Let There Be Light

The scientific enterprise could be said to have begun when the Greeks tried to account for physical observations by means of theoretical constructions—the harmonies of music, for example, by means of mathematical relations between the notes. Sacred numbers, Platonic and Archimedean solids, circles, squares, and triangles became the building blocks for a theory of natural order that remained unchallenged for two millennia. These are not far removed from everyday experience. When the ancient notion of order was finally challenged (by Galileo, Kepler, Newton, *et al.*), it became clear that the principles governing the universe were more complex than this, and could not be easily deduced from the basic axioms that seem most natural to our imaginations. The planetary orbits form ellipses not circles, for example.

In the course of a few years at the beginning of the 20th century, everything changed again. In 1900, Max Planck laid the foundations of quantum mechanics. In 1905, Albert Einstein came up with special relativity and the equivalence of matter and energy, and two years later extended the principle of relativity to gravitational fields. These breakthroughs were based not on calculation or experimental observations but on acts of the imagination, affecting the most basic assumptions of physics. (This does not mean, as Fritjof Capra suggested in his book *The Tao of Physics*, that "geometry is not inherent in nature, but is imposed upon it by the mind."[1] We still believe there is an objective geometrical order, even if it is not Euclidean.)

The human imagination is naturally influenced by the way things appear to the senses (the sun rises and sets, light appears to travel instantaneously, and the angles of a triangle add up to 180°). But the

1. F. Capra, *The Tao of Physics: An Exploration of the Parallels between Modern Physics and Eastern Mysticism* (London: Fontana, 1983), 178.

intellect and imagination together are not so restricted, and one such assumption after another can be suspended or replaced by others. If the resulting theory is hard to visualize, it is nevertheless based on concepts that can be explained, in principle, to anybody, and thus remains rooted in a common world of human experience. It is rooted in that world in another way too, namely by the fact that all the empirical observations on which it depends are necessarily made in the world as we experience it.

Imagining Light

We have all been taught that the speed of light in a vacuum is a constant 186,000 miles or just under 300,000 kilometers per second—that nothing can break that barrier. Unlike the speed of anything else we observe, it is not relative to anything else. So the speed of a car may be 70 mph in relation to the surface of the road, and 5 mph in relation to the car I am overtaking which is traveling at 65 mph. But light is different. It is always traveling at the *same speed* in relation to me, no matter where I am or how fast I am going.

That is bizarre. How did Einstein come up with the idea? In the early 19th century, Michael Faraday had to invent the notion of a "field" as a way of explaining the mysterious action at a distance between electricity and magnetism. If you put an electric current through a wire, it affects a nearby compass needle. If you push a magnet through a coil of wire, an electric current starts to flow in the coil. Building on this discovery, James Clerk Maxwell was able to show that the speed with which the influence travels is exactly determined by the ratio of the *strengths* of the electric field and the magnetic field. Being dependent solely on this ratio, the number does not vary with the *movement* of the wire or the magnet—hence the absoluteness of the speed, which is the observed speed of light.

Light was in this way revealed to consist of vibrations in a unified "electromagnetic" field, which is a description of the way energy propagates through space. The movement of electrons in a wire (which constitutes an electric current) is induced by the energy transmitted by the field, and vice versa. This discovery enabled the manipulation and generation of electricity on a large scale and

powered the second phase of the Industrial Revolution. (One important question remained: light or radiant energy in general is a vibration, but a vibration of what? The Michelson-Morley experiment showed it could not be a vibration in any kind of universal "ether." Einstein later showed that it also has a particulate nature—it consists of particles or packets of something.)[2]

It is worth noting the role of *theology* in this breakthrough by Faraday and Maxwell. Thomas Torrance writes:

> Clerk Maxwell's belief in the God who became incarnate in Jesus Christ made him question whether the universe created by the Wisdom of God did really behave in the way described by Newtonian mechanics. The crisis came when he failed again and again to find a Newtonian mechanistic explanation for the behavior of electromagnetism and light. It was through allowing Christian thought (such as the understanding of interpersonal relations derived from the doctrine of the Holy Trinity) to bear upon his scientific thinking that he came up with the conception of the continuous dynamic field, to which Einstein was to point as introducing the most far-reaching change in the rational structure of science and our understanding of nature.[3]

