theories of relativity. Time and space are shown to be elastic and not fixed. In fact space and time are shown to be a single trampoline-like field that appreciably distorts around a great mass and thus make objects fall toward it, like a ball rolling toward someone standing on the trampoline.

But then things become even stranger when we enter the tiny atomic level. The principles of quantum mechanics reign here. Certainty gives way to probabilities. Everything moves. Nothing is static. And things we thought were a continuum are in fact granular, made of quanta. It seems even space itself could be made of quanta: an absolute minimum length exists, Planck's length, which is approximately a miniscule  $1.6 \times 10^{-35}$  centimetres.

So the cosmos is revealing itself to be full of surprises. Just as we can be changed into Christ's likeness from glory to glory, to use St Paul's phrase (2 Corinthians 3:18), so the created cosmos is showing itself to have layer upon layer of mystery and wonder.

This divine tactic to woo us through the wonders and mysteries of His creation is put beautifully in The Song of Solomon: "...With great delight I sat in his shadow, and his fruit was sweet to my taste" (Song of Solomon 2:2b). The world is not God, but it is an image or shadow of Him. Like a shadow, it is a promise of His presence.

"...The voice of my beloved...Behold, there he stands stand behind our wall, gazing in at the windows, looking through the lattice" (2:8,9). He speaks to us initially from beyond this world, looking in "through the lattice", teasing us with hints of His presence, fuelling our desire for Him, preparing us for when He enters the paradise garden to meet and commune directly with us.

"My beloved put his hand to the latch, and my heart was thrilled within me. I arose to open to my beloved... I opened to my beloved, but my beloved had turned and gone. My heart failed me when he spoke" (5:4,6). He reveals Himself, then hides Himself, preparing us for a yet deeper relationship. He wishes us to pass from grace to grace, and not settle just for one gift of Himself. He bathes us in one colour or "wavelength" of His divine light, only to add to this yet another colour. His graces and names are multiple, His depths beyond end. And the riches of creation are His proof to us that life with Him is even richer.

### **Asceticism and science**

The Church Fathers both East and West describe three stages in our relationship with God: purification, or practical theology as it is called in the East; illumination, or natural theology; and finally, union, or mystical theology. I want to show that the scientific study of the world can greatly aid us in the first and second of these two stages.

The rigour of modern scientific research demands two things simultaneously, both of which are a form of purification: humble assimilation of previous knowledge, and a frank desire to see things as they are rather than as they appear, or as others have said they are.

Father Sophrony of Essex said that, except for martyrs on the cusp of their death, all of us to some extent suffer from some form of self-deception (called *plany* in Greek). We try to force God, people and His world into a system that is either too small or not tailored to fit reality. We make God into our own distorted image, mistaking our caricatures for reality. Asceticism is to interrogate these images to see if they are true icons or caricatures. Science, as in the ascetic life, demands similar precision and watchfulness, an awareness that things may not be as they seemed at first. Consequently an ascetic can be a very good scientist, and a scientist can make a very good ascetic, for both require the same discipline: utter honesty and a frank search for objective truth.

What of the second stage: illumination or practical theology? The essence of this stage in the spiritual life is to hear God's words or *logoi* within the created world. Each thing is created and directed by God through its unique logos. This unique logos is the subject's true name and nature. This divine word was not only spoken by the Logos to bring that thing into existence, but it also continues to guide that thing or being towards its culmination in the New Jerusalem. As the writer to the Hebrews puts it, Christ "upholds the universe by his word of power" (Hebrew 1:3). The Greek word translated here as *word* is *rhemati*/ ῥήματι and means live utterance rather than a word of the past. It is therefore something that can be heard here and now.

As created beings we need to adjust our eyes bit by bit to the brilliance of God's presence. And so, in God's economy, we first find Him veiled by the garment of the cosmos, just as Moses veiled his shining face so that the Israelites could look at him without being dazzled. The cosmos therefore serves both to reveal something of the Creator's form - just as a well-tailored suit tells us something about the wearer's physique - and to partly conceal Him, protecting our eyes from the full radiance of His indwelling glory. Creation is a bush burning without being consumed.

All this lays the theological foundation for what I want to say about science. Let us now pass to this subject in a little more detail.

### **The naming of things**

Science can be seen as our natural desire and our divine calling to name things. A name in its truest sense conveys the essence of the subject named. It also expresses a desire to enter relationship with that thing - or at least to

include it in our relationships with others. As the great Russian saint, Seraphim of Sarov affirmed:

*When the Lord commanded Adam to give names to all the creatures, Adam gave every creature a name which completely expressed all the qualities, powers and properties given it by God at its creation. Owing to this very gift of the supernatural grace of God which was infused into him by the breath of life, Adam could see and understand the Lord walking in Paradise, and comprehend his words, and the conversation of the holy angels, and the language of all beasts, birds and reptiles.*<sup>1</sup>

Although, as St. Seraphim indicated, this naming in its fullest sense is a supernatural gift, it does nevertheless include the natural capacity of humankind to understand the world through observation and scientific enquiry. Let me give one example: spectral lines.

