

Issues in Science and Religion: Publications of the European
Society for the Study of Science and Theology

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Issues in Science and Theology: Are We Special?

Human Uniqueness in Science and
Theology



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ESSSAT

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Preface

From 26 April to 1 May 2016, ESSSAT, the *European Society for the Study of Science and Theology*, arranged the Sixteenth *European Conference on Science and Theology* (ECST XVI) in Łódź/Warsaw, Poland, in collaboration with the *Cardinal Stefan Wyszyński University* in Warsaw and the *Archdiocese of Łódź*. Over 100 participants from Europe and beyond were attracted to the conference, and ESSSAT members and other conference participants alike were inspired to present and discuss about 70 papers in the conference's paper sessions. ESSSAT's conferences thus continue to promote the study of the interactions of science and theology by creating opportunities for scholars from a wide diversity of backgrounds, geographically and linguistically, and from different disciplines and confessions to engage in conversation and debate. The theme of the conference was *Are We Special? Science and Theology Questioning Human Uniqueness*, and it was approached from a number of different perspectives, including cosmology, neuroscience, psychology, philosophy and theology. The plenary lectures of the conference covered a broad spectrum of disciplines and approaches and are printed in this volume in revised and edited versions. In addition, the editors chose a selection of short papers presented at the conference and thus composed this volume of the *Issues in Science and Religion* (ISR) series.

As ESSSAT's president, it is my pleasure and duty to take the opportunity provided by the publication of this volume to thank the organisers and sponsors of the conference. ESSSAT expresses its gratitude to the local organiser Grzegorz Bugajak (ESSSAT vice president for the conference) and his team from the *Cardinal Stefan Wyszyński University* in Warsaw and the *Archdiocese of Łódź*. Other members of the organising committee were Lotta Knutsson Bråkenhielm, Ingrid Malm Lindberg (ESSSAT secretaries), Knut-Willy Sæther (scientific programme officer) and Roland Karo (ESSSAT treasurer). We express our deep gratitude to the *Udo Keller Foundation Forum Humanum*, Neversdorf (Germany), which again supported the ESSSAT prizes. Finally, we thank the staff from Springer and especially Cristina dos Santos for their cooperation on this volume, now the third in this series.

Halle/Saale, Germany

Dirk Evers

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Introduction

Human beings are that one species which asks about its own existence and has developed an apparently unique sense of its own uniqueness. We are self-interpreting animals and have developed cultural traditions to find answers for our quest for meaning. Both science and religion contribute to this quest, and both can promote or challenge the idea of human uniqueness. Religions have promoted different kinds of special relationships between human beings and the divine, but have also emphasised links to our fellow creatures. Science has led to transformations of traditional world-views, of our place in the universe and in the tree of life, and thus has contributed to our quest for truth and meaning. Where do we stand today, when we enquire about the distinctiveness of human kind, of ourselves?

The first section of this volume is dedicated to cosmological questions. David Wilkinson reviews the quest for human significance in the context of astrophysics. He identifies four areas in which the question of what it means to be a human being occurs: the scale of the universe, the design of the universe, the end and destiny of the universe, and questions of whether or not we as human beings are alone in the universe. In all four areas, the findings of modern cosmology pose both challenges and opportunities for a dialogue with Christian theology. While not arguing for a simplistic attempt to directly infer a divine Creator from cosmological evidence, David points to the biblical insight that the real significance of human beings is not to be derived from nature but is to be seen in what God has done.

Elisabeth Loos follows up on the issue of the uniqueness of the human species and how science can, on solid methodological ground, discuss the question of life 'out there'. For that purpose, she compares what we now call 'astrobiology' with the claims and findings of synthetic biology. While the first discipline is looking for trees of life on other planets, the other aims at expanding and transcending the tree of life on earth. Both share the conviction that life is a phenomenon which allows for diversity and historical change. Elisabeth's claim is that synthetic biology might shed new light on what astrobiology is looking for.

Alfred Kracher also reflects on extraterrestrial life, and on the possibility of having contact within a cosmic oikumene, but even more on the question of what this

tells us about ourselves. He points to the fact that the cosmic distances are so huge that, given the finite speed of light, they render the exchange of information difficult to imagine and any meeting in 'person' virtually impossible. Life forms may even be so diverse that we may never receive any signal at all, and may also never know why. However, he sees the value of reflections on extraterrestrial life forms in telling us something about ourselves and in revealing our beliefs, expectations and fears. These reflections are part of our story as self-interpreting human beings, but it might be difficult to open up our spiritual story to what extraterrestrial beings might have to tell us as long as mutual disclosure renders this impossible.

Andreas Losch extends the question to issues of salvation and eschatology. By drawing on the philosophy of the Jewish philosopher of religion Franz Rosenzweig, he enquires about the significance of the symbol of a cosmic Christ. The ends of God and the end of the cosmos provide a test case for any Christology with universal claims. However, as full truth is with God alone, Andreas argues for a pluralist approach to the universal and eschatological meaning of Christ, with Judaism stressing the unity of God and Christianity exploring the relationality of God and creation.

The second section of the book shifts the focus towards evolutionary perspectives. Jerzy Dzik gives an introduction to Darwinian evolution and presents a view of the relation between biological and cultural evolution which sees many aspects of human behaviour, such as sexual behaviour, family love, herd instinct, and feeling of ownership, as inherited from our animal ancestors and thus having a very ancient evolutionary history. However, the human brain also allows for cultural developments which lead to tensions with our biological, evolutionary heritage. And even more, it brings about ideas and concepts which no longer depend on the success and survival of their promoters but develop an attraction to human minds by their cultural plausibility.

Jonathan Jong takes a critical stance against essentialist versions of anthropology which try to identify human uniqueness by establishing the notion of a paradigmatic human being. Neither on purely scientific or biological grounds (neo-Darwinism), nor on metaphysical argument (neo-Aristotelianism), nor on a combination of both, is it possible to get the question of human uniqueness and the specificity of human beings off the ground. On the contrary, we fall into egocentric or ethnocentric traps by doing so. What we are seeking when we ask about, or question, human uniqueness is not a cladistic but a robust theological category.

