

«Fighting against Religion in the Name of Science»

Has the Battle been Won?

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It is a great honour to give the fifth Mariano Artigas Memorial Lecture. I came to know Mariano personally when we were both involved in a project sponsored by the European Science Foundation. The aim was to explore the role of religious values in the rise of European science. During that project, Mariano won my great respect as a deeply compassionate man as well as an energetic and rigorous scholar. I learnt of the exciting discoveries he had made in the archives of the Holy Office, following their release in 1998. These threw new light on the background to the trial of Galileo in 1633 (Artigas, Martinez, and Shea 2005; Shea and Artigas 2006: 165-180) and on the way in which the Catholic Church later negotiated Darwin's controversial science of evolution. Partly because of the long shadow of the Galileo affair, the Church was careful to avoid an official condemnation of Darwin's theory. The archives nevertheless revealed more subtle ways in which it had censored Catholic biologists known to favour the science of evolution (Artigas, Glick, and Martinez 2006).

In the English-speaking world, Mariano's legacy is perhaps best enshrined in his book *The Mind of the*

Universe (Artigas 2000). In this he attacked the view that there is an inherent, inevitable conflict between science and religion. He was deeply critical of those who deny the reality of anything that cannot be studied using the methods of empirical science (Artigas 2000: 303). He was also convinced that scientific progress was not the main reason for the secularisation of Western societies (Artigas 2000: 300-305). This is a view that I share with him (Brooke 2010). When Mariano discussed the «disenchantment» of nature, he recognised that its causes were «anything but simple and trivial» (Artigas 2000: 303). A critic of Max Weber, he did not believe that scientific progress has removed all indication of divine activity from the world (Artigas 2000: 300-301). His personal faith found expression in the belief that the language of purpose and direction should not be removed from discourse about nature. One of his main objectives was to show that «the existence of teleology is supported by a great variety of phenomena that belong to quite different fields» (Artigas 2000: 322).

Although we all find complexity stressful, it cannot be avoided when discussing the relations between scientific thought and religious belief. Mariano was complimented in the journal *Contemporary Physics* on having provided a «sure guide to their complexities.» Because I, too, have been credited with a complexity thesis (Numbers 1992; Brooke 2009; Lightman 2019), I would like to make secularisation and complexity the two main themes of this lecture. I have taken my title from a passage in *The Mind of the Universe* where Mari-

ano made two striking observations. These were that «fighting against religion in the name of science is as old as human history», and secondly that «in every epoch, naturalism presents itself as if it were the result of human progress» (Artigas 2000: 301). These observations were directed against the enemies of religion who like to use military language when proclaiming that it has been, or will be, defeated by science. I shall therefore begin by asking what is wrong with that formulation. I shall then introduce some of the reasons why I reject the view that science has been the main cause of secularisation. I would also like to explain why historians of science have been drawn to the discussion of complexity. With that in mind, I conclude with a brief reference to three contemporary issues in which scientific and theological interests have been inter-related: climate change, the prospect of intelligent life elsewhere in the universe, and advances in artificial intelligence. In each case, the pressing concerns raised for humankind are such that a *combination* of scientific and religious resources may be more propitious for their resolution than an approach simply premised on the defeat of religion by science.

Problems with Fighting Talk

It is not hard to find public spokesmen who do fight religion in the name of science. Authors such as Richard Dawkins and Daniel Dennett spring to mind. In their work scientific and religious understandings compete

for the same territory. They are treated as if they operate on the same level in a zero-sum game. Scientific advance means religious retreat in a discourse that pits the natural against the supernatural (Dennett 2007: 9). Dawkins has promoted the view that religious understandings of our place in the world are simply primitive science now corrected by modern science (Dawkins 2006). Yet it is surely not that simple. From the scientific revolution of the seventeenth century until the second half of the nineteenth century, explanations of phenomena by «natural» causes generally sat comfortably *within* a Christian theology of nature (Numbers 2003: 272-282; Harrison 2019: 10-18). Distinctions between primary and secondary causality allowed both the science and the theology to co-exist. To conflate religious understandings with primitive science overlooks fundamental differences between the provinces of science and religion. It overlooks the ways in which religions embrace questions of human identity, moral values, meaning and purpose, outside the scope of the natural sciences.