Spectral lines are a unique combination of either bright or dark lines caused respectively by the emission or absorption of a narrow wavelength of light by a given atom, molecule, or anything else up to the scale heavenly bodies like stars. The dark lines (called absorption lines) appear on an otherwise continuous spectrum, while the bright lines (emission lines) are bands of particular colours from within the spectrum. This “spectral name” is a unique fingerprint that tells us precisely what elements the source is made of.

A star that we see in the sky is billions of miles away, and to most of us it is just a distant pin of light. But its unique spectrum provides us with a great deal of information about it: what elements it is made of; the density and temperature of those elements; the magnetic fields on that star; whether or not it is orbiting another star; its mass; and even what is floating in the space around it. When we know its spectral name, this pin of light then takes on a specific character for us, differentiating it from the millions of other pinpricks of light that we see in the night sky. (For those interested how these lines are created, when an atom is excited electrons jump between energy levels and this jump causes the atom either to emit or to absorb photons of light of a specific frequency. The observer experiences these as the presence or absence of specific wavelengths of light.)

### **Ideas need words to grow**

It is well known that an idea needs to be expressed in order to grow. For this reason authors and thinkers often keep a notebook with them— even beside their bed. If an idea comes to them, they need to encapsulate it in words before it disappears into the ether of other brilliant thoughts that weren't incarnate in words. Or in images, for a visual image can express ideas even more powerfully than words. In fact Einstein developed his theories of relativity first as thought experiments, as images. He then later used the mathematical language of numbers to prove the theories that he had already developed in his thought experiments.

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<sup>1</sup> Seraphim of Sarov, in *A Conversation of Saint Seraphim of Sarov with N. A. Motovilov*, Holy Trinity Jordanville (Jordanville, New York, 1962. p. 11.

Christ understood this principle of visualisation and therefore did much of His teaching in parables – imaginative stories that conveyed truths. I believe that the ever-growing body of scientific discoveries can be regarded and used by the religious person as an expanding resource of images with which to better understand spiritual truths.

The mind-expanding theories of relativity and quantum mechanics continually remind me that there is a world out there – and in the case of quantum mechanics, in here - that is much stranger and mysterious than my everyday life, but which at the same time underpins it. This in turn reminds me that the God I know and love is also infinitely more strange and mysterious than I will ever be able to comprehend. Whatever I say about God – however true – I need straightaway to unsay. “God is love”. Yes. But God is love in a way much greater than my limited conception of love.

### **Scientific truths as types of theological truth: Relativity**

An understanding of certain theological principles could I think assist new scientific discovery, precisely because God preceded creation and creation naturally reflects something of His nature. The following are some examples of this parallelism between scientific theory and theological doctrine. Although these parallels are observations made in hindsight, after the scientific discoveries have been made, the correlations are I think sufficient to show that it could work the other way around, from theology to science.

For example, all created things are relative; only God is unchanging and self dependant. Icons often have inscribed within Christ’s halo the Greek words  $\Omega\text{N}$ , which can be translated as ‘The Existing One’, or ‘The Being’. In other words, only God is: All else has. Consequently, everything created is relative, liable to change, reliant on something.

It should have therefore been no surprise to Christians when Albert Einstein published his theories of Special Relativity (1905) and then General Relativity (1915), which showed that time, space and mass are relative and elastic. According to Einstein’s Special Theory of Relativity, now proven, the rate of change of time varies depending on one body’s speed relative to another’s. Time for an astronaut travelling at very high speeds, for example, will from our point of view pass slower than our own on earth.

According to Einstein’s Theory of General Relativity, time for two bodies will vary relative to each other depending also on their positions in a gravitational field. Time for a body close to a great mass will move slower relative to time on a body further from that mass. So Einstein showed that time is not an absolute measure uniformly valid to all observers. It is relative to the observer's velocity and experience of gravity.

Black holes are an extreme example of this slowing of time relative to us. The hole’s gravitational field is so strong because of the incredibly high mass at its heart that, relative to us, its time slows to a virtual stop. The area around the mass beyond which light cannot pass because time has virtually stopped is called the event horizon. Light travelling outwards from within that mass can never reach us, which is why, somewhat anachronistically, it is called a black

hole. As far as the black hole mass is concerned its light is travelling at the speed of light towards us. But as far as we are concerned, who are from from the influence of the black hole's gravitational field, this light can never reach us. As far as the black hole is concerned its light is still travelling at 186,282 miles per second towards us, but for us the hole's clock is infinitely slow, that second virtually infinitely long, so the light never reaches us. This is not science fiction fantasy, but has been proven to be true again and again.

