GRESHAM COLLEGE

21 NOVEMBER 2017

WATCHING THE HEAVENS: ASTRONOMY AND THE MEANING OF LIFE

PROFESSOR ALISTAIR MCGRATH

Welcome to my second of my final series of Gresham Lectures in Divinity. I hope that you won't think it is inappropriate to begin this lecture with a verse from a relatively well-known hymn, which captures something of the themes I want to explore in this lecture.

> Th'unwearied Sun from day to day
> Does his Creator's power display;
> And publishes to every land
> The work of an Almighty hand.

These words were written by Joseph Addison in 1712, as he concluded an article in the *Spectator* magazine with an "Ode" which – perhaps rather to its author's surprise – has found its way into the hymnbooks of the English language. Addision's prose and poetry alike took the form of reflection on Psalm 19:1 – "the heavens declare the glory of God." His words pose a question which continues to intrigue us, perhaps because it has never been definitively answered: to what extent do the wonders of the natural world – whether we think of the starlit night sky that Addison could see so clearly from his rooms in Magdalen College, or the rainbows that so excited the Romantic poets – point beyond themselves, to something or to *someone* beyond the world that we can see, hear and touch? Many of you will know the lines from the philosopher Kant's *Critique of Practical Reason* (1788), which his colleagues arranged to be placed on his gravestone:

> Two things fill the mind with ever new and increasing admiration and awe, the more often and steadily we reflect upon them: the starry heavens above me and the moral law within me.

Kant stands in a long and distinguished tradition of reflection. Since history began, people have been enthralled by the wonder of the sky at night. Few have failed to be overwhelmed by the solemn stillness of the star-studded heavens. The great astronomers of ancient Assyria and Babylon traced the slow movement of the planets through the heavens, wondering if they might somehow shape the mystery of human destiny. The ancient Greeks saw patterns in the stars, and named these constellations after their heroes – Orion the great hunter, Pegasus the flying horse, and Andromeda the doomed heroine. The heavens themselves were mirrors of the great events that had shaped history in the past, and had the potential to shape it again in the future.

Many scientists are critical of astrology – the idea that the sun, moon, planets and stars exercise some deep influence over human destiny. And while I share those criticisms, I feel we have to note that it was an interest in astrology that led to the detailed study of the movements of the planets, and hence stimulated the rise of the science that we now call astronomy. The classical philologist Franz Boll suggested that "astrology attempted to be a religion and a science at the same time; that defines its essence".[1] Both the Old and the New Testaments subverted astrology by their insistence that the sun, moon, and stars were part of God's created order, and as such were neither to be worshipped nor feared.

[1] Franz Boll, *Sternglaube und Sterndeutung – Die Geschichte und das Wesen der Astrologie*. Leipzig, 1931, 72.

There is an interesting link with astrology in the New Testament. I think we are all familiar with the "star of Bethlehem" which is reported in the Gospel of Matthew. There the story is told of three "Magi from the east" who saw a star which they interpreted as a sign announcing the birth of a new "king of the Jews." The Magi were probably Persian astrologers. If so, the "star of Bethlehem" might not be a new star that suddenly appeared in the night sky, but was more likely a conjunction of the planets which was interpreted as being of astrological significance.

The starry heavens were, of course, beautiful – but they were also useful. The ancient Egyptians learned to predict the annual flooding of the river Nile – of such central importance to the nation's agriculture – by watching for the rising of the star we know as Sirius. The Arabs developed the astrolabe as a way of determining the position of a ship with reference to the stars, allowing mariners to plot their course across the oceans.

Yet not everyone experiences a sense of wonder when contemplating the starlit heavens. For some, the lonely pinpoints of light against the dark velvet of the night speak of loneliness and pointlessness. Those same stars have witnessed generations rising and falling. Human empires rise and fall; the same stars shone down on them all. The same stars shone while generation after generation flourished, and passed into the dust. Like Tennyson's *Brook*, they remind us of the brevity of human life:

> For men may come and men may go,
> But I go on for ever.