The anthropologist Mary Douglas once observed that those who imagine science to be the main cause of secularisation forget that religious activity is grounded in social relations, not primarily in concepts of nature (Douglas 1982). Her view is shared by a leading sociologist of religion, John Evans. For Evans, the problem with the conventional secularisation paradigm is its definition of religion as a method of explaining the physical world through the supernatural. This is precisely how Dawkins and Dennett have treated religion.

On the contrary, says Evans, «it is explaining the social world, giving it meaning and moral value, which is religion's primary concern» (Evans and Evans 2008: 90). In his recent book *Seven Types of Atheism* the philosopher John Gray makes the same point: «the practice of religion expresses a need for meaning, which would remain unsatisfied even if everything could be explained» (Gray 2018: 12). An imaginative and telling response to Dawkins comes from the literary critic Terry Eagleton: To regard religion as a botched attempt to explain the world is «like seeing ballet as a botched attempt to run for a bus» (Eagleton 2009: 50).

Yet it is easy to oversimplify. One of Dawkins's most recent critics, Hugo Rifkind, makes the illuminating suggestion that he is a «greater advocate for atheism when he leaves God alone and just offers us the other, better story» (Rifkind 2019). This underlying belief that there is an alternative, «better» story to be told than that of biblical tradition, scientifically informed and comprehensive in scope, surely can impact on the strength of religious belief? As an example of the kind of big history in which science and religion are not necessarily embattled, but in which all the prestige is given to the sciences, I would cite Yuval Noah Harari's bestseller *Sapiens* (Harari 2014). Harari never doubts that, during the last 500 years, science has won immense prestige because of the new powers it has given us (Harari 2014: 288). And that must have consequences for religious world-views. Exactly what those consequences are, though, is not self-evident. This is because Harari's story is one

in which the sciences have still left room for religious ideologies and values. There is a compelling reason for this and it is a pointer to the complexity we shall be exploring later. As Harari observes, scientists face the recurring problem of where to give priority when research projects compete for funding. He suggests that scientists are not always aware of the political, economic and religious interests that control the flow of money. Crucially, there is sometimes no *scientific* answer to the question why one research programme should be favoured rather than another, or why one application of the resulting research should be given priority over another. His striking conclusion is that «scientific research can flourish only in alliance with some religion or ideology» (Harari 2014: 305). This is a long way from saying that scientific discoveries have defeated the religions or that there is no place left for religious values in public debates about science.

Science and Secularisation

The word «secularisation» usually refers to the displacement of religious authority and control by civic powers that take over the functions formerly fulfilled by religious institutions. The term «secularisation» can also mean the loss of beliefs characteristic of religious traditions. It may include a greater indifference to religious norms among the public and to the privatisation of religion among believers. For a historian, the subject

is especially interesting because, within Europe for example, there have been different degrees and patterns of secularisation in different countries, making it extremely difficult to generalise about its causes. During the Enlightenment, one of England's most radical religious publicists, Joseph Priestley, found himself dining in France at the table of a Monsieur Turgot. He was told that the two gentlemen opposite him were the Bishop of Aix and the Archbishop of Toulouse, but his informant had immediately added that «they are no more believers than you or I». Priestley had assured him that he was a believer «but he would not believe me» (Orange 1974: 781). England's most radical Protestant scientist was shocked by what he found in Catholic France. The narrative of secularisation cannot be the same for both nations.

My own view is that the relationship between scientific progress and the secularisation of society is too complex to be captured by a single formula. In giving my reasons for this conclusion I shall be drawing on considerations that I have examined in previous publications (Brooke 2001 and 2010a). The association of scientific rationality with a secular mentality *is* commonly assumed by natural scientists today as a constitutive element of the culture of modern science. Many *social* scientists, however, have become more critical of what was once known as the secularisation thesis – that a continuous reduction of religious authority and function is irreversible in societies permeated by science and technology. Social scientists have been forced to recognise

that religious beliefs and practices may flourish, even regain allegiance, in scientifically advanced societies.