### **Icon Perspective systems and relativity**

I am an icon painter, and have been very interested in the different forms of perspective utilized in icons. Among other things, these systems exist to open the praying viewer's mind to different ways of seeing God and the world. As an after-effect, this can make the mind more elastic and able to absorb – and even to discover - the laws governing the strange world of physics. Let me explain.

Most westerners equate perspective with the linear system developed by Filippo Brunellesco (1377-1446), in which lines converge on a single point or points on the horizon. This is the world seen by one person from one place. But icons rarely use this system because it is too egocentric. The icon tradition instead uses up to six other perspective types in any one icon. Three of these are particularly relevant to our discussion.

In multi-view perspective an object is shown as though viewed from a number of viewpoints simultaneously. This helps us to see things as God sees them, unbound by space and time. In isometric perspective the parallel sides of a cuboid, such as a building, are shown as parallel, with no convergence or divergence. This helps us respect things as they are in themselves, irrespective of how they appear to us. And in so called inverse perspective the lines do not converge in the distance behind the icon, but in the space in front of the icon, in the viewer. This helps the viewer to know that not only is he or she contemplating God and his saints in the icon, but God and his saints are contemplating them. We are not only seeing God relative to us, but are being helped to see ourselves relative to God.

The role of these perspective systems in an icon is ultimately spiritual. But exposure to them over a long period does also open the mind beyond the mechanistic world of Newton to an awareness of larger realms, to dimensions of our material world that are, in a good sense, stranger. Such as the atomic world of quantum mechanics, to which we shall now turn.

### **Quantum mechanics and Trinitarian doctrine**

Einstein's theories of relativity deal with very large scales. Quantum mechanics deals with the very small scales of the atomic and sub atomic world. The three principles that underpin quantum mechanics have remarkable similarities to the doctrine concerning the Trinity that theologians formulated about sixteen centuries ago. The three principles of quantum mechanics are:

1. *Granularity.* Put in layman's language, things can only be subdivided so far. The infinitely small does not exist. One reaches a size beyond which things cannot be subdivided any more, whence the term quantum, the smallest discrete unite of which something is made. Light, for example, is made of quanta – called photons. It is not continuous. You can't have one and a half photons. You can have one or two photons of light, but nothing in between. This smallest scale that exists in the universe is determined by something called Planck's constant (denoted  $h$ ), named after the mathematician Max Planck who recognized it in 1900. Put more precisely in scientific terminology, this Planck's constant is a function of energy and time (usually measured as Joules ( $J$ ) or electron volts per second). Planck's constant is approximately  $6.26 \times 10^{-34}$  J/s, which is mind-bogglingly small!

Even more surprisingly, not only is all stuff made of quanta, but so also it seems is space itself. Both volume and area are made of discrete packets or nodes. Space can only come in multiples of a set size. For those interested, the area that separates two grains of space is denoted by the formula:  $A=8\pi Lp^2\sqrt{j(j+1)}$ , where  $Lp$  is the Planck length, and  $j$  is a half-integer, that is, the area may only have values that are multiples of  $\frac{1}{2}$ , and we all know what  $\pi$  is. The two important features of this formula are: (a) The area  $8\pi Lp^2$  is extremely small, about  $10^{-66}$  cm<sup>2</sup>. (b) This area can only come in multiples of  $\frac{1}{2}$ , that is, in discrete or quantized amounts.

2. *Relationality.* According at last to one school of quantum mechanics (relational quantum mechanics, RQM), entities like electrons only manifest themselves when they interact with something else. A system can only be understood, or even exist, in relation to another system. And the quantum state needs to take into account the state of the observer (as in relativity theory). Nothing is an island unto itself, to use Shakespeare's phrase.
3. *Indeterminacy.* We can only know the statistical likelihood of something happening in the subatomic world. A particle's position is not predetermined by the events of its past. The image taught to most of us at school, that electrons follow tidy orbits around the nuclei, is in fact false. These orbits are really clouds of probability that tell us the statistical chance of a given particle likely to be found here rather than there at any given time. And even then, it is not possible to know both this particle's speed and its position at once.

Furthermore, and for us quite bizarrely, it is the act of observing something that seems to determine the outcome. Before being measured, there exist a number of possible outcomes for the thing under observation, and it is only the act of measuring that determines for us which of these possibilities becomes reality. The famous experiment that illustrates this and other phenomenon such as light's particle-wave duality is the double slit experiment. In this, light or sub-atomic entities are fired through two slits and the outcome recorded on a plate on the other side. Limits of

space do not permit us to describe this here, but the interested reader can find excellent descriptions on the internet and in books.