The implications of the identification of light as an excitation of a universally pervasive electromagnetic field are rarely in the forefront of our minds. But when a scientist pauses to express himself in imaginative terms we can be astounded. In a book of essays dedicated to the science and theology of light, Andrew M. Steane pauses to describe how his view of ordinary, everyday objects such as chairs

2. The 1887 "ether-wind" experiment of Michelson and Morley undermined the hypothesis of a universal etheric fluid or "luminiferous ether" within which light waves were the vibrations. An attempt to save the hypothesis was devised by FitzGerald, Lawrence, and Larmor, involving a complex mathematical transformation that was later accounted for and incorporated in Special Relativity. Today the space-time continuum itself has taken the place of the "ether," as we see later.

3. Thomas F. Torrance in Robert J. Russell *et al*., *John Paul II on Science and Religion: Reflections on the New View from Rome* (South Bend, IN: University of Notre Dame Press, 1990), 106–112. Maxwell was not the originator of the field concept, which emerged from the observations and speculations of Michael Faraday. However, Faraday was also a devout Christian.

and coffee cups has changed under the impact of quantum electrodynamics ("QED"). Since electrical charge itself is essentially a "propensity to emit or absorb" photons, those photons exist in the interior even of solid objects, "enabling them to hold themselves together." Thus: "The table before me is full of light. We don't see that light because it is mostly not coming up out of the table, but passing to and fro within it, hidden inside, each photon glimmering just long enough to pass from one particle to another."[4] In fact, the world is even more luminous than that, because reflected light itself is not what we assume—a collection of photons bouncing off a hard surface. Rather it is a collection of photons being absorbed by the surface and *another collection* of photons radiated back (in wavelengths, i.e. colors, determined by the properties of the surface itself). In reality, everything is glowing.

And, as Dr. Steane puts it, "if it were not for this dance of energy and light, I would fall through the surface of the road into the interior of planet Earth—or to be more thorough and accurate, my body would dissipate entirely into a vapor of dust, and so would Earth."[5] Add to this fact that the very particles of which we are made, and which are performing this constant dance to keep us in existence, were themselves (that is, these identical atoms) forged in the hearts of exploding stars millions of years ago, and it is hard not to be overwhelmed by wonder.

The existence of every particle implies the existence of a "field of force" within which the particle may be interpreted as a vibration. The discovery of what appeared to be a Higgs boson in 2012 confirms that even the atoms of matter are only possible because the particles that compose them (leptons and quarks) have interacted with the Higgs field, like bullets ploughing through a vat of treacle. It is this interaction that mainly causes them to have mass or momentum, and therefore not to exist at the speed of light, and to be capable of "settling down" in the form of atoms into the universe

4. Gerald O'Collins SJ and Mary Ann Meyers (eds), *Light from Light: Scientists and Theologians in Dialogue* (Grand Rapids, MI: Eerdmans, 2012), 47.

5. Ibid.

we know. In other words the universe is entirely made of energy interacting with itself.[6]

Imagining Time

One thing that follows from the invariability of the speed of electromagnetic radiation is a weird relationship with time. For if the speed of light is constant regardless of the speed of the observer, *time must slow down* as one accelerates. Einstein tried to imagine observer A trying to catch up with a vehicle traveling at light speed. A fails to do so, no matter how fast he goes, since the speed of light in relation to any observer is a constant. Observer B, however, who is traveling much slower than A, sees him getting faster and faster, and therefore he *must* be approaching the speed of light. The only way to reconcile these two observations is if the rate of time for A has changed when compared to that for B (and *vice versa*).

The faster A travels, the slower his clock runs compared to B, until at light speed it appears to have stopped altogether. Similarly, A sees his own clock as running normally, but to him it seems that B's clock has slowed down. If A then slows down to the same speed as B, his own time continues to flow as normal but he will observe B's time speeding up until the two are matched. However, comparing the two clocks they will find that less time has elapsed for A than for B.