Rubén Herce leads the reader back to the evolutionary history of human beings on this planet. He discusses the recent finding of fossils of the so-called *Homo naledi* in South Africa. These comprise the largest collection from a single hominin species that has ever been found, and there are strong indications that the remains of these human-like individuals have been deliberately deposited in a gravelike environment. Such behaviour might point to a ritualistic background. Rubén carefully investigates the evidence and comes to the conclusion that *Homo naledi* might help us to better understand the origins of our own species, but that this behaviour is still far from what we understand as human in the full sense.

The next contribution continues this debate. Lluís Oviedo and Jay Feierman ask if religious behaviour draws a clear line between human beings and other animal species. They follow three lines of research: studies of great apes, behavioural isomorphism between human behaviour and animal behaviour, and cognitive studies of religion. They arrive at a nuanced conclusion: there are affinities and isomorphisms between human and animal behaviour, while other aspects of religion on a symbolic and cultural level can be understood as specific traits of human religion. Those traits might have co-evolved with the human capacity of language.

Ernst M. Conradie closes this section of the book with a conversation with the work of Frans de Waal and his widely acclaimed studies on the behaviour of great apes, especially chimpanzees. Ernst begins by presenting theological views on the relation between human behaviour as rooted in our biology and shared with other species and a theological notion of sin. He then engages with Frans de Waal's thesis that the positive aspects of human moral behaviour point back to the proto-moral behaviour of animals, and suggests that the quest for human uniqueness must not leave the negative aspects of human behaviour out of the picture.

The third section of the book is dedicated to reflections on anthropology, technology and culture. Ivan Colagè opens this section by exploring the differences between biological and cultural evolution. He claims that the cultural dynamics which are central to theological inquiry about human uniqueness have a clear and direct biological counterpart that cannot be overlooked. Any reflection on the cultural specificity of human behaviour has to take its biological underpinnings into account. This cannot but lead to a new interpretation of traditional theological concepts, like the concept of human beings as the image of God.

Sara Lumberras refers to the theological notion of the image of God as well, but links it to technological developments and especially to the progress of artificial intelligence in recent decades. With IT, human beings build machines in their own image and likeness and thus seem to prove that their own nature can be reduced more or less to algorithmic procedures. However, Sara argues for the irreducibility of subjectivity and for the significance of the difference between simulation and reality, and she proposes a notion of authenticity which rests on the concept of emergence, which by definition is irreducible.

Victoria Lorrimar questions the equation of human specificity with the human genome. In her view, it is rather the use of technology which defines what it means to be human. Drawing on Philip Hefner's model of human beings as 'created cocreators' and on Ronald Cole-Turner's interpretation of this model, she suggests expanding it by taking the human capacity for imagination into a more considered account. She therefore refers to the significance of narratives for shaping human identity and human aspirations, and their importance for a responsible as well as inspired use of modern technology.

Michael Fuller suggests that the phenomenon of big data offers a novel space for the interaction of theology and the sciences. It raises fruitful ethical and hermeneutical issues to engage with, and thus throws light on relevant areas of this dialogue. The insights into the diversity and richness of data together with the different means of data analysis provide interesting parallels to the hermeneutics of scripture, while

insights into the ways in which quantitative accumulation may turn into qualitative differences may provide new ways of understanding human uniqueness.

Luis O. Jiménez-Rodríguez, S.J., then engages in a dialogue with neuroscience in order to overcome a notion of human uniqueness which can be misunderstood as anthropocentrism. He explores Antonio Damasio's analysis of the complexity of human neurobiology and links it to the theological anthropology of the Belgian theologian Adolphe Gesché. Both provide the tools to clarify different meanings of human uniqueness, so that Luis can finally suggest an understanding of human nature as relational and as a mode of being in the world that corresponds to God's mediated agency in creation.

Angela Roothaan takes a deconstructivist turn. She questions the human–animal divide as an ontological construction of Western philosophy, and confronts this divide with notions of shamanistic cultures which in differentiated ways link human beings ontologically to animals and other life-forms. She deconstructs this divide by drawing on Jacques Derrida's work, offering a kind of psychotherapy of Western thinking by unveiling its roots in a particular ontotheology. A second challenge, then, is the transfer of the human–animal divide to the rational vs. savage human being divide which is at the centre of colonial studies. Angela suggests decolonising both divides by bringing light into the shadows of the history of Western thinking and by listening to the voices of those who were kept in those shadows, including animals and nature.

The fourth section contains papers in which authors engage in philosophical and theological reflections. Michael Heller deals with the history of the universe from a philosophical perspective. He explores the nuanced balance between the cosmic tendency towards structure and order, and the inevitable decay and destruction of everything which comes into being during the history of the universe. Suffering, death and decay are the prize for a fruitful universe. However, although physical evil is inevitable because of physical laws, moral evil is not. It transcends physics and is in itself irrational. Thus, it cannot be rationally explained and justified. However, and this thought is proposed instead of a rational answer, the gap in rationality can be tolerated because a universe containing both evil and freedom is better than a universe without evil and without freedom.

James Collin's essay turns to theological concepts of the image of God which understand this concept as linked to the human capacity for rational thought and action. He draws on Robert Brandom's semantic inferentialism in order to show that rationality must be understood in normative terms. He then argues that because what it means to be rational can be expressed only in normative language, and the language of the natural sciences is nonnormative, explaining what it is to be human falls outside the scope of science, at least strictly speaking: any scientific accounts of what it is to be human will always be incomplete. Thus, he identifies a hard problem of *sapience*: a complete naturalistic description of human behaviour will not entail anything about the normative fundamentals of rationality.

Roland Karo follows a different track. He points to the many respects in which primatology has questioned traits like language or culture as 'special' traits of humans. Even the domain of the sacred, as a sense of the beyond, can be found in

other species. As a consequence, Roland argues that our uniqueness may be found in how we relate to our sense of the beyond, and not in that sense as such.

Joanna Leidenhag continues with a critical assessment of the traditional notion of humans as the image of God. She wants to take seriously the empirical and methodological challenges which the dialogue between science and theology has brought to bear on this notion, and she argues that traditional anthropological considerations alone are not sufficient to maintain any kind of doctrine of humans as the image of God. Traditional theological anthropology has to be complemented with pneumatological perspectives and the concept of participation. She analyses different models for engaging the concept of the spirit in the science and religion dialogue, and elaborates on their potential for the notion of the image of God.