In controlling natural forces, science-based technologies have far surpassed the results of petitionary prayer or meditation. Their effects on religious practice, however, have been strangely diverse. They have introduced new means of transport and recreation, which have provided seductive alternatives to the religious life. Conversely, in large American churches, modern power-point technologies were rapidly adopted to make church services more attractive. Churches have been exploiting the internet in various ways to boost the size of their congregations, their websites providing instruction in their respective beliefs and values. In Britain, on 28 May 2019, *The Times* newspaper ran as its front-page headline: «Say a little prayer for me: Alexa app helps users to connect with God.» New technologies can facilitate religious observance in other ways, as in some Jewish communities where pre-programmed elevators and pre-programmed ovens have helped to obviate the need for work on the Sabbath, as my wife and I discovered on our first visit to Jerusalem. Another complication stems from the fact that the form, and even the content, of scientific theories may *reflect* the values enshrined within a particular society at a particular time as much as they may impact on them. During the period of the Revolution in France, secular attitudes were in the ascendant. This was also the era when more radical scientific theories were taking shape – as in the cosmological theories of Laplace and in Lamarck's ac-

count of biological evolution (Hahn 1986; Corsi 1988: 23-24; Burkardt 2013). Secular science in part reflected a secularising society.

This suggests an important difference between secularisation *of* science and secularisation *by* science. By the end of the nineteenth century, religious language had almost completely disappeared from technical scientific literature; but this does not mean that religious beliefs were no longer present among scientists. Crucially, the cultural significance given to scientific discoveries and theories greatly depends on the preconceptions of their interpreters. Scientists with religious convictions have often found confirmation of their faith in the beauty and elegance of the mechanisms their research uncovers. For the seventeenth-century astronomer Johannes Kepler, the mathematical elegance of the laws describing planetary motion prompted his confession that he had been carried away by «unutterable rapture at the divine spectacle of heavenly harmony» (cited by Caspar 1959: 267). A contemporary example would be the former Director of the Human Genome Project, Francis Collins, who has spoken of his work as the unravelling of a God-given code (Collins 2007).

Instead of regarding science as the driving force of secularisation, it is surely more accurate to say that scientific theories are usually susceptible of both theistic and naturalistic readings? Historically they have provided resources for both. The same concept has been manipulated by some to generate a sense of the sacred and, by others, of the profane. There is a striking example

in the way in which the concept of the atom was used in the seventeenth century and later to argue for anti-religious, anti-providential readings of the natural world. This was possible because, in antiquity, there was a school of thought which ascribed the origins of the universe to the chance collision of atoms. Not even the gods, said the Roman poet Lucretius, could make something from nothing. But this anti-religious creed was not entailed by an atomic theory of matter. A theistic interpretation was perfectly possible, as it was for Pierre Gassendi in France, Francis Bacon and Isaac Newton in England (Osler 1994: 36-57; Iliffe 2016 and 2017: 204). Bacon found it inconceivable that a philosophy that stressed the random motions of atoms could possibly account for the ordered world he experienced. In his essay «Of Atheism», he protests that «even that school which is most accused of atheism doth most demonstrate religion» (Bacon 1965: 49; Brooke 2019: 124). The atomic philosophy was more in need of God, a «divine marshal», to explain the order in the universe than was the Aristotelian philosophy.

Some scientific theories have undoubtedly been more damaging to religious sensibilities than others. Darwin's theory of evolution by natural selection is an obvious example. Whether a transcendent divine being exists or not is nevertheless a question on which science can ultimately only be neutral. Instead of seeing science as necessarily secular in its implications, a strong case can be made for respecting that neutrality. Interestingly, this is how the matter *was* seen by Darwin's most vig-

orous populariser, Thomas Henry Huxley. For Huxley, science was neither Christian nor anti-Christian but «extra-Christian», meaning that it had a scope and autonomy independent of religious interests. Hence his insistence that Darwin's theory had no more to do with theism than had the first book of Euclid – meaning it had no bearing on the deeper question whether evolutionary processes themselves might have been seeded in an original design (Huxley 1887).

Scientific theories, Darwin's in particular, have been endlessly used to justify unbelief. But this underlines the need to better understand the reasons for a person's unbelief – an unbelief that may not have its origins in science but which may turn to science for its justification. The main reasons Darwin gave for his unbelief help to dispel the myth that it was his science that was primarily responsible (Brooke 2010b). As with other Victorian thinkers, Darwin reacted strongly against evangelical Christian preaching on heaven and hell. Members of his family had been freethinkers: his grandfather Erasmus had been an early advocate of organic evolution, his father was probably an atheist, his brother Erasmus certainly so. The doctrine that after death they would suffer eternal damnation was, for Charles, a «damnable doctrine» (Darwin 1958: 87). He was also sensitive to the extent of pain and suffering, among non-human animals too, which he described as one of the strongest arguments against belief in a beneficent deity (Darwin 1958: 90). Each of these concerns was crystallised by deaths in his family – that of his father in the late 1840s

and of his ten-year old daughter Annie early in 1851. Darwin did believe that, as science advanced, appeals to the miraculous became more incredible; but his loss of faith had deeper existential roots.