What Einstein realized is that both the speed of light and the flow of time cannot be constant—one of them has to give. The rate of time, or the speed of a clock, must be "relative," in the sense that it depends on where it is measured from, and how fast the observer

6. "Modern science has come to the understanding that matter is only condensed energy—which, moreover, was known [in principle] by alchemists and Hermeticists thousands of years ago. Sooner or later science will also discover the fact that what it calls 'energy' is only condensed psychic force—which discovery will lead in the end to the establishment of the fact that all psychic force is the 'condensation', purely and simply, of consciousness, i.e., spirit. Thus it will be known for certain that we walk not thanks to the existence of legs, but rather than legs exist thanks to the will for movement, i.e. that it is the will for movement that has fashioned the legs so as to serve as its instrument. Similarly, it will be known that the brain does not engender consciousness but that it is the latter's instrument of action." (Anon., *Meditations on the Tarot: A Journey into Christian Hermeticism* [Amity, NY: Amity House, 1985], 574.)

himself is moving in relation to it. Just as electrical and magnetic force turned out to be different manifestations of "electromagnetism," so space and time are simply different aspects of "space-time." Time is now conceived as another dimension added to the three that define a volume of space. We cannot talk about distance or speed without involving time, or of either without stating the observer's frame of reference.

It also turns out that what we are investigating is not just the relationship between time and space, but between time, space, and *mass*. To have mass, i.e. inertia, is to resist acceleration. That means that it takes time to speed it up by the application of force (according to Newton, F = ma). Mass or matter therefore exists in a state of variable motion. Light, on the other hand, has no mass. It is pure energy. It exists in a state of constant motion. That motion, or changing "position," is a function of measurement, and specifically of measurement in relation to something with mass. But this is a measure applied by the world to the photon, and not the other way around—from the photon's point of view, it is not moving at all. Or rather, it is not moving through the "time" dimension of space-time, only the other three spatial dimensions. Its "time" vector is flat. (Of course, our imaginations get confused at this, because we imagine drawing a line on a graph in two-or three-dimensional space, not four-dimensional space.)

As Einstein declared, at the speed of light "all moving bodies—viewed from the 'resting' frame—shrivel up into plane figures."[7] Space as well as time is contracted. Symbolically, therefore, 'c' represents the ontological distance between light and the material universe (the universe of mass and temporal change). If the biblical "garden of Eden" represents a state outside time and entropy—because it was only after we left it that death became necessary and life a struggle—perhaps we could even say, rather whimsically, that man was expelled from Eden at precisely this velocity. But, like the angels in medieval thought, who live not in time but in an intermediate state called the *aevum* or "sempiternity," light still

7. Cited in Arthur Zajonc, *Catching the Light: The Entwined History of Light and Mind* (New York: Bantam Books, 1993), 270.

dwells in this timeless moment from which the rest of us have been expelled.[8]

Creation from Nothing

It is certainly tempting to make such speculative connections between the hypotheses of modern science and ancient metaphysics. Tempting, but dangerous. In this chapter, so far, I have tried to avoid it. But my somewhat haphazard survey of the current theories about light and space-time cannot but bring us to the threshold of a very big metaphysical question indeed: that of the creation itself. It gives us the background we need to appreciate the most well-established cosmogonic theory of modern times, but one that on the face of it appears to endorse the ancient doctrine of creation found in the first chapter of Genesis.

The Big Bang hypothesis is based on the idea that the entire material universe originated in an infinitely small point called a "singularity," and expanded from there to its present dimensions. The expansion continues—not just in the sense of an ordinary explosion, which affects the things contained within space-time, but as an expansion of space-time itself, along with all its contents. The hypothesis of this explosion, revealed in the progressive "red shift" or elongation of light waves sent out by more distant galaxies, was first put forward in 1927 by the Belgian physicist and Catholic priest Georges Lemaître, and soon after reinforced by the work of Edwin Hubble. It was eventually acclaimed by Einstein and became established as the standard model after 1933.

Interestingly, Lemaître's theory—the disintegration of a "primeval quantum of energy"—was in some ways the revival of a medieval idea put forward by the Oxford Franciscan Robert Grosseteste in the 13th century.[9] Following Aristotle, Grosseteste saw the world as based upon two principles: first form, and first matter. He speculated that the universe was created as a single point of light in mat-

8. See Wolfgang Smith, "Celestial Corporeality," in *Ancient Wisdom and Modern Misconceptions* (Tacoma, WA: Angelico Press /Sophia Perennis, 2013), 68–91.

9. See Marco Bersanelli, "Light in the Beginning," in O'Collins and Meyers, *Light from Light*, 82–5.

ter, a point which instantaneously propagated or multiplied itself in all directions as an expanding sphere, dragging first matter after itself to form the material universe in three dimensions, and rebounding from the point of maximum extension (the celestial firmament) to create the progressively denser planetary spheres and the four elements.