The German Catholic theologian Johanna Rahner seeks to promote new ways for a critical and productive dialogue between the sciences and theological thinking. She points to the shortcomings of purely naturalistic anthropological views, such as those of Peter Sloterdijk or Richard Dawkins, and elaborates on what is lost in those perspectives from a theological point of view. She identifies the hubris of human self-creation and the denial of meaning as fundamental shortcomings in certain naturalistic anthropologies, and argues for an enlightened theology, which puts robust notions of human freedom and dignity at the centre of its argument and which is able to translate those notions into the modern world.

The essay of Jacek Poznański, S.J., explores the recent encyclical *Laudato si'* of Pope Francis. He identifies a transdisciplinary shift for Catholic theology in this text. Confronted with ecological challenges, the Pope argues for human responsibility as well as for an engagement in various kinds of dialogue, like ecumenical and interreligious dialogue, as well as dialogue with politics, economics and science. Jacek understands both demands as fundamentally linked: responsibility calls for dialogue and vice versa, and Christianity has to develop responsible dialogical contributions for promoting a balanced world order.

Jaeho Jang addresses the question of human uniqueness from an interreligious perspective. He takes theologian John Haught's idea of 'information' and compares it to the Daoist idea of *qi* (vital energy) in the book of *Zhuangzi*. He identifies analogies between Haught's concept of information, which allows for a non-interventionist view on the emergence of conscious beings, and the *Zhuangzi*'s notion of *qi*, which emerges from matter and, in turn, animates matter and brings about the cycle of life and death. Jaeho claims that both concepts allow for a notion of human uniqueness without getting into conflict with evolutionary biology, and that the Daoist idea of *qi* might expand Haught's evolutionary concept of information.

Part I
Reflections on Cosmology

Chapter 1

Being Human in a Cosmic Context

David Wilkinson

Abstract Current research in observing and understanding the structure and evolution of the universe has featured its extent in space and time, its fine-tuning in law and circumstance, its accelerated expansion and an ever-growing number of exoplanets. These four areas are reviewed in their impact on the question of what it means to be human. It is argued that they pose both challenges and opportunities for a dialogue with Christian theology. They may not in themselves raise questions that theology has not grappled with before, but they do sharpen and at times revive these questions. Indeed, Christian theology can learn much from these questions but also can contribute fruitfully in exploring what it means to be human in a cosmic context.

Keywords Cosmology • Creation • Accelerating universe • Fine-tuning • Multiverse • Natural theology • SETI • Exoplanets • Incarnation • New creation

Introduction

The question of what it means to be human is one of the central questions of contemporary culture, whether in the science fiction of the *X-men* franchise, the rapid development of artificial intelligence or in the ever-tightening relationship of mind and brain disclosed by neuroscience.

Such earthly questions resonate with the question of what it means to be human in a cosmic context, which has received fresh energy in recent years due to exciting new discoveries in observational astronomy. We will review four such areas of astronomy as they pose questions of the significance and role of humanity specifically in dialogue with Christian theology.

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The Scale of the Universe

It may appear to be somewhat trivial to note that the universe is big! Yet the scale of the universe has continually questioned the place of human beings. When Tycho Brahe observed comets and supernova explosions, and when Galileo reported sunspots, craters on the Moon and the phases of Venus, the perfect simplicity of the Aristotelian universe with its centrality of the Earth was undermined.

Today, observations of galaxies such as GN-z11 show just how seemingly insignificant the Earth is in terms of the vastness of space and time of the universe. GN-z11, a rather small galaxy, is one of the furthest astronomical objects that we have ever seen (Oesch et al. 2016). We see it as it was 13.4 billion years ago. By comparison we see the sun as it was some 8 minutes ago. Now of course this does not only give us a sense of the distance scale of the universe: it also says something about the history of the universe. In fact we are seeing that galaxy 400 million years after the Big Bang itself. Telescopes such as Hubble routinely observe objects from within a billion years of the origin of the universe and the next generation of telescopes, such as the long awaited James Webb Space Telescope, will push even further in observing early objects in the universe.

The universe contains of the order of 100 billion galaxies each containing on average 100 billion stars. One implication of this, which has a long tradition in Christian theology, is that it re-orientates perspective from human beings at the centre of the universe to something of the majestic nature of God. The scale and diversity of the universe can, for some, be seen in terms of Psalm 19:1: 'the heavens declare the glory of God'. This may be important in imaging God not as the dry mathematician of simple equations, but as the divine artist who creates with extravagance.

This approach was demonstrated in a significant but largely unknown figure of the nineteenth century, Temple Chevallier. He was lured from Cambridge to be the Chair of Mathematics at my own Durham University, then he became Reader in Hebrew, and in 1841 he also became its first Professor of Astronomy. In 1826 and 1827 he delivered the Hulsean Lectures, basing them on Psalm 19. Although published in 1835, under the title 'On the proofs of Divine Power and Wisdom, derived from the study of astronomy and the evidence, doctrines and precepts of Revealed Religion', he did not use his extensive knowledge of astronomy to prove the existence of a Creator in a way propounded by William Paley's design argument. Rather, he used the size and beauty of the universe as pointers to a deeper story, and to encourage a bigger view of God. It was an approach based on awe (Wilkinson 2015).

This sense of awe opens up the possibility of dialogue between science and religion, between the academy and the lay person, and it seems to me to be key to learning and building in students a passion for their subjects. The vastness of the universe is not trivial.

Yet when it comes to what this means directly for being human there are some complications that should not be underestimated. We can see something of this in

Psalm 8. Debate continues as to its connection with wisdom material, similarities to the form of the lament, its authorship, the era when it was written and how it was used in worship (Craigie 1983). Whatever was its original setting, it is certainly true that this psalm has been used regularly in both individual and corporate worship of both Jewish and Christian communities.