The heavens thus heighten our sense of transience, forcing us to ask whether this life is all that we can hope for. Is there more to life than we know? And can the silent witness of those distant stars help us to find it?

The *Rubáiyát* of *Omar* Khayyám, one of the finest works of Persian literature, written around 1120, gives expression to a deep sense of despondency evoked by contemplating the heavens. Khayyám's intellectual interests were wide-ranging, and his astronomical calculations were far ahead of his time. Yet his reflections on the heavens appear to have been sobering, rather than uplifting. We are powerless to change our destiny. The sun, moon and stars declare both our transience and apparent inability to change our situation. As I think many of you know, the Persian word "rubai" means a quatrain. Let me cite one of the best known of these quatrains, in the translation by Edward FitzGerald (1809–1883):

> And that inverted bowl we call "the Sky",
> Whereunder crawling cooped we live and die,
> Lift not thy hands to It for help – for It
> Rolls impotently on as Thou or I.

The stars can thus be a melancholy symbol of the vastness of the universe, and our utter significance within it. Perhaps the slowly orbiting planets are the secret masters of our destiny, influencing us in ways we could not even begin to understand, let alone to resist. The stars may evoke an unspeakable sense of yearning for something that seems unattainable – a sense of longing for something significant, which the night sky can heighten, yet not satisfy. Maybe the stars point to something mysterious, something unfathomable, which somehow lies beyond them. Something seems to lie beyond the whispering orbs of the night. But what? And how is it to be known?

Questions like these have intrigued people since the human race began to think. Maybe these are pointless questions, the musings of people who cannot cope with the sobering thought of mortality and meaninglessness. Yet maybe we are *meant* to think such thoughts. Maybe the spectacle of the night sky is *meant* to trigger off such ambivalent and unsettling patterns of reflection within us – and by doing so, open the door on a new way of thinking and living. We seem to have been created to ask questions – to try to make sense of what we see around us, and how we fit into the greater scheme of things.

As we reflect on the wonder of the universe, we find questions being raised in our minds that both challenge and excite us. There seems to be some inbuilt longing for purpose which drives us to look for clues to the

meaning of the universe. We contemplate the glory of the night sky, wondering if the silent beauty of the stars might cast light on the riddle of human destiny. Our view of life, our way of looking at the world, our way of conceiving reality, is the means of opening a door to where we truly belong, to our native land? Is our real homeland out there somewhere, beyond this world? We appreciate the beauty of a glorious sunset, while wondering if the sense of beauty it awakens within us is somehow a pointer to another and more wonderful world that we have yet to discover. Shelley put it like this in a poem of 1824:

> The desire of the moth for the star,
> Of the night for the morrow,
> The devotion to something afar
> From the sphere of our sorrow.

We might thus listen as a distinguished astronomer lectures on the remarkable ordering of the cosmos, and wonder if this might lead us to discover the mind of God. The Second World War pilot and poet John Gillespie Magee (1921-41) saw flying high above the earth as an image of a deeper journey:

> I have slipped the surly bonds of earth
> And danced the skies on laughter-silvered wings . . .
> Put out my hand and touched the face of God.

Might our hopes and fears allow us to do the same? Or are we like the moth who feels drawn to the distant light of a star, but has no hope of ever reaching this distant and lonely goal?

The sense of wonder evoked by the starry skies or the rainbow thus acts as a pointer to something deeper, something beyond our grasp, yet for which we long with what can easily become a painful, sickening yearning. This "wistful, soft tearful longing" (Matthew Arnold), surrounded by a misty indefiniteness, is fundamentally a longing to be reconnected with something in the universe from which we now feel cut off, to be on the inside of some door which we have always seen from the outside. This sense of longing is not so much a rational judgement grounded in the ordering of the universe, as an imaginative encounter with the world, opening up the question of its deeper meaning. As George MacDonald argued, this kind of encounter with reality "is aroused by facts, is nourished by facts, seeks for higher and yet higher laws in those facts; but refuses to regard science as the sole interpreter of nature, or the laws of science as the only region of discovery." Science may give us access to truth; but can it illuminate meaning?