It was not a bad intuition.[10] Current thinking places the initial singularity at 13.77 billion years ago. The first phase of the universe was completely dark, but very dense and intensely hot—corresponding perhaps to the Bible's "formless void" with darkness over the deep (Gen. 1:2). The second phase was one of extremely rapid inflation—"a wind from God swept over the face of the waters"—with the waters in this case representing a primordial soup of electrons, photons, and protons that had condensed out of energy during inflation. The third phase took place 380,000 years after the bursting of the initial singularity: "Let there be light." The universe had by now cooled enough (to below 3000 K) to allow atoms to form, and thus became transparent to the large number of photons that were present. The resulting blaze of light would have shone in all directions, and is still visible today in the form of the Cosmic Microwave Background, the wavelength of this "fossil light" having since that time, by continuing expansion, been stretched into the microwave range, which is invisible to the human eye. (This, incidentally, explains why the night sky appears black rather than luminous.) Interestingly, the first seeds of "structure" in the universe are caused by sound vibrations—akin to music—developing out of the unevenness in the primordial soup of light and matter.[11]

10. Grosseteste, of course, could not know that the speed of light was not infinite, nor that light was electromagnetic radiation extending over a vast range of frequencies outside the capacity of the human eye, nor that time and space were two aspects of a single mathematical continuum.

11. See Bersanelli, "Light in the Beginning," 88–100. Since light takes time to travel, our telescopes are able to look back in time, and are able to see the "surface" where the first light was scattered by the first matter, a surface that encloses our entire universe although it is "much smaller than the regions of space that it contains" because, being earlier in time, it belongs to a smaller universe (Bersanelli, 98–99).

From Nothing

What does it mean, though, for light—or anything—to be created "out of nothing"? Where did the singularity "come from"? The very question is meaningless. If time and space both began with the singularity, there was no before and no elsewhere. As we confront this question, we are standing on the very threshold between physics and metaphysics.[12]

For Grosseteste, as in a more systematically worked-out way for Thomas Aquinas, the existence of a thing simply *is* its dependence upon God. To be created is to be ontologically dependent. It is not to be changed from a state of non-existence to a state of existence. Creation is not a change; it is a more radical beginning than that. It takes place "outside time," because time itself is a creature, or a dimension of created things—as Einstein saw, but not Newton, for whom space and time were in a sense "absolute"—an eternal receptacle into which certain things had been placed by God at a certain time. (It is this way of thinking of time that still to a large extent shapes our imagination, even though we are supposed to know better.)

There are consequently many mysteries around this notion of a "beginning" of time, and of tracing things back in the direction of—but never quite arriving at—an initial singularity. Science has no way of describing the beginning of things. The Bible uses poetry and metaphor, and is perhaps more accurate.

Even the word "nothing" (*nihil*), out of which the world is said by theologians to have been created, needs careful handling if we are not to mistake it for "something," namely an empty box into which something is put.

Even for modern physics, there is no such thing as complete "nothingness." Even a complete vacuum is said to be permeated by "fields of force" (electromagnetic, gravitational, etc.), or perhaps a "dark energy," shaping the space-time continuum. Put this together with the Uncertainty Principle, which means that the value or intensity of the field and its direction cannot both be fixed, and it

12. Strictly speaking, science cannot establish the existence of this (infinitely dense) singularity because the laws of nature as we know them break down as we approach t = 0.

follows that quantum field activity can never be reduced to zero but is always subject to random fluctuation.

In fact the energy in a "complete vacuum" is potentially infinite—assuming that space is a continuum and that all the variations in this fluctuating field cancel each other out overall. The existence of such "zero-point energy" in a vacuum has even been experimentally demonstrated (the Casimir effect). According to the inflationary universe model, the birth of the cosmos is based on such a quantum fluctuation in the field-value of nothingness.

You could say that the whole world—according to this theory—is a product of zero and infinity, in a sense poised between these two extremes. What can be manifested is not the infinite itself, but only the differences in energy between the "virtual particles" (quantum fluctuations) that happen to appear there. This enables scientists to handle the calculations without involving infinite quantities.