Those readers who know their theology might have recognized that these three principles of quantum mechanics are similar to the three theological principles regarding the nature of the Holy Trinity:

1. *God is Trinity.* Quantum's granularity loosely corresponds to the trinitarian nature of the one God. The three divine Persons (*hypostases* in Greek) of the Trinity are distinct. The Father is not the Son, the Son is not the Holy Spirit. God is not a vague spirit, but three distinct Persons - distinct, but not separate. The phrase used in the Council of Chalcedon (451 AD) to describe the relationship of Christ's human and divine natures can equally be used for the Persons of the Trinity; "no confusion, no change, no division, no separation". As with the quantum world where nothing can be reduced further than the quanta, so the Holy Trinity cannot be reduced beyond the Three Persons to a nebulous spirit. There was no time when God was single and "non-granulated". The divine Persons of the Trinity are the Quanta of the Trinity. God is One, but this does not negate the distinctions and discrete reality of the three Persons.
2. *Love.* The persons of the Holy Trinity are in eternal relationship. God is love because He is three, but with one will, one nature and essence. God is love, because He is a Trinity of hypostases. The Father, Son and Holy Spirit exist always in relation to one another, never in isolation. They are Persons, not individuals. The relational nature of quantum reality can be seen as a type of this Trinitarian relationality.
3. *Freedom.* God is love and therefore "free". He is not a system predetermined by some rational laws superior to Himself. He created the universe because He willed to do so. There is no compulsion in the Godhead. In this sense, God is indeterminate. He always acts according to His nature, but precisely how He acts is always surprising. The indeterminacy of quantum mechanics can therefore be regarded as an albeit crude image of this divine freedom.

In making these parallels between the three principles of quantum mechanics and the three dogmatic principles concerning the Holy Trinity, I am not at all suggesting an identity between the two. They are as different as they are similar. The Trinity is the living God, while quantum mechanics is dealing with the inanimate world of matter and energy. But, as one would expect between Creator and creation, there are correspondences.

### **Dogma and freedom**

The caricature promoted by many secular commentators can get banal and tedious: religious dogma is close minded, subjective, and unrelated to reality, while scientific thought opens vistas, is objective, and is rooted in the real world.

First, Christian dogma has actually developed as an antidote to the closed mindedness of heresies, which invariably come from people who truncate truth, who try to put God in a box. Dogma preserves the profundity, limitlessness and objectivity of truth from the aridity, rationalism and subjectivity of heretical untruths.

It is with this supra-rational nature of truth in mind that theologians often prefer apophatic descriptions to kataphatic, that is, they prefer to say what God is not rather than what He is. When we say that good is infinite, for example, we are not saying that He goes on forever – a very limited human concept - but that He is not finite. It is safer to say that God knows no end, rather than that He goes on forever.

Secondly, this pejorative description of the relationship of faith and science is a perversion of history. It bears little resemblance to historical truth. Among the pantheon of scientists, physicists and mathematicians who were Christians (though some of an unorthodox kind) and whose faith underpinned their work, we can name just a few here, in no particular order: Michael Faraday, Henry Acland, James Maxwell, Isaac Newton, Johannes Kepler, Bishop Robert Grosseteste, Francis Bacon, and Father Georges Lemaître.

The relationship of faith and science is a complex field, and different scientists have had different approaches to it. In a recent interview on BBC Radio 4 (“Desert Island Discs”, broadcast 15<sup>th</sup> June, 2018), the leading cosmologist, Professor Carlos Frenk of Durham University, UK, outlined very clearly how he relates his belief in God to his cosmological research. Professor Frenk is one of the originators of the Cold Dark Matter theory for the formation of galaxies and the structure of the universe. The interviewer, Kirsty Young, opened the subject of his faith by saying:

“You said once that you do believe in God, but not while I am working. Tell me more about that.”

Professor Frenk’s answer was very illuminating: “I think one of the most amazing things I have discovered as a cosmologist is that the very same laws of physics that govern phenomena here on earth, for some reason these laws apply not just in a laboratory here on earth, but everywhere, at all times and at all places. And here is where God is to be found, in the universality and the regularity of our universe.”

“Are you a religious person. Do you think there is something greater?”

“Yes. I think that God was a physicist! I don’t see how the order of the universe can be explained intrinsically within the universe itself. Now, I should hasten to add that in physics we don’t provide you with any evidence in favour of or against God. So physics is limited in its reach. It asks some very well defined questions, and God is not part of those. So that’s why I only talk about

God out of hours. But to me, you're a cosmologist, you look at the universe, but to me there is only one conclusion."<sup>2</sup>

### **The Logos and the modern scientific understanding of information**

In the past hundred years scientists have come to understand that knowledge of a system does not correspond to an absolute state of that system in and of itself. What we know of that system concerns rather the knowledge we have about our relationship with that system. When we say that a car is moving, we mean it is moving in relation to us (or to the ground, or to something else).

Also, the scientific understanding of information is that everything, including inanimate objects, possesses information. An obvious example is the hard drive of a computer. But even a left shoe possesses information. If I ask you to close your eyes and pick one shoe from a box that contains a left and a right shoe, and you choose the left shoe, then that shoe possesses the information that the shoe remaining in the box is right footed. Or if a particle is smashed into by a second particle, the second particle gains some information about the first particle (and vice versa), such as its size and speed at impact.