It certainly begins with a sense of awe in the refrain (v. 1):

*O LORD, our Lord,
how majestic is your name in all the earth!*

It then goes on to give us a picture of the greatness of God, in these terms: ‘*You have set your glory above the heavens*’ and ‘*the moon and the stars, the work of your fingers*’ (v. 3). The psalmist stands in awe of such a God. And yet, this sense of awe, leading to a sense of the greatness of God, is not straightforward. The psalm opens up another couple of perspectives. The first is puzzling. Verse 2 is difficult to translate. It is not clear whether ‘*from the lips of children and infants*’ is a qualification to the previous verse or whether it is connected to the rest of verse 2. However, the contrast is clear between the apparent weakness of children and the apparent strength of God’s enemies. But this is strange. The God whose praise is above the heavens has enemies, and sometimes his praise can only be heard through children. The complexity of God’s power and revelation of himself is highlighted – God’s subverting of his enemies comes through weakness. In the New Testament, Jesus uses the Psalm in this way. In Matthew 21:16, after the cleansing of the temple, he is criticized by the chief priests and scribes for accepting the praise of children. His reply uses Psalm 8:2, saying that the truth comes from infants rather than enemies. The biblical material is a caution to reading too much of the nature of God from the universe itself.

But the second perspective can be more distressing. The psalmist asks the obvious question that in the light of creation, ‘*what are mere mortals that you are mindful of them, human beings that you care for them?*’ (v. 4). What are human beings in relation to this? Indeed, the question is phrased in such a way that the obvious answer is ‘nothing’!

Pascal wrote,

When I consider the short duration of my life, swallowed up in the eternity before and after, the little space which I fill, and even can see, engulfed in the infinite immensity of spaces of which I am ignorant, and which know me not, I am frightened, and am astonished at being here rather than there; for there is no reason why here rather than there, why now rather than then...The eternal silence of those infinite spaces frightens me (Pascal 1958: 61).

The vastness of the universe may not lead to a sense of the greatness of God – for some it may lead to the insignificance of human beings.

These perspectives act as a caution to those who want to use the universe to prove God. The psalmist is saying that it is far more complicated than that, and for some creation by itself can lead to the despair of insignificance. We shall return to Psalm 8 at the end of this paper, but let us first move to another area in modern observational and theoretical cosmology which has come close to arguing for the existence of God and the special place of human beings.

Pointers to Design?

Might being human in a cosmic context be enriched by recognising some pointer to design? It is an often-repeated mantra that the Darwinian controversies of the nineteenth century were focused on a clash between natural selection and a literal reading of the first chapter of Genesis. Far more important in challenging the religious belief of the day, however, was the way that Darwinian evolution impacted on human uniqueness and the way that it demolished the design argument. The design argument, which argued from design in the natural world to a designer, had flourished with the growth of the scientific revolution and found its classic expression in William Paley's *Natural Theology* (1802). Paley's image of walking across some land and finding a watch, so intricate in its design that you infer a designer of the watch, had become a standard way of interpreting the intricacy of the biological world. Indeed, natural theology – that is, the movement from evidence in the natural world to belief and description of a Creator – had replaced for many Christians the Bible in being the foundation for belief. This was despite the fact that there had been aggressive attacks upon it earlier by Kant and Hume.

However, Darwin gave an alternative explanation for design in the natural world. That which was thought to be the special creation of God, and therefore evidence of a great designer, was shown to be *possibly* the result of the process of the random and brutal nature of natural selection. It is important to be clear about this. Darwin did not have a full explanation. He lacked the mechanism that would later be provided by genes, and he had a number of contemporary scientific challenges, not least in the timescale of evolution. However, before the scientific case amassed the weight of evidence which it now has, natural selection provided an alternative explanation for design. Once an alternative explanation was recognized both in the academic and popular mind the power of a logical proof for the existence of God became unconvincing. The edifice of the logical proof of the design argument was reduced to rubble. In addition, it was clear that human beings were not the inevitable and the central outcome of the evolutionary process.

Yet in the last few decades we have discovered that the laws and circumstances of the universe need to be just right in order to give us a universe of structure and intelligent, self-conscious life. It is what Paul Davies calls the 'Goldilocks Enigma' (Davies 2006), and raises the question of whether such life is the inevitable and central outcome of the processes within the universe. It has led to some contemporary toying with the design argument.

Perhaps the clearest contemporary exposition of its significance came in Martin Rees' *Just Six Numbers*. He highlights the apparent fine-tuning of the ratio of the electrical force to gravitational force, how firmly atomic nuclei bind together, the amount of material in the universe, the cosmological constant, the ratio of energy needed to disperse an object compared to its total rest mass energy and the number of spatial dimensions in the universe. If any of these were just slightly different to what they actually are then intelligent life would not develop within the universe. He then gives three options to explain this striking feature of the universe. First, one

can simply accept that this is just the way that it is and not ask further questions. Rees resists this option on the ground that this fine-tuning is of such an extraordinary degree that it pushes you to consider whether there is a deeper story to the universe. The second option is to see it as evidence of a creator God. This is not discussed in depth. The third option is the one he sees as ‘compellingly attractive’ and ‘a natural deduction from some (albeit speculative) theories’ (Rees 2000: 150). This is that the anthropic principle selects this universe out of many. We see fine-tuning because we are here to observe it. In another universe where there is no fine-tuning there would be no observers to see it.

The move here is to introduce the concept of the multiverse. This has become very popular in recent discussions, and there are a multitude of multiverse theories. One popular in the eighties and nineties claimed that the mass of the universe is so great that eventually gravity will reverse the expansion bringing the universe back to a Big Crunch. Some then said that the universe ‘bounces’ back into a Big Bang and the process of this oscillating universe goes on into infinity, thus providing an infinite number of universes. At each ‘bounce’ the parameters change, leading to different universes. As we will see in a moment, this way of imaging an infinite number of universes has now been ruled out by the observation in the late nineties that our universe will in fact expand forever and not collapse. A second multiverse theory is to say that our universe is one of many bubble universes which emerge out of fluctuations in a quantum field. Just as you form different sizes of bubbles with detergent on the surface of water, our universe may have been one among many and had just the correct fine-tuning to expand and produce observers. A third and somewhat bizarre suggestion is Everett’s interpretation of quantum theory, which says that whenever a measurement is made of the quantum world the universe fulfils all quantum possibilities, forming a new universe with each possibility. This leads to literally billions and billions of independent universes, all slightly different to each other.