Let me show you a picture. It's well-known, and it opens up beautifully some of the questions I want to explore in this lecture. This is often described as a medieval woodcut, showing the world-view of its age. By studying the heavens, we are able to see beyond the world of appearances to something deeper and more significant which liles beyond them, perhaps hearing the "music of the spheres." In fact, this is now believed to be a nineteenth-century invention, which was produced for Camille Flammarion's 1888 work *L'atmosphère: météorologie populaire*. Flammarion, who eventually became France's leading astronomer, was originally apprenticed to a woodcutter while a young man, before changing his career. He developed his own illustrations for his works, and this is now known to be one of them. The caption accompanying this illustration reads: "A medieval missionary relates how he found the point where the sky and the Earth touch."[2]

The point to consider is this: are the heavens an object of study, or a gateway to the transcendent? Some of you might rightly object that this seems to exclude the possibility of their being both, and I fully accept this criticism. But for my purposes this afternoon, it is easier to treat these as two distinct possibilities.

Let's begin by looking at the great astronomical debates of the sixteenth and seventeenth centuries, and try and tease our their scientific and religious importance. One of the more important elements in the medieval worldview was the belief that the sun and other celestial bodies – such as the moon and the planets – rotated around the earth. This "geocentric" view of the universe was treated as self-evidently true, simply because there was no reason to think otherwise. The Bible then came to be read or interpreted in the light of this belief, with

[2] "Un missionnaire du Moyen Âge raconte qu'il avait trouvé le point où le ciel et la Terre se touchent."

geocentric assumptions being brought to the interpretation of a number of passages. Most living languages still bear witness to this geocentric worldview. For example, even in modern English, it is perfectly acceptable to state that "the sun rose at 7.33 a.m." – despite the fact that this reflects the belief that the sun rotates around the earth. As the truth or falsity of the geocentric model of the solar system made little difference to everyday life anyway, there was little popular interest in challenging it.

The model of the universe which was most widely accepted during the early Middle Ages was devised by Claudius Ptolemy, an astronomer who worked in the Egyptian city of Alexandria during the first half of the second century. In his *Amalgest*, Ptolemy brought together existing ideas concerning the motions of the moon and planets, and argued that these could be understood on the basis of the following assumptions:

1. The earth is at the centre of the universe;
2. All heavenly bodies rotate in circular paths around the earth;
3. These rotations take the form of motion in a circle, the centre of which in turn moves in another circle. This central idea, which was originally due to Hipparchus, is based on the idea of *epicycles* – that is, circular motion imposed upon circular motion.

Increasingly detailed and precise observation of the movement of the planets and stars caused increasing difficulties for this theory. Initially, the discrepancies could be accommodated by adding additional epicycles. By the beginning of the sixteenth century, the model was so complex and unwieldy that it clearly needed revision. So did it just need further modification? Or did it need radical revision?

During the sixteenth century, the geocentric model of the solar system was gradually abandoned in favor of a heliocentric model, which depicted the sun as lying at its centre, with the earth being seen as one of a number of planets orbiting around it. This represented a radical departure from the existing model, and must be regarded as one of the most significant changes in the human perception of reality to have taken place in the last millennium. Although it is customary to refer to this shift in thinking as "the Copernican revolution", it is generally agreed that three individuals were of major importance in bringing about the acceptance of this change.

Nicholas Copernicus (1473-1543), a Polish scholar, argued that the planets moved at constant speeds in concentric circles around the sun. The earth, in addition to rotating about the sun, also rotated on its own axis. The apparent motion of the stars and planets was thus due to a combination of the rotation of the earth on its own axis, and its rotation around the sun. The model possessed a simplicity and elegance which compared favourably with the increasingly cumbersome Ptolemaic model. Nevertheless, it still proved incapable of explaining all known observational data. Copernicus' radical new model was simply not able to explain the observational data, despite its conceptual elegance and simplicity, on account of his flawed assumption that orbits were necessarily circular. This assumption, interestingly, seems to have derives from classical Euclidian geometry; Copernicus never really freed himself completely from classic Greek ways of thinking. Circles were perfect geometrical figures, whereas ellipses were distorted. Why should nature make use of deformed geometry?