And so, current science tells us, the wonderful world in which we live and of which we are a part is more than just a conglomeration of atoms, however well organised, but consists also of the network of information that each atom and system has of the others. Hold up your hand. Every minute a few photons of light will reach it that have been travelling for about 13.8 billion years without hitting anything. Your hand is the first thing it has encountered since then. And so it contains virtually unadulterated information about the beginning of its journey – the Big Bang. It is a memory stick waiting to be read.

So life and the cosmos is not just its constituent stuff but also the web of information that binds it all together. This insight correlates with what St John the Evangelist wrote in his Gospel: 'In the beginning was the Word, and the Word was with God, and the Word was God. He was in the beginning with God; all things were made through him, and without him was not anything made that was made' (John 1:1-3). The Word is of course Λόγος (logos) in the original Greek. And logos at the time of John meant not just the expressed word or thought, but the thought itself. In our present discussion concerning the relationship of science and faith, John understands that life and the cosmos is not just inanimate matter, but matter directed and ordered, and more particularly, order by the Logos, who Himself is the expression of God the Father. John is not just saying that the world has order, but that it is ordered by the Personal God, and in this sense is an icon of the Logos. To use the term in its scientific meaning, the world has information about the Logos, and the Logos has information about the Father. Or to use the language of the Scriptures, Christ "reflects the glory of God and bears the very stamp of his nature, upholding the universe by his word of power" (Hebrews 1:3).

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<sup>2</sup> <https://www.bbc.co.uk/programmes/b0b5s44q>. Transposed 16 June, 2018.

The word Λόγος comes from the root λεγ, which appears in λεγω, which first meant ‘to lay’, and then ‘to pick out, gather, pick up’; hence ‘to put words together’ and thus ‘to speak’. Logos means to collect things in the mind and then to speak them. It denotes both the external and the internal, the thought and its expression, the subject and the object. This relates to the scientific definition of information, put plainly in 1948 by the mathematician and engineer Claude Shannon as ‘the measure of the total number of possible alternatives for something.’ The actuality of something is which of these alternatives is ‘picked out’. Again, a fundamental idea of quantum mechanics is that when a system is observed it is compelled to ‘pick out’ one of a number of alternative states, one of its total number of possible options.

### **Chaos and God**

There is a particular painting technique used in icon painting called the proplasmos method that has helped me to view the indeterminacy of the quantum world in a positive way, and not feel threatened by it as a Christian.

In the proplasmos technique one first lays down a semi-translucent and somewhat untidy layer in a middle or dark tone. Such a chaotic first layer (whence pro-plasmos) is particularly effective for garments. One then builds more precisely modelled highlights and shadows on top of this base, and it is these that establish the order and harmony. However, the chaotic first layer is still visible underneath this more ordered modelling. This underlying untidiness creates much more interest and life in the finished painting than if the proplasmos were flat, opaque and predictable.

After using this method for some years, and at the same time reading about quantum mechanics, it occurred to me that I would have to rethink my understanding of the creation account given in the Bible’s Book of Genesis. In the beginning of the creation account we read that “the earth was without form and void”. In the Septuagint Greek Bible this reads: *ἀόρατος* (literally, invisible, but in this context probably “unsightly, not to be looked at”) and *ἄκατασκευάστος* (literally not built, unconstructed, so by inference, unorganised, in a state of disorder<sup>3</sup>). In the Hebrew these words are *wabohu* (void) and *tohu* (without form).

In the six ‘days’ or epochs that follow, the Lord by stages creates the complexity and order of the world in which we live today.

I used to think of this creation account linearly, that is, the unsightly and chaotic state is gradually left behind and we end up only with order. But now I view the phases of creation vertically, each day stacked upon the previous. In this view, the formlessness of day one remains bubbling away as a sort of background proplasmos, throwing up new possibilities. Day one is the proplasmos of the cosmos.

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<sup>3</sup> See Cook, “A Theology of the Septuagint?” *OTE* 30/2 (2017), page 270. Johann <http://www.scielo.org.za/pdf/ote/v30n2/05.pdf>

So belief in a created world does not exclude an element of disorder. Just as an overworked painting or sculpture lacks life, so would a clock-like and entirely predictable world reduce wonder. Evidence repeatedly shows that our visible and highly ordered world is actually made of a sub-atomic world that is surprisingly unpredictable.

As we have seen, this indeterminacy and continuous movement in the atomic world is a foundation of quantum mechanics. Physicists still debate how the uncertainty of the atomic world relates to the order of the visible world. The formulae of quantum mechanics begun by Werner Heisenberg, Max Born and Pascual Jordan and formalised by Paul Dirac and Wolfgang Pauli predict outcomes with remarkable accuracy. However, these formulae do not actually explain what is happening and why. It is a sort of calculating machine that produces the right answers, but we are uncertain why. This has led to a common held and pragmatic approach to quantum mechanics: "Shut up and calculate!"