Now the crucial point in all of this is whether other universe speculation is metaphysics or physics. Can we know that they are there by the passing of information from one universe to another, or do we accept their existence on the basis of the prediction of theories which solve other problems to do with our early universe? There is considerable disagreement on these matters at the moment. Some argue strongly that this coupling of the anthropic principle with a theory of many universes is more of a metaphysical suggestion than a physical theory (Holder 2013). In that sense it is an alternative explanation to that of a Creator God, although the Christian theologian would put forward the evidence of God becoming a human being in Jesus as a strong argument in favour of the existence of God. However, others point out that if (for example) a particular theory, inflation, is required to explain certain features of our own early universe and a particular form of this theory predicts the existence of other universes, this could be seen as a physical rather than metaphysical theory (Cox and Forshaw 2016).

How do we then assess the Goldilocks Enigma and the multiverse? The multiverse sounds a necessary cautious word that our observation of the universe is dependent on the fact that we are here. And it further gives an alternative (if only at

the very least metaphysical) explanation of design. The design argument depends on the possibility that there is no other explanation apart from that of designer. What Darwin did in the nineteenth century was to give through natural selection an alternative explanation to design. The multiverse acts in the same way. The possibility of a multiverse cautions us against resurrecting the design argument as a means of proving the existence of God.

Yet the Goldilocks Enigma of fine-tuning can still be used in a manner reminiscent of Chevallier in pointing to at least a question of whether there is a deeper story to the universe in terms of the relationship of humanity and the cosmos. Perhaps the awe and wonder of not only the vastness of the universe but also that things are just right for human life may be the beginning of a search or an intriguing puzzle.

Another aspect of the close and intriguing relationship between humanity and the cosmos is to be found in our experience of the intelligibility of the universe. In November 1915 Albert Einstein, after a number of years' hard work, was able to extend his work on the Special Theory of Relativity to what became the General Theory of Relativity. He was able to derive the field equations for gravity, which would describe how the geometry of space and time was shaped by the presence of matter and radiation, and then to apply them to the decades-long puzzle of the small advance of the perihelion of Mercury (that is the closest point of the planet to the sun). Einstein's theory of gravitation accounted for the advance exactly without the need for other planets or other attempted 'fixes'.

The consequences of the general theory were profound. It implied that on the rare occurrence when two black holes collided they would produce gravitational waves, small ripples in the fabric of space-time. Einstein himself was sceptical about whether it would be possible to see these gravitational waves but on the 11th February 2016, the LIGO collaboration announced the detection of gravitational waves, from two black holes with masses of 29 and 36 solar masses merging about 1.3 billion light years away (Abbott et al. 2016). LIGO – the Laser Interferometer Gravitational Wave Observatory – shoots two light beams over 4 km in length at 90 degree angles to each other and then recombines the beams. A passing gravitational wave will slightly stretch one arm as it shortens the other. The ripple in space-time led to stretching of the distance covered by one light beam of a fraction of the diameter of a proton!

This is an extraordinary example of intelligibility, that is, our ability to understand the universe even in its most bizarre and counter-intuitive outworking of the laws of physics. Some see this as a pointer to some kind of rationality behind the universe. Of course some Christians responded positively to Darwin's natural selection, with awe that God should have used an intricate process, and saw God in the biological laws rather than the special design of each creature. Indeed this has a long tradition stretching back to Newton, who saw the laws of the universe as work of the divine lawgiver. The same can be said of some physicists today who see the laws of physics as a reflection of the consistent work of God in sustaining the universe.

An End in Futility

If scientific work on the origin of the universe raises questions of awe and wonder and a mysterious connection between humanity and the cosmos, work on the long-term future of the universe at first sight seems to raise questions of a very different kind. Here the future is full of despair and futility in thinking about being human in a cosmic context.

Earlier we touched upon the belief in the latter part of the twentieth century that the expansion of the universe was slowing down. The universe might expand for ever or, if there was enough mass in the universe, the expansion might be reversed into a contraction leading to a big crunch.

However, work in 1998 completely changed our understanding of the universe, and this work was of such significance that it was recognized in the award of the Nobel Prize for physics. Astronomers looked at distant supernovae explosions of stars. Their results showed something that was completely unexpected. The universe is accelerating in its rate of expansion due to some unknown type of force, the so-called dark energy (Perlmutter 2003; Perlmutter et al. 1999; Riess et al. 1998). There had been no theoretical prediction of this, apart from Einstein's original inclusion of his cosmological constant in his solution of the equations of general relativity for the universe. It led to near panic among theorists, and to a range of possible explanations, none of which at the time of writing come anywhere near to a generally accepted understanding.

Yet the accelerating universe points to a future of futility for the physical cosmos, and with it the end of the survival of intelligent life within the universe. An accelerated heat death is a bleak end. When the universe is 10^{12} years old, stars cease to form, as there is no hydrogen left. At this stage all massive stars have turned into neutron stars and black holes. At 10^{14} years, small stars become white dwarfs. The universe becomes a cold and uninteresting place composed of dead stars and black holes.

Some physicists have tried to argue that the ability of humans in manipulating the environment will lead to the creation of forms of life able to survive such a universe (Dyson 1988; Tipler 1994). Dyson, for example, famously suggested that human intelligence could be downloaded into interstellar gas clouds which could survive the low temperatures of a heat death universe. However, while this may be possible (although not terribly attractive!) in a universe slowing down in its expansion, it becomes increasingly impossible in an accelerating universe. Paul Davies is therefore correct in suggesting that an 'almost empty universe growing steadily more cold and dark for all eternity is profoundly depressing' (Davies 2002: 48). Steven Weinberg famously put it:

The more the universe seems comprehensible, the more it also seems pointless. But if there is no solace in the fruits of research, there is at least some consolation in the research itself. ... The effort to understand the universe is one of the very few things that lifts human life above the level of farce, and gives it some of the grace of tragedy (Weinberg 1977: 144).

It is a sobering thought that the optimism of science and technology in shaping our world for good, is unable to find any hope in its own prediction of the futility of the end of the universe apart from the fact that we know the end is coming.