This heliocentric ("sun-centered") view of the solar system caused some controversy, both scientific and religious. People were so used to thinking of the sun rotating around the earth that they found this new way of thinking unsettling and disturbing. Surely the Bible taught otherwise? Didn't Psalm 119:90 declare that God had "established the earth, and it stands still"? So how did this fit in with Copernicus's radical new idea that the earth moved? Yet it was soon realized that this wasn't quite what the text meant. A better translation was easily proposed: God had "established the earth, and it stands firm".

Not everyone liked this new way of seeing things. The real opposition to Copernicus came from other scientists, not (as is often suggested) from religious people. There were two major problems with Copernicus's theory. First, it did not account for planetary movements with much greater accuracy than Ptolemy's model. The reason for this was simple. Copernicus wrongly assumed that the planets moved in perfect circles around the sun; we now know that they move in ellipses – somewhat flattened circles, with the sun slightly displaced from their

centres. This insight arose decades later, as a result of Johannes Kepler's close study of the movement of the planet Mars in the early seventeenth century.

Second, if Copernicus's theory was right, it meant that the appearance of the fixed stars should change over the period of a year. As the earth moved through space, the relative positions of the fixed stars would be expected to change. This was investigated by the great Danish astronomer Tycho Brahe (1546-1601), who found no evidence of this "parallax effect". We now know the reason for Brahe's failure to observe this effect. The stars are much further from the sun than anyone realized at the time, and the very small parallax effect – invisible to the naked eye – was only observed as a result of improvements in telescope design in the early nineteenth century. Brahe concluded that the evidence thus pointed to the sun revolving around the earth, rather than the other way round. We need to realize that Brahe's interpretation of the observational evidence was actually *right* on the basis of the evidence available to him at that time.

We now, of course, quite happily speak of the "solar system", and think of the earth as one of the planets to orbit the sun. It's no longer controversial. Yet the watching of the skies has thrown up new questions, which have enormous religious importance. Let's look at one of these. Let's begin by thinking about a simple question: Why is the sky dark at night? Our initial answer might be equally simple: because the sun isn't shining. Or, to put this a bit more accurately, because the rotation of the earth blocks out the light of the sun, allowing the stars to be seen. After all, the stars are still there, even in daylight – it's just that their faint light is overwhelmed by that of the sun. Yet in 1826, Heinrich Wilhelm Olbers pointed out that it was actually quite strange that the sky was dark at night.

Olbers assumed that the universe is static, uniform and infinite. This means that the earth will be bombarded with light emitted from stars throughout the galaxy. The more distant the stars, the fainter their light. Yet the greater the distance from the earth, the greater the number of stars that exist at this distance. The two factors cancel each other out, meaning that the light emission received from a set of stars at any given distance is independent of that distance – and hence that every point in the sky should appear equally bright. And if our sun can be considered to be an "average" star, then every point in the sky should appear as bright as the sun, overwhelming its brilliance. There should therefore be no significant difference between the brightness of the sky at night and during the day.

So imagine that the earth stands at the centre of a series of imaginary concentric shells, each of the same thickness. If the thickness of each shell is much smaller than its radius, then the number of stars contained within that shell is proportional to the square of its radius. Yet the intensity of the light received on earth is inversely proportional to the square of the distance from the star to the earth. This means that, assuming a uniform distribution of stars, and that one can speak of an "average" brightness, that each of these hypothetical shells will emit the same amount of light. Every line of sight will receive equal levels of illumination. The night sky should therefore be bright. Except it isn't. So what has gone wrong with our thinking?

One answer to Olbers' paradox is that we now know that the universe is expanding, so that distant stars are red-shifted into obscurity. . Medieval science was thus committed to the idea of the eternity of the world, because this was such a significant feature of Aristotle's thought. This put Christian theologians in a difficult position. They liked Aristotle, especially his ideas on intellectual method. But they couldn't go along with his core belief that the universe had always existed. It seemed like an irreconcilable difference between science and religion – between Aristotle and Augustine. Both sides remained committed to their positions, and no reconciliation was really achieved.