### **Quantum uncertainty, personhood and freedom in the inanimate world**

According to classical theories of physics, if an electron could head straight into the nucleus of an atom it would be swallowed up and disappear – and the world as we know it could not exist. However, the electron does not get swallowed up and disappear. Why? According to the uncertainty principle of quantum mechanics, an electron cannot be constrained within a defined trajectory, or fixed in space. It is always on the move, more of a cloud or field than a predictable line. Quantum reality therefore means that the closest the electron can get to the nucleus is as a cloud or orbit of probability. If the electron were to crash into the nucleus and become stationary, this would contravene all the laws of quantum mechanics, since we could tell its speed and position precisely. Thus, thanks to this uncertainty in the sub-atomic realm, we have the certainty of atoms and therefore of matter, and therefore of this wonderful world in which we live.

We might say that this scientific principle – namely that uncertainty underpins the existence of matter - has its parallel in the nature of personhood. Personhood is fulfilled in love, but love requires freedom. The uncertainty of freedom underpins the verity of persons. No freedom, no persons. We become isolated individuals, associated only by function, cogs in a machine with predictable futures.

The same could be said of the animal and vegetable realms. The chance production of DNA mutations and the unpredictability of how parents' DNA combine to make the off-spring is an important mechanism that helps plants and animals adapt to their changing environments. If DNA duplicated itself predictably in all respects then there would be less variation, therefore less possibility of that species adapting to a changing environment, and therefore more likelihood of its eventual extinction.

And what of the inanimate realm? It clearly does not have free will. But I think that God in His humility did give it a certain freedom, albeit limited, through this underlying uncertainty and chance in the atomic level. Seeing it this way, I have come to regard the unpredictability within the atomic world as God's gift

of (relative) freedom to the inanimate world, just as He granted the freedom of free will to the human world. The power of God is therefore not only manifest in His might and control, but also in His humility to grant space to creation to, in a limited manner, do its own thing. He has made Himself weak by creating spaces into which He does not intrude. To put it humanly, God took a risk.

## Infinity

Many things that used to be considered infinite are now proving to be finite. That the universe is finite should not be surprising to a person of faith, since only God is boundless.

Firstly, Einstein's theory of Special Relativity tells us that there is a limit to velocity. This is the speed of light ( $c$ ). Quantum mechanics tells us that there is a limit to the information we can gather about actions (Planck's constant, denoted by  $h$ ). In the more recent field of quantum gravity, in which scientists are trying to connect the macro-world of general relativity with the micro-world of quantum mechanics, the loop theory tells us that there is also a limit to the divisibility of space (denoted by  $L_p$ ). There exists the smallest possible unit of space. An infinitely small point does not exist.

According to the Heisenberg principle, particles can't be pinned down, kept still. In fact the smaller the region one tries to limit a particle to, the faster it moves. It thus increases energy. From General Relativity, we know that gravity i.e. space-time, bends increasingly with increased energy. So as we make our region smaller and smaller, the particle's energy increases and gravity bends even more. Decrease this region enough and the particle would disappear into a black hole. So this means there is a minimum «zoom in» size beyond which nothing can go. Space as well as energy is granular. This lower limit is called the Planck length (denoted  $l_p$ ). To be precise, this is the unimaginably small length of  $1.616 \times 10^{-35}$  metres. <sup>4</sup>

But this leaves the question of whether or not the universe is infinite. Is space infinitely big, or is it finite, with a theoretically measurable size? Physicists can't agree on the answer. Some say it is impossible ever to know.

We can use the analogy of a sheet of paper to help understand possible answers, all of which have been believed to be true by scientists at some time. Imagine the geometry of space reduced to a two dimensional plane, like a sheet of paper. The universe might be like a sheet paper of infinite breadth and width, extending in all directions with no end. Or it might be like an infinitely expanding sheet of paper – finite but infinite in infinite time. Or it might expand for a while, and then crumple back up into a ball, and therefore be bonded by time. Or it could be like a sheet of paper rolled up into a tube, then that tube bent back into itself like a doughnut shape (called a torus in

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<sup>4</sup> The formula used to find this length is:  $l_p = \sqrt{\frac{(\frac{h}{2\pi})G}{c}}$  where  $h$  is the Planck constant,  $c$  the speed of light, and  $G$  the gravitational constant.

science). In this case, an ant walking on the surface of the doughnut can walk forever, but still be on the surface (i.e. in space). In this scenario, space is finite, although bent back on itself so that for those within the system it appears infinite.

For my part, judging by the surprising limits already discovered, and believing that only God is infinite, I put my bet on the universe being finite, while on the other hand being bent back on itself as an image of God's boundlessness.