The sense of futility undermines the way that science has been enrolled in the myth of human progress. This is the idea that as science and technology progress they will lead to some kind of eternal utopia for humanity. In contrast, Christianity can face the challenge and rediscover within its own tradition resources that give hope (Wilkinson 2010). The theme of new creation, that is a new heaven and earth, is present within a range of biblical genres. This is not about some other-worldly existence that has no connection with the physical universe. It is about God doing something with the totality of existence. This new creation is a possibility because of a Creator God. The new creation is continually linked to God's original creative work, and hope for the future is built on an understanding of God as Creator. Whatever the circumstances, creation is not limited to its own inherent possibilities because the God of creation is still at work. The evidence of this work is focused in the resurrection of Jesus, which is also the model by which the continuity and discontinuity between creation and new creation are held together. If, as Paul argues (1 Cor 15), the resurrection is the first fruits of God's transformative work, then there should be both continuity and discontinuity in the relationship of creation and new creation, just as there was in the relationship of Jesus before the cross and Jesus risen. The empty tomb is a sign that God's purposes for the material world are that it should be transformed and not discarded. If resurrection affirms creation, then it also points forward to new creation. Continuity and discontinuity in the transformation of the physical universe may be located in the nature of matter, space, and time. To take time as an example, the resurrected Jesus does not seem limited by space and time. In new creation the continuity may be that time is real but the discontinuity is that time no longer limits us in the way that it does in this creation. It could be argued that the resurrection body is characterized by decay's reversal, that is, a purposeful flourishing. In this creation, time is associated with decay and growth, but in a new creation might time be simply about growth? We are therefore suggesting that our experience of time in the physical universe is a small and limited part of an ontologically real time that we might call eternity.

Such insights are offered as a structure for dialogue. They do not set out to map the biblical account exactly onto the scientific account, or to see them as completely independent. The Christian will come to the scientific description of the future of the physical universe with much to learn, but also much to offer.

Are We Alone?

Some four light years away, the nearest stars to our sun make up Alpha Centauri. The recent discovery of a planet, Proxima b, around one of its stars, Proxima Centauri, is significant in a number of ways (Anglada-Escudé et al. 2016). First, it is one of a deluge of discoveries of exoplanets made in the last two decades

(Wilkinson 2016). Proxima b was found using the radial velocity method, where the host star exhibits small Doppler shifts of light as it is gravitationally tugged by an orbiting object. Another technique is to look at the dip in light from a star as a planet passes in front of it. This has been used extremely successfully by the Kepler satellite, which simultaneously monitored the brightness of more than 100,000 stars in a particular patch of the sky. In its initial phase, Kepler discovered 77 confirmed planets and collected over 2300 planet candidates. Then in 2013 the second of four reaction wheels, which are used to stabilize the spacecraft, failed and the Kepler mission seemed to be at an end. However, engineers were able to use pressure from sunlight as a 'virtual reaction wheel' to help control the spacecraft. The resulting K2 mission continued Kepler's planet hunt. The third method of discovering planets uses the micro-lensing of light by planets. Einstein's Theory of General Relativity predicts that the path of light can be bent by the presence of a gravitational field around a massive body such as a star or even a planet. Thus light from distant stars has a temporary brightening due to the presence of mass between the distant star and the observer.

Twenty years ago we had scant evidence of any planets beyond our solar system. The count now at time of writing is over 3000 in over 1000 planetary systems. We have been able to see planets in a wealth of different star systems, where stars differ in their age and temperature and may be in binaries. A conservative estimate is that these results suggest that at least 10% of stars have planets.

Second, Proxima b seems to be a rocky planet within what is called the habitable zone. The early discoveries of exoplanets tended to be large gas giants on a scale of Jupiter rather than earth. As techniques have been refined we have begun to see Earth-size rocky planets. Proxima b orbits its host star approximately every 11 days, at a distance which is 5% of the distance from the Earth the Sun. However, as its host star is less powerful than the Sun the orbit is within the habitable zone, which is the region where liquid water may exist on the surface of the planet.

Third, the fact that this system is the closest system to us in astronomical terms raises the exciting possibilities of observations looking at the planet in detail, radio communication over timescales of just a few years and even possibilities of sending something to this system. A recent suggestion from Stephen Hawking and others, the so-called Breakthrough Starshot project, proposes using a laser to push a tiny, wafer-size spaceship to about 20 percent of the speed of light, allowing it to complete the journey in a mere 21 years, although it has to be said its arrival might not be noticed!

These kinds of discoveries have changed completely our view of the search for extraterrestrial intelligence and raise the question again of what it means to be human in such a cosmic context. But we should be careful of not getting carried away. It is easy to say that if most stars have planetary systems, and there are a hundred billion stars in each of a hundred billion galaxies, then that there must be another Earth-like planet capable of producing intelligent life out there.

Yet we need to be cautious about thinking that the universe is teeming with intelligent life. A planet needs to be 'just right' for life to evolve. In addition, it is a long way from an amoeba to an accountant! There could be lots of bacteria, but they may

have not evolved to intelligence. Perhaps the strongest argument against other intelligent life within our Galaxy came from Enrico Fermi. He argued that if the Earth is not special in having intelligent life, then civilisations should already have evolved many times in the Galaxy, since there are billions of stars older than the Sun. If any one of these civilisations wanted to colonise the Galaxy, they could have done so within 300 million years, even using technology that is almost within humanity's grasp. However, the Galaxy is 10 billion years old, and so he concluded: 'where is everybody?'

The discovery of exoplanets highlights again the complex web of arguments regarding whether we are alone. It also focuses the question of what would be the effect on humanity's self-understanding if the search for extra-terrestrial intelligence proved successful. Some have suggested that one consequence would be the demise of religion, as it will no longer be able to maintain the uniqueness of human beings or the special revelation of God, for example in the way the Christian faith sees the life, death and resurrection of Jesus of Nazareth.

However, just as it would be wrong to jump to conclusions about aliens on the basis of the discovery of exoplanets, it would also be wrong to oversimplify the relationship between religion and SETI. In fact, some of the first scientists to speculate about life on other planets were in part motivated by their Christian faith. Astronomers such as Richard Bentley and Christiaan Huygens in the seventeenth century, impressed by the size of the universe, speculated about life around the millions of stars and insisted that this showed God's ability to create life anywhere he wished, and that the universe existed not for the sole benefit of human beings but to exhibit God's glory.