The theory again bears a strange resemblance to many ancient metaphysical theories that were advanced to explain the world as the result of an interplay between two Principles; such as (in Plato) the One and the Unlimited, or, in Grosseteste, Light and *Materia Prima*. The world of Being was the result of Form (the Form of the One or the Good) having been imposed upon something—Chaos perhaps.

In that case, however, the "infinite" principle was the lower one, which seems odd to us because of the notion of "positive infinity" that matured after Aristotle under the impact of Christian thought about God, and which we now take for granted. The concept of divinity as an "infinite oneness" or an "absolute maximum" than which nothing greater can be conceived was developed by Plotinus in the third century, Gregory of Nyssa in the fourth, Augustine and Dionysius in the fifth, John Scotus Eriugena in the ninth, Saint Anselm of Bec in the late twelfth, and in the fifteenth Cardinal Nicholas of Cusa (who introduced it into the realm of mathematics and geometry). Infinity, applied now to actuality rather than potentiality, was used to express the utter transcendence of God over creation.

For Aquinas, God is the unlimited act of Being (or supra-Being), inexhaustible "isness," unknowable by us directly until we come in

the Beatific Vision to share by grace in God's knowledge of himself. God is "infinite" in the strict etymological sense, meaning without limits of any kind. If we wish (anachronistically) to reconcile this idea with Plato's original conception, we might say that the limits we wish to deny God are in this case merely any limitations imposed from without. As pure isness, he does in fact have "limit" in the (Platonic) sense of form—he is "the Form of the Good" or the One. All else, including everything created and everything numerical, is limited in the sense that its existence is "restricted" in relation to the divine plenitude: it participates or shares in one aspect or another of that plenitude but never completely. It may be indefinitely prolonged or extended in one respect or another, making it "indefinite," but it cannot be said to be infinite in the same sense as God. To the most limited of all we now give the name "zero."

To Infinity—and Beyond

The mathematician Georg Cantor (d. 1918) uses the word *infinite* to refer to a number defined as being greater than any finite number. In this sense of the word, the number of whole integers and the number of rational fractions are both "infinite" in the same degree. This is because for every fraction, no matter how many there may be of them, a new integer can always be assigned to it without ever running out of integers, and vice versa. In other words, you can use whole integers to number each item in a series of fractions.

The irrational numbers are rather different. Both integers and rational fractions of integers possess an inherent "graininess" because they are essentially definite, i.e. discontinuous with each other. Irrational numbers, on the other hand, occupy the spaces between each of the rationals, and fill them up continuously. The number of irrationals always exceeds that of the rationals, and therefore, according to Cantor, the "infinity" of the irrationals is of a different order.

The discovery of *orders of infinity* is highly significant for us. In fact Grosseteste had already anticipated this to some extent in his own theory of unequal infinities, but Cantor's set theory proves that there is an *infinite series* of infinities, each of a higher order than the

last, right up to an "absolute" infinite, transcending all sets, which he identified with God. As he wrote: "The fear of infinity is a form of myopia that destroys the possibility of seeing the actual infinite, even though it in its highest form has created and sustains us, and in its secondary transfinite forms occurs all around us and even inhabits our minds."[13]

Cantor's analogical account creates a possible way to understand the reality of the world as distinct from that of God. He himself believed that his discoveries would be of great help to theologians; indeed he found support among Catholic scholars, and at one time appealed to Pope Leo XIII for support when his academic and Lutheran colleagues opposed his ideas. His work was one of those developments (like that of the non-Euclidean geometries) that helped to undermine a closed Kantian conception of the universe, and strengthened the sense of creation as contingent—that is to say, in order to find out how it is, we need to observe it, rather than deduce its nature or project our own conceptions upon it.

This also helps to answer a question that has been bubbling just under the surface: is the world some kind of automatic or "random" product or is there a meaning to it? Does the existence of the cosmos "add anything" to that of God? If it does not, why would God create it? Was it even possible that the world might not have existed?