### **From theology to science**

But using hindsight is cheating a little. It is not so difficult after a scientific discovery has already been made to look back and see parallels between theological dogma and scientific theories. But has it ever worked the other way around? Has a scientist ever used theological insight as a hint to a direction for scientific enquiry or an hypothesis?

Indeed they have, according to a recent book jointly authored by the Oxford physicist Andrew Biggs and artist theologian Roger Wagner, "The Penultimate Curiosity: How Science Swims on the Slipstream of Ultimate Questions". One example given in their book is Francis Bacon. His work *Novum Organum Scientiarum* – "New Instrument of Science" - published in 1620, set forth the general basis for modern scientific method. He stressed the need to begin with accurate observation of what is, rather than the assumption of how we think things ought to be. An hypothesis is then proposed that best explains these observed facts, and this hypothesis is then tested by experiments, which are rigorously recorded. An idea is thus exposed to a rigorous series of tests. He asserted that although we "cannot command the nature of things" we can "command our questions".

Now the point I want to make is that Bacon came to his method of induction as a logical conclusion of his theology. He wanted people to learn new things about God through finding new things about His creation. He challenged people to not simply recycle old ideas, many of which had proved to be scientifically false anyway. *Novum Organum's* founding principle was that "by finding out the true nature of things...God might have the more glory in the workmanship of them and men more fruit in the use of them"<sup>5</sup>. And earlier in his same book, Bacon wrote: "If we should rest only in the contemplation of the exterior...as they first offer themselves to our sense, we should likewise do injury to the majesty of God".

The "old instrument" which Bacon was trying to replace with his *Novum Organum* was Aristotle's assertion that truth may be arrived at through pure logic. This primacy of logic had by and large dominated, and in many ways hindered, scientific progress for centuries up to Bacon's time. For example, it had been assumed that since God had made the heavenly bodies and that God is perfect, and that the circle is the perfect shape, then the heavenly bodies must therefore move in a circle. This had led to all sorts of mathematical contortions to try and explain the observed movements of the

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<sup>5</sup> F. Bacon: *The Advancement of Learning and New Atlantis*, p. 230, quoted in Wagner and Briggs, p. 239.

planets, which, we were later to find out, in fact moved in ellipses and not in circles.

Isaac Newton and a Cambridge mathematician called Richard Cotes further developed Bacon's work on scientific methodology. Cotes edited Newton's second edition of his seminal work *Philosophiae Naturalis Principia Mathematica*. Like Bacon, they both asserted that because the tremendous variety that we observe in the universe is the direct result of God creating freely and not from necessity, we ought to approach its study with an open mind and with rigour, lest our preconceptions hinder discovery. Cotes wrote in his preface to *Principia*: "The variety of forms is entirely inconsistent with necessity", while "this World is so diversified with the variety of forms and motions we find in it, could arise from nothing but the perfectly free will of God directing and presiding over all"<sup>6</sup>.

This theological truth in turn has consequence for our scientific methodology, Cotes asserted. If the world had come into existence through some internal necessity then the light of reason would have been sufficient to understand it, as Aristotle thought. However, Cotes goes on to say, those who acknowledge that God created the world freely recognize "that we must seek from uncertain conjectures but learn them from observation and experiments"<sup>7</sup>. Cotes and Newton were saying: God made things with splendid variety, so we must open our minds to something beyond our preconceived ideas and start a voyage of mind-opening discovery.

## Looking forward

As we acknowledged earlier, it is not so difficult using hindsight to draw parallels between theology and scientific discoveries. But are there new fields of scientific exploration onto which religious insight might cast a little light and suggest possible patterns, principles, or different ways of seeing?

The biggest field of enquiry in physics at present is the attempt to unify quantum field theory (QFT), which is concerned with the atomic scale, with general relativity (GR), which concerns itself with the cosmic scale. Or to put it another way, this is the quest to unify the gravitational field with the three fundamental forces of nature, namely electromagnetism, which along with gravity works on the large scale over large distances, and the weak and strong forces, which work at tiny distances on the atomic level.

Both QFT and GR have repeatedly proven themselves extraordinarily accurate, each in their own scales. But there is a problem. As they stand at the moment, their formulations are mutually exclusive. Both can't be right. This hasn't been a problem practically, since they are concerned with opposite scales, GR with large masses and large distances, and QFT with small masses and small distances. The conflict occurs when we get extremely

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<sup>6</sup> R. Cotes, Preface, in I. Newton, xi, *The Mathematical Principles of Natural Philosophy*, second edition, xxxvii – quoted in Wagner and Briggs, p. 271.

<sup>7</sup> *Ibid.*, p. 272.

small scales and big masses, as in black holes and in the very beginning of the big bang.

There are two unifying theories that are currently the most popular among scientists: string theory and loop quantum gravity, or LQG. At least until recently, the two camps have tended to have little to do with each other, seeing the other camp's model is incompatible or just plain incorrect.