Why had such speculations become so respectable? We can draw together a number of influences. First, prior to the Copernican revolution, human beings considered themselves placed at the centre of everything. The universe as described by Aristotle and Ptolemy had the Earth as its centre and everything orbiting around in beautiful (but increasingly complex) circles. The interpretation of this is, however, quite complex. There were some voices that suggested that the Earth was viewed as the furthest away from the glory of the spheres and was, in the words of Montaigne in 1568, 'the lowest story of the house' (Danielson 2010: 53). Copernicus may not therefore have dethroned men and women but in fact suggested that there were greater possibilities for human beings and beyond human beings. Alternatively, as Russell has pointed out, the decoupling of physical position and actual status of human beings was a major influence (Russell 1985). In the Aristotelian universe, position and status were closely associated. We were special because we were placed at the centre. In contrast, the Bible does not associate status and place. The dignity and worth of human beings comes from the gift of relationship with God. The problem of the devaluing of human beings by moving them away from the centre of everything could be countered by this view.

These types of argument opened up the space for belief in ETI. The Copernican revolution was in turn dependent on the overthrow of Greek thought and the mediæval theology which was so coupled to it. The influence of Judæo-Christian theology on this should not be underestimated. A number of historians of science have

pointed out the way that Christian theology demystified nature, and led to the experimental method. Although sometimes this can be overstated, nevertheless belief in a God who freely creates the universe and welcomes the enquiring mind gives a strong basis for the empirical method (Foster 1934; Hooykaas 1973). Thus Bentley, Huygens and others were set free to use observations of the world as the primary basis of science. And observing such a vast universe raised the real possibility of other inhabited worlds. These other inhabited worlds, far from a threat to humanity's special relationship with God, would be an expression of God's extravagance and freedom in creating the universe.

If intelligent life elsewhere in the universe does not undermine a Christian view of being human in creation, might it however impact the doctrines of incarnation and redemption? Arthur Peacocke put this bluntly: 'Does not the mere possibility of extraterrestrial life render nonsensical all the superlative claims made by the Christian church about the significance (of Jesus)?' (Peacocke 2000: 103). He was worried by the particularity of revelation and salvation focused in the life, death and resurrection of Jesus Christ. Were the events of Bethlehem and Calvary once for all for the whole universe?

The distinguished cosmologist E. A. Milne thought so:

God's most notable intervention in the actual historical process, according to the Christian outlook, was the Incarnation. Was this a unique event, or has it been re-enacted on each of a countless number of planets? The Christian would recoil in horror from such a conclusion. We cannot imagine the Son of God suffering vicariously on each of a myriad of planets. The Christian would avoid this conclusion by the definite supposition that our planet is in fact unique. What then of the possible denizens of other planets, if the Incarnation occurred only on our own? We are in deep waters here in a sea of great mysteries (Milne 1952: 103).

Milne eventually solved his great mystery by suggesting the Christian missionary mandate was sending of the good news of this one event by radio waves!

Milne was severely criticized by E. L. Mascall in his Bampton lectures in 1956, stressing that salvation has to be achieved through incarnation:

If there are, in some other part or parts of the universe, rational corporeal beings who have sinned and are in need of redemption, for those beings and for their salvation the Son of God has united (or one day will unite) to his divine Person their nature, as he has united it to ours (Mascall 1956: 39-40).

There are a number of theological issues which are not easy to untangle here (Wilkinson 2013). Why was there only one incarnation for the different cultures and times of human beings? The coupling of incarnation and salvation is in part due to the reality of sin, and (as explored in the fiction of C. S. Lewis) would an alien civilization have sinned and be in need of salvation?

Origen presented Christ's redemptive work as a transcendent action which gradually through time takes effect in every realm of creation but which, nevertheless, needs to find corporeal expression in a particular place on a particular occasion – that is, on Calvary. There is some attraction to this view, but it poses the question of further working out the relationship of Christ to the universe as a way into understanding better the nature of being human.

Being Human in the Physical Cosmos

We have reviewed four areas of modern observational astronomy as they impact on the question, What does it mean to be human? While the Goldilocks Enigma may point some to the centrality of human beings in the created order, in contrast SETI, the futility of the future, and the vastness of the universe point in the opposite direction.

This is a warning against simplistic attempts to resurrect the classical arguments for the existence of God. This can be welcomed by Christian theology. As we saw earlier in terms of Psalm 8, the glory of the heavens can quite easily lead to a mounting sense of despair in the human condition: ‘what are human beings’? Being human cannot be fully worked out by science and philosophy alone. For the psalmist, human beings have significance in the light of God’s revelation, which leads to joy in the place given to human beings by God. The real significance of human beings is not to be seen in anything inherent within human nature, but is to be seen in what God has done. Verses 5 to 8 stress the initiative of God in terms of ‘you made’ (v. 5), ‘you crowned’ (v. 5), ‘you made’ (v. 6) and ‘you put’ (v. 6). The tenses of these verbs are difficult, perhaps referring to what has been accomplished in the past but also providing a contrast with what will be the future for human beings. Once again there is a clear resonance with Genesis 1, especially in the responsibility of stewardship over the world.

Human beings are given a special place in the created order by God, made a little lower than ‘heavenly beings’ (verse 5). Some traditional translations have used ‘angels’. Craigie suggests that this translation was prompted by modesty, and argues that the better translation is ‘God’ (Craigie 1983: 108). Such is the high view of human beings. Human beings are ‘crowned with glory and honour’ (verse 5). Verses 6 to 8 fill out the Genesis command, setting the stewardship in terms of domestic and untamed animals, birds and fish.

The final refrain of praise is a reminder of how this is known. The significance of being human is not read from the universe alone, it is understood as a result of God’s self-revelation. ‘O Lord, our Lord’ uses the name of Yahweh, the name revealed to the Jewish people, the special name of God who had saved them and delivered them from Egypt. This Creator God was also their covenant God, revealed in his actions in the space-time history of the universe.

For Christians, the significance of human beings in the universe is demonstrated by the revelation of God in Jesus Christ. For being human is not being at the centre of everything or being different from everything else in creation. It is supremely a gift of grace.