13. Cantor himself was aware of the fact that one cannot consistently define a set of all transfinite sets, and for him this implied that "absolute infinity" was something that could only be approached by intuition or revelation. But David Hilbert and others made another objection, seeming to prove that even an infinity such as that of the irrationals cannot exist within a finite structure, such as the circumference of a circle or the diagonal of a rectangle, without bringing down the whole edifice of mathematics. Such infinities, which they term C-infinities, must be notional only. On the other hand, A-infinities and B-infinities—meaning negatively defined infinities (*un*-limited) and *potential* infinities—can exist. Robert J. Spitzer constructs from this an argument for God. Since no universe can be infinitely old, though it may *continue* indefinitely, the world must have had a beginning, if not an end. This points us to its dependence on an infinity that actually transcends the universe and time, namely the A-infinity (defined apophatically) we call "God." See Robert J. Spitzer, *New Proofs for the Existence of God: Contributions of Contemporary Physics and Philosophy* (Grand Rapids, MI: Eerdmans, 2010), 177–215.

Does it really come from "nothing"? (We will return to this later, because the fundamental Christian insight into creation is at stake.)

Monistic philosophies assume that the finite is strictly nothing in relation to the infinite, but this is not the case. Since there are orders of infinity, everything that exists can partake of infinity in a certain respect. In modern mathematics the multiplication of zero by infinity results not in zero, as one might expect, but in an *indefinite* quantity (reminiscent of Plato's *Apeiron*). As Robert Bolton puts it,

> Every finite quantity is in fact infinitely more than nothing, as one may illustrate from the way in which the equation $n \div \infty = 0$ gives rise to $\infty \times 0 = n$, where the finite quantity differs from zero by a factor of infinity. (This does not contradict the meaning of $n \div \infty = 0$ because this form of the equation establishes only the *relative* nullity of n, like that of a surface in relation to a volume, whether the surface and volume are both finite or both infinite.) . . . In all such cases, nullity in relation to a higher-order reality is all of a piece with the possession of a real degree of infinity. Because of this, there is a real sense in which the finite can add something to the infinite.[14]

The "infinite" is not in fact the "maximal conceivable quantity," he adds, for the *true infinite* (which represents Cantor's absolute infinite) is a combination of the infinite and the finite. "Thus the essential nature of the infinite is one of an inherent passing-beyond itself, while the infinite is also a primal reality whose nature is participated in by all forms of being as much as they participate the finite."

By introducing such distinctions into the concept of infinity, we begin to understand how instead of dissolving into God, the world may achieve in him an eternal existence ("the finite can add something to the infinite").[15] The ultimate resolution of the manifold

14. Robert Bolton, *The Order of the Ages: World History in the Light of a Universal Cosmogony* (Ghent, NY: Sophia Perennis, 2001), 32–3.

15. And yet at the same time, it can be true that in a sense, as Eckhart states, "people think that they have more if they have things together with God, than if they had God without things. But this is wrong, for all things added to God are not more than God alone" (cited in C.F. Kelley, *Meister Eckhart on Divine Knowledge* [New Haven: Yale University Press, 1977], 149). This is one paradox of "A-Infinity."

tensions of existence is not the silence of the One, but the music of the Trinity. At the same time, it overcomes the worry we had that the world's creation might be nothing but an arbitrary or "random" act. For if the world has some real existence of its own, an *infinity of its own degree*, by virtue of its participation in God's *actus purus*, then it too is "good" (as God pronounces it in Genesis) and the motivation for its creation is nothing other than love.

Let There Be…

We seem to have wandered some distance from thinking about light, but it is not so. It is simply that light has disappeared into the act of existence, the act of creation. The blaze of light that (perhaps) corresponds in the early universe to the moment of light's creation in Genesis is deceptive. The vast majority of the universe before that moment consisted already of photons, or light energy, even though it was locked in darkness. Light had already been created. *The light shone in darkness; but the darkness received it not*.[16]

When we employ physical metaphors to describe or allude to a spiritual reality—and light is one of the most popular of metaphors the world over—we tend to think of the physical referent as the most real of the two. In reality, the spiritual is higher in the scale of reality, and physical light is nothing but a shadow of God's intelligible self-communication. The true light, the light of heaven, is the archetype of which the light of the stars, and the light of torches and candles, the light that we can measure and manipulate, is a participating symbol.

Once this is understood, we look at the world in a different way. Even before the creation or first appearance of light in space and time, God's eternal light filled the heavens. The light we see is manifested for a purpose. It exists to turn our souls towards the glory of the infinite, which we cannot see until we become united with it. *Let the light of your face shine upon us, O Lord* (Ps. 4:6).

16. John 1:5. The translation is by John Lingard.