For non-mathematicians like myself these theories are somewhat esoteric and complex, and in fact few there be that can really understand them. But put simply, string theory postulates that everything broken down to its smallest scale (its Planck length) is made of tiny one-dimensional strings, some loose, some joined back to themselves. These strings vibrate, and can join, split and stretch. It is this variety that creates the diverse particles of the universe, such as electrons and quarks. The strings themselves are made of the same 'stuff', so it is the pattern they make or the 'tune' they play that creates the different particles or waves. String theorists say that at the beginning of the universe all four forces were in fact one, and they then diversified into the four.

But string theory requires ten dimensions in space-time, and this puts it at odds with LQG.

LQG concerns itself not so much with the matter that inhabits space-time as with the quantum properties of space-time itself. It starts with gravity and moves towards quantum mechanics, whereas string theory starts with quantum mechanics and then tries to integrate gravity into it. Instead of a smooth background of gravity, LQG sees space-time itself as a network of nodes and links. In this theory, space-time is made up of tiny chunks. And it doesn't need the higher dimensions required by string theory.

Some scientists have recently come to think that these two theories might in fact be two sides of the same coin, and they just need more work to unite them. Other scientists still say that they are mutually incompatible.

It might be interesting to see if the theological principles that describe the nature of the Holy Trinity might suggest some avenues of thought to scientists regarding unified theory. We have already seen how the three principles of quantum theory - granularity, relationality and uncertainty - have parallels in trinitarian dogma.

But there are also other elements of trinitarian dogma that may suggest possible avenues of research for "the theory of everything". On the one hand each person of the Trinity is fully God. On the other hand, the Father is the eternal source of the Son and the Holy Spirit, the Son begotten of the Father and the Spirit proceeding from the Father. So in this sense there is a certain primacy of God the Father. And yet there was never a time when the Son and the Spirit were not. The Son is "light of light, true God of true God", fully God and of the same divine nature as the Father. Likewise the creed affirms that Holy Spirit is "the Lord and giver of life, who together with the Father and the Son is worshipped and glorified."

So perhaps the four fields that physicists are trying to unify do in one sense all derive from one, but in another sense cannot be separated from one another. They are not forces alien to one another, and yet at the same time they always have been distinct from the beginning, and always will be distinct. Just an idea!

### **Uncertainty and religion**

A common misconception among those scientists who debunk religion, both for itself and for its perceived deleterious effect on science, is that they say that while science is all to do with acknowledging one's ignorance and testing ideas for their truth or falsehood, religion is all to do with certitude. Religion, they assert, is therefore static, allowing of no exploration, and at the same time too subjective. Are these assertions well founded? The atheistic theoretical physicist Carlo Rovelli says that 'Science is not reliable because it provides certainty. It is reliable because it presents us with the best answers we have at present.'<sup>8</sup> Against this pragmatism is set the doctrinaire, authoritarian approach to truth that religion is supposed to have.

First, I think that the monastic ascetic tradition of Christianity is like a university of people who strive to observe with pitiless honesty the world of cause and affect within the world of the human mind, heart and body. Ascetics are scientists of the soul. Books like the *Philokalia* read like a scientific manual of the human person's inner workings, written by people from experience. At the same time these ascetic scientists know that God is bigger than themselves and that therefore any knowledge they do possess is partial. They of all people know their own ignorance and capacity to deceive themselves. Like good scientists, they begin with what has already been discovered, but like good scientists they also want to test it for themselves and continually extend their experience.

Ascetics, like scientists, are also acutely aware of the human tendency for self-deception, whether to jump to conclusions too early, to believe something because it is the easy way, or to seek fame rather than truth. This deception can take the extreme form of believing that bad is good, which is the equivalent in science of clinging onto a false theory even in the face of evidence. Or it can take the more mild form of settling for one revelation without thirsting for more revelation, which is the equivalent of a scientist not considering whether or not a certain law – such as Newton's laws of gravity - applies in all situations, which it turns out it does not.

So if lived properly, Christianity will make a scientist more aware of his or her ignorance rather than less. And it continually challenges people to be true, because this truth is a matter of life and death. While on earth, like a good scientist, Christ spent a great deal of His time testing, challenging and undoing falsehood. The Pharisees and Sadducees were the established authorities of the time – the scientists of religion if you like. But Christ tested their teachings and found them wanting.

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<sup>8</sup> "Reality is not What it Seems", by Carlo Rovelli, Penguin, 2017, page 230.

The word science comes from the Latin *scire*, to know. The religious person seeks to know the personal God. This is ultimately a spiritual knowledge. The scientist seeks to know the world. This is primarily a mental knowledge. For the religious scientist the world happens to be made by the God he or she loves. And so for him or her the two fields of knowledge, though distinct, are not separate but complement each other. Scientific knowledge leads to God knowledge through wonder and thanksgiving. This in turn can make the believing scientist a better scientist.