By the end of the nineteenth century, the scientific consensus remained roughly the same on the issue of the eternity of the universe. The great Swedish physicist Svante August Arrhenius (1859-1927), who won the Nobel Prize for chemistry in 1903, wrote a bestselling work entitled *Worlds in the Making* (1906). In this, he argued for an infinite, self-perpetuating universe, without beginning or end, based partly on the recently-discovered principle of the "indestructibility of energy". Arrhenius made clear his fundamental "conviction that the Universe in its essence has always been what it is now. Matter, energy, and life have only varied as to shape and

position in space." Matter and energy might move around the universe; there was, however, no overall change within the system as a whole.

This static view of the universe – which allowed for internal movements of energy and matter, but not for either origination or decay – remained the scientific consensus until the end of the First World War. Religious ideas of creation were regarded as outdated mythological notions, being completely incompatible with cutting-edge scientific knowledge. Then, slowly but surely, evidence began to accumulate suggesting that the universe, far from being eternal, had an origin. It is a fascinating story, and I shall tell a little bit of it in this lecture.

During the period between 1900 and 1931 astronomers witnessed three dramatic alterations in their view of the Universe. First, the accepted value of the size of the star system increased by a factor of ten; secondly, the work of Edwin Hubble (1883-1953) led to the realization that there are other star systems beyond our own galaxy; and thirdly, the behaviour of these external galaxies indicated that the universe was expanding. The expansion of the universe was a difficult idea to accept at the time, as it clearly implied that the universe had evolved from a very dense initial state – in other words, that the universe had a beginning. Some resisted any such suggestion, sometimes fearing the potential religious implications of the idea of the origins of the universe. In 1948, Fred Hoyle and others developed a "steady state" theory of the universe, which held that the universe, although expanding, could not be said to have had a beginning. Matter was continuously created in order to fill in the voids arising from cosmic expansion.

Opinion began to shift decisively in the 1960s, chiefly on account of the discovery of the cosmic background radiation. In 1965, Arno Penzias and Robert Wilson were working on an experimental microwave antenna at the Bell Laboratories in New Jersey. They were experiencing some difficulties. No matter which direction in which they pointed their radio antenna, they picked up an unwanted and obtrusive background hissing noise which they simply could not eliminate. Their initial explanation of this phenomenon was that the pigeons roosting on the antenna were interfering with it. Yet even after the enforced departure of the offending birds, the hiss remained.

It was only a matter of time before the full significance of this irritating background hiss was grasped. It could be understood as the "afterglow" of a "big bang" –
a primal cosmic explosion, the existence of which had been proposed in 1948 by Ralph Alpher and Robert Herman. When seen alongside other pieces of evidence, this background radiation provided significant support for the idea that the universe had a beginning, and caused significant difficulties for the rival "steady state" theory.

Since then, the basic elements of the standard cosmological model have become clarified, and have secured widespread support within the scientific community. Although there remain significant areas of debate, this model is widely agreed to offer the best resonance with observational evidence. The universe is now believed to have originated some 14 billion years ago, and that it has been expanding and cooling ever since. The two most significant pieces of evidence in support of this theory are the cosmic microwave background radiation and the relative abundance of light nuclei (such as hydrogen, deuterium and helium) synthesised in the immediate aftermath of the "big bang". This entails the recognition that the origins of the universe must be recognized to be a singularity – a unique event, something which can never be repeated, and hence never subjected to the precise experimental analysis that some hold to be characteristic of the scientific method.

It was a dramatic development, which caused a sea-change in thinking about religious language about "creation". It is often said by atheist apologists that science has eroded the plausibility of faith over the last century. And perhaps that may be true in some respects. Yet in others, it is demonstrably false. The "standard cosmological model" resonates strongly with a Christian narrative of creation, but is not identical to it.