It is certainly a myth that science, *more than any other factor*, is the agent of secularisation. Studies of the reasons given by secular leaders for their conversion from Christianity to unbelief have shown that, in many cases, references to science barely featured at all (Budd 1977: 104-123). Conversions to unbelief often accompanied a change from conservative to more radical politics – with religion rejected when it was seen as part of established, privileged society. The fact that every Christian sect, indeed every religion, claimed its own hotline to the truth was another long-standing consideration having nothing to do with science. The perceived immorality of religious doctrines, particularly concerning an after-life, and the perceived immoral behaviour of some priests, also fuelled a rejection of religious authority, as it does today. Reading subversive anti-clerical literature, such as Thomas Paine's *The Age of Reason*, was often mentioned as an influence by the leaders of secular movements in England. The Hebrew Bible itself featured in secularist polemics for its depiction of a vengeful, anthropomorphic deity. Realisation that atheists could be as morally upright as believers also affected attitudes as it did for Darwin. In the hundred years from 1850 to 1950, historical, more than scientific, research was proving subversive as biblical writers were seen not as timeless authorities but as unreliable products of their own culture.

If science should not be privileged as the main agent of secularisation, what alternative narratives are possible? In his penetrating analysis, *A Secular Age*, Charles Taylor examined the change «from a society in which it was virtually impossible not to believe in God, to one in which faith, even for the staunchest believer, is one human possibility among others» (Taylor 2007: 3). This is a change that Taylor argues could only come about through the presence of serious alternatives to Christian monotheism. The most important of these alternatives, he suggests, can be traced back to the early eighteenth century with the development of what he calls a self-sufficient humanism. It was a humanism that, in contrast to Christianity, accepted no final goals beyond human flourishing, and no allegiance to anything else beyond it (Taylor 2007: 117). This has to be understood as a new moral sensibility, not as a response to the physical sciences.

Among the deists who exemplify this new sensibility was the belief that the world runs according to laws set up by a benevolent creator who had not, however, made any special revelation to humankind. In Matthew Tindal's *Christianity as Old as the Creation* (1730), often described as the bible of the deists, the biblical miracles were attacked. However, it was not their incompatibility with scientific laws that Tindal stressed, but rather the relativising presence of miracle stories in every religious tradition (Brooke 2014: 227-232). Taylor gives a sophisticated account of how the new moral sensibility arose, at the same time warning that when scientists

do invoke their science to legitimate unbelief they may easily overlook the real reasons for their stance and the hidden assumptions concealed in them.

Because different countries and cultures have experienced tensions between secular and religious values in contrasting ways, there is no one universal process of secularisation that can be ascribed to science or to any other factor. Interestingly, where nations with a long religious tradition have been oppressed by a foreign power, their religion has often reinforced a sense of national identity, bursting out of its chains with a new vitality on gaining freedom. The strength of Catholicism in Poland has been a modern example. With the end of the Cold War an old union of faith and nation was re-ignited as, for different reasons, it has been latterly in Putin's Russia. A history of secularisation in France would be very different from its history in Poland, Russia and, markedly, in the United States of America, where centralising tendencies of all kinds have been resisted (Martin 2007: 9).

To avoid misunderstanding, it has not been my intention to sever all connection between scientific progress and the aetiology of secularisation. I have argued elsewhere that, during the European Enlightenment, there were definite connections between reverence for science and irreverence toward religion (Brooke 2014: 207). In particular, it is possible to point to three trends in the emergence of a scientific culture that almost certainly did contribute to a de-sacralisation of nature. They have recently been affirmed by Peter Harrison