Bibliography

- Abbott, B. P., et al. (2016). Observation of gravitational waves from a binary black hole merger. *Physical Review Letters*, 116(6), 061102.
- Anglada-Escudé, G., Amado, P. J., Barnes, J., Berdiñas, Z. M., Butler, R. P., Coleman, G. A. L., de la Cueva, I., Dreizler, S., Endl, M., Giesers, B., Jeffers, S. V., Jenkins, J. S., Jones, H. R. A., Kiraga, M., Kürster, M., López-González, M. J., Marvin, C. J., Morales, N., Morin, J., Nelson, R. P., Ortiz, J. L., Ofir, A., Paardekooper, S.-J., Reiners, A., Rodríguez, E., Rodríguez-López, C., Sarmiento, L. F., Strachan, J. P., Tsapras, Y., Tuomi, M., & Zechmeister, M. (2016). A terrestrial planet candidate in a temperate orbit around Proxima Centauri. *Nature*, 536(7617), 437–440.
- Cox, B., & Forshaw, J. (2016). *Universal: A guide to the cosmos*. London: Allen Lane.
- Craigie, P. C. (1983). *Psalms 1–50, Word Biblical commentary*. Waco: Word.
- Danielson, D. R. (2010). That Copernicanism demoted humans from the Center of the Cosmos. In R. Numbers (Ed.), *Galileo goes to jail and other myths about science and religion* (pp. 50–58). Harvard: Harvard University Press.
- Davies, P. (2002). Eternity: Who needs it? In G. F. R. Ellis (Ed.), *The far future universe: Eschatology from a cosmic perspective* (pp. 41–52). Radnor: Templeton Foundation Press.
- Davies, P. (2006). *The Goldilocks Enigma: Why is the universe just right for life?* London: Allen Lane.
- Dyson, F. (1988). *Infinite in all directions*. New York: Harper & Row.
- Foster, M. B. (1934). The Christian doctrine of creation and the rise of modern science. *Mind*, 43, 446–468.
- Holder, R. (2013). *Big Bang, big god: A universe designed for life?* Oxford: Lion.
- Hooykaas, R. (1973). *Religion and the rise of modern science*. Edinburgh: Scottish Academic Press.
- Mascall, E. L. (1956). *Christian theology and modern science*. London: Longmans.
- Milne, E. A. (1952). *Modern cosmology and the Christian idea of god*. Oxford: Clarendon Press.
- Oesch, P. A., Brammer, G., Dokkum, P. G. V., Illingworth, G. D., Bouwens, R. J., Labbé, I., Franx, M., Momcheva, I., Ashby, M. L. N., Fazio, G. G., Gonzalez, V., Holden, B., Magee, D., Skelton, R. E., Smit, R., Spitler, L. R., Trenti, M., & Willner, S. P. (2016). A remarkably luminous galaxy at $z=11.1$ measured with Hubble space telescope Grism spectroscopy. *The Astrophysical Journal*, 819, 129.
- Pascal, B. (1958). *Pensées*. New York: E. P. Dutton & Co., Inc..
- Peacocke, A. (2000). The challenge and stimulus of the epic of evolution to theology. In S. J. Dick (Ed.), *Many worlds: The new universe, extraterrestrial life and the theological implications* (pp. 89–118). Radnor: Templeton Foundation Press.
- Perlmutter, S., et al. (1999). Measurements of omega and lambda from 42 high-redshift supernovae. *Astrophysical Journal*, 517, 565.
- Perlmutter, S. (2003, April). Supernovae, dark energy, and the accelerating universe, *Physics Today*, 53–60.
- Rees, M. (2000). *Just six numbers: The deep forces that shape the universe*. London: Weidenfeld and Nicholson.
- Riess, A., et al. (1998). Observational evidence from supernovae for an accelerating universe and a cosmological constant. *The Astronomical Journal*, 116, 1009.
- Russell, C. (1985). *Cross currents: Interactions between science and faith*. Leicester: IVP.
- Tipler, F. J. (1994). *The physics of immortality*. London: Weidenfeld & Nicolson.
- Weinberg, S. (1977). *The first three minutes*. New York: Basic Books.
- Wilkinson, D. (2010). *Christian Eschatology and the physical universe*. London: T&T Clark.
- Wilkinson, D. (2013). *Science, religion and the search for extraterrestrial intelligence*. Oxford: OUP.
- Wilkinson, D. (2015). Proofs of the divine power? Temple Chevallier and the design argument in the 19th century. *Scottish Journal of Theology*, 68, 34–42.

Wilkinson, D. (2016). Searching for another earth: The recent history of the discovery of exoplanets. *Zygon*, 51, 414–430.

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Chapter 2

Is Life Unique? Perspectives from Astrobiology and Synthetic Xenobiology

Elisabeth Loos

Abstract My paper takes up the question of the ‘Uniqueness of Life’ from the perspectives of astrobiology and synthetic xenobiology, two sciences that pose considerable challenges to the presumption that life is unique. Astrobiology is dedicated to studying the possibility of extraterrestrial life and the forms it might take. If alien life forms were to exist, life on Earth would lose its uniqueness and could no longer be regarded as a cosmic exception; this would not leave mankind’s exceptional status in the universe untouched. In recent years, synthetic biologists have also begun to shake the very foundations of the presumption that life is unique. Synthetic xenobiology attempts to create life in the laboratory, and has the aim of producing xenobiological artefacts, i.e. unknown versions of organisms. This raises the question as to whether these synthetic organisms represent a new type of life or whether they might be the root of an alternative Tree of Life. In this paper I discuss the problems bound up with both fields’ attempts to find or create new forms of life that are nevertheless similar to known forms. Analyzing the concepts of ‘life’ in both sciences will help clarify the debate and will elucidate whether doubting the uniqueness of life is justified.

Keywords Astrobiology • Bioengineering • Contingency of evolution • Extremophiles • Origin of life • Principle of plenitude • Synthetic biology • Tree of Life • Xenobiology

Introduction

‘Are We Special?’ The topic of the 2016 ESSSAT conference links up the very particularity of human life with its uniqueness. Accordingly, being special means that the human species is seen as unique and should exhibit at least one unique feature.

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