I'll repeat that point, as it's important. The Christian narrative of creation and the scientific narrative about the origins of the universe are not *identical*. Although some Christians have read their Bibles as teaching that the world is a mere 6,000 years old, it is clear that this is a figure that has been read into the text on the basis of a series of questionable assumptions, which have long been known to be simply wrong. The core themes of the

biblical idea of creation are that God created the universe; that this was "good"; and that it possessed an ordering which in some way reflects the divine rationality. There's plenty of theology – but no chronology.

The scientific narrative of the origins of the cosmos is not the same as the Christian narrative of creation; the two can, however, be intertwined, like a dual helix, to offer a deeply satisfying vision of our universe. The theological notion of creation and the scientific notion of origination are not the same, in that they are framed in terms of different informing conceptual frameworks. Yet there was now a convergence of intellectual focus between these religious and scientific narratives, leading to a synergy of possibilities that had arguably not been possible for a thousand years. "Creation" and "origination" can be seen as two different "maps of meaning", two different "levels of explanation", for the universe. They are not identical; they are, however, increasingly being seen as complementary and mutually enriching.

Now I have spoken of "skywatching" throughout this lecture – the enterprise of looking at the starry heavens. So let me ask you a question, which lies at the heart of the philosophy of the natural sciences. When we look at something – such as a star, or a sunrise – what do we *see*? Now I know that this seems a strange question to ask. But let me explain what I mean. Philosophers of science emphasise that observation is a theory-laden process. We see the world through theoretical spectacles, even if we don't realize that we are doing this. A medieval observer of the world would have believed that the sun, moon, and planets all orbited around the earth. So when medieval observers spoke of the "sun rising", that is exactly what they believed to be happening. The earth stood still. The sun rotated around the earth, and what we observe at dawn is the sun rising above the horizon, because it revolves around the earth. Do you see the point I am making? For us today, of course, we know that the earth rotates around the sun. So we know that it is not that the sun rises, but that the earth rotates on its own axis every 24 hours, and as a result the sun appears to rise above the horizon – when in fact, it is the earth that is moving. Yet we all happily continue to speak of the sun rising!

Or take the rainbow – a rather wonderful natural phenomenon, which many people find beautiful, and some even awe-inspiring. As you all know, the phenomenon of the rainbow can be explained naturally on the basis of the diffraction of light by water droplets.

This anxiety about the limits of the natural sciences in our quest for meaning is echoed in the famous 1820 poem "Lamia", in which John Keats (1795–1821) complained of the effect of reducing the beautiful and awesome phenomena of nature to the basics of scientific theory. Such a strategy, he argued, is aesthetically impoverishing, emptying nature of its beauty and mystery, and reduces it to something cold and clinical.

> Do not all charms fly
> At the mere touch of cold philosophy?
> There was an awful rainbow once in heaven:
> We know her woof, her texture; she is given
> In the dull catalogue of common things.
> Philosophy will clip an Angel's wings.

In his important work Unweaving the Rainbow (1998), Richard Dawkins takes issue with Keats. Dawkins regards Keats' poetry as typical anti-scientific nonsense, which rests on the flimsiest of foundations. A good dose of basic scientific thinking would have sorted him out in no time.

> Why, in Keats' "Lamia", is the philosophy of rule and line "cold", and why do all charms flee before it? What is so threatening about reason? Mysteries do not lose their poetry when solved. Quite the contrary; the solution often turns out more beautiful than the puzzle and, in any case, when you have solved one mystery you uncover others, perhaps to inspire greater poetry.

Dawkins illustrates this point by drawing attention to the consequences of Newton's analysis of the rainbow:

> Newton's dissection of the rainbow into light of different wavelengths led on to Maxwell's theory of electromagnetism and thence to Einstein's theory of special relativity.

The points that Dawkins makes are important and valid. Perhaps the road from Newton to Maxwell and thence to Einstein was not quite as easily discerned and followed as Dawkins' prose suggests, but the connection certainly exists. And if the unweaving of the rainbow led to the discovery of such greater mysteries (presumably perfectly capable of being expressed poetically, if poets could get their minds around the rather difficult ideas involved), then how can anybody suggest it was a foolish or improper thing to do?

For Dawkins, things are admirably clear. Scientists tell the truth, occasionally in less than inspiring prose; poets, on the other hand, dislike and distrust science, and generally know little about it. Dawkins clearly believes that Keats argues that knowing how the rainbow works will destroy its beauty, so that we will not be able to appreciate it any more.

> Keats believed that Newton has destroyed all the poetry of the rainbow by reducing it to the prismatic colours. Keats could hardly have been more wrong.

Dawkins' refutation of Keats has understandably won many plaudits from some of his fellow-scientists, who have welcomed his dismissal of critics who claim that science's tedious and plodding message robs nature of her beauty and inspiration. Yet I cannot help but feel that an important point has been overlooked here. For Dawkins' response to Keats is unassailable if and only if Keats' concern was to excoriate the scientific investigation of nature and take refuge in the safety of a premodern world. When Keats is read against the background of the Romantic movement, however, the critique he offers of the natural sciences begins to take on a quite different meaning. Far from refuting Keats, Dawkins might actually confirm precisely the fears that Keats expressed. Let me explain.

The key to Keats' concern lies in his reference to "clipping" an angel's wings. For Keats, as for the classic tradition in general, the natural world is a gateway to the realm of the transcendent. The human reason could grasp at least something of the real world, enabling the imagination to reflect on what it signified beyond itself. Keats (and the Romantic movement at large) prized the human imagination, seeing this as a faculty which allowed insights into the transcendent and sublime. Reason, in contrast, kept humanity firmly anchored to the ground, and threatened to prevent it from discovering its deeper spiritual dimensions. For this reason, we need to treasure C. S. Lewis' enigmatic remark that, "while reason is the natural organ of truth, imagination is the organ of meaning".

For Keats, a rainbow is meant to lift the human heart and imagination upwards, intimating the existence of a world beyond the bounds of experience. For Dawkins, the rainbow remains firmly located within the world of human experience, possessing no transcendent dimension. The fact that it can be explained in purely natural terms is taken to deny that it can have any significance as an indicator of a beyond. The angel that was, for Keats, meant to lift our thoughts heavenwards has had its wings clipped; it can no longer do anything save mirror the world of earthly events and principles.

Dawkins' curt, vigorous dismissal of religion or any human quest for the transcendent corresponds precisely to what Keats feared. Despite Dawkins, Keats does not appear to have had major problems with scientific explanations of the rainbow. His criticisms were directed against those who denied that, precisely because the rainbow could be analysed scientifically, it could not have any symbolic or imaginative significance, both heightening the human yearning for a transcendent realm and hinting at means of its resolution.

Personally, I think that it is a matter for regret that Dawkins does not make any attempt to empathize with Keats – to try to understand the fear that Keats expresses and its wider resonance within western culture. Keats reacted against a form of reductionist materialism, which he feared would rob human life of its purpose and meaning. Yet there is clearly a middle way here, which allows us to affirm the materiality of our universe, while allowing that it can signify something deeper. The clarification of a scientific mechanism within our world does not invalidate our perceptions of what it might mean.

So let me conclude by returning to that woodcut I displayed earlier. As you all know, images, like texts, can be "read" and understood in different ways. The way that Flammarion uses this image suggests that he wanted to illustrate the legendary idea of some mysterious point in the world when the heavens touched the earth. But maybe you and I can interpret it in a slightly different way. We might see it as signifying the human quest for meaning. We remain anchored to the world, but sense that there is something that lies beyond it, of which we catch at best only a glimpse. Renaissance philosophers spoke of the "music of the spheres", reflecting the harmony of the universe as a whole, which was often seen as a metaphor for achieving a balanced and meaningful relationship with our universe.

Psychologists have noted how human beings often seek meaning by trying "to transcend their own concerns or experience and connect up with something greater". Perhaps this image captures both this human search for meaning, and hints at the possible role of watching the heavens in helping us to achieve this.