whose judgment I share (Harrison 2017). The first was the shift in seventeenth-century Europe from an organic to a mechanistic understanding of nature, one in which the quest for laws of nature superseded the quest for final causes, the Aristotelian ends or purpose within natural processes. Despite the fact that these laws were largely understood as divine legislation, they allowed, in Harrison's words, an easy re-description of a theological totality in naturalistic terms (Harrison 2017: 58). The second shift, also clearly visible in seventeenth-century Europe, was a democratisation of theological reflection. Members of the laity increasingly took on the mantle of theologians. Natural philosophers were prominent among them. And prominent among *them* was Galileo, who, in his *Letter to the Grand Duchess Christina* (1615), argued that a sound knowledge of nature was a necessary pre-requisite for correct biblical exegesis. Thirdly, and ironically, the incorporation of new scientific knowledge into schemes of physico-theology eventually backfired as zealous proponents of the design argument not only conspired in the transformation of «religion» into propositions requiring demonstration (Harrison 2017: 60-61) but also accumulated their evidence in such trivial and excruciating detail that they dug their own graves (Brooke 2014: 297-306). It is an old joke, but it was said early in the eighteenth-century that no-one had doubted the existence of God until the Boyle lecturers undertook to prove it. These three historical processes nicely illustrate Peter Burke's insight that the scientists could be destructive despite themselves (Burke 1979: 303).

Complexity in Contemporary Public Debate

By looking at the complex relations between science and secularisation, I hope I have shown why historians resist simple stories about triumphant science and defeated religion. I am aware, however, that my examples of complexity have been taken from the past. So I would like to turn now to my three contemporary topics of major scientific interest. These are firstly climate change; secondly the prospect of extra-terrestrial life; thirdly the impact of advances in artificial intelligence. Technology and the sciences have a central place in public awareness of these issues. Yet human values are also critical when thinking about the challenges that each of these developments presents and how they are to be met. Given Harari's point that scientific research cannot flourish in an ideological vacuum, it is not surprising that there have been calls for greater public consultation on major questions of policy. In all three cases it is more constructive to look not for ways in which the sciences have defeated religion but for ways in which the resources of both can be combined in tackling the major ethical issues.

Very recently my own University, Oxford, has announced the establishment of a new Centre for Artificial Intelligence and Ethics. The Royal Society in London has been holding public consultations on the same subject. There have been calls for the public to be consulted on how we should respond in the event of our receiving signs of intelligence from other worlds.

The recent fires in the Amazon rain forest resulted in political protest from around the world. Religious voices were among them. A Declaration from the Interfaith Rainforest Initiative, reported in the September 2019 *Newsletter* of the Yale Forum on Religion and Ecology, asserts a «profound moral obligation to make care for tropical forests a top spiritual priority.» In this second part of the lecture I shall try to show some of the ways in which theological ideas can still be relevant when addressing these issues. But there is no simple one-to-one fix in which Christian theology, or other religious principles, can provide the solution to each ethical problem.

Climate change and environmental protection

Anxiety about the increasing pace of climate change is growing fast, as we learn more about the interdependence of the biosphere and the physical consequences of global warming – the melting of the ice caps, for example, and the catastrophic effects of a rising sea-level. As I was preparing this lecture, distressing pictures appeared of the Solomon Islands in the South Pacific. Progressively inundated, several have already disappeared. In the late Summer of 2019, much publicity was given to the international protests of young people concerned for their future on what has been called «the day the world took to the streets». The political issues are also ethical issues concerning, for example, how to protect not just

the indigenous tribes in the Amazon, but the poorest inhabitants in many vulnerable parts of the world.

There surely are ethical values within Christian tradition that should be heard in the context of environmental protection. To understand the world as a gift from its creator, rather than a planet to be plundered, should provide motivation for action. The biblical image of Adam entrusted with the care of creation has indeed encouraged references to our stewardship. The need for self-sacrifice, if urgent changes of life-style are essential, surely resonates with the place of self-sacrifice in Christian theology. Press coverage of Pope Francis's visit to Madagascar in September 2019 was a reminder of the high priority he has given to fighting climate change as an essential component of Catholic teaching on social justice. Madagascar is home to the lemurs, apparently the most endangered primates in the world, their numbers drastically reduced by rampant deforestation. Francis spoke when fires were burning not only in the Amazon but also in Angola and Congo; when a glacier in Iceland was melting; and when food shortages remained acute in Mozambique, following the devastating cyclone that struck in March 2019. Francis's message, that something must be done if catastrophe is to be averted, was widely reported, as in *The New York Times*, and struck a chord with many, if not all, his listeners [[nytimes.com/2019/09/07/world/Africa/pope-africa-climate-change.html](https://www.nytimes.com/2019/09/07/world/Africa/pope-africa-climate-change.html)].

In the context of ever rising carbon emissions it is interesting to read about the activities of the Global

Catholic Climate Movement and its role among other religious organisations in pledging to divert financial assets from investment in companies promoting the use of fossil fuels. This is part of a wider «pledge to divest» movement that has grown substantially during the last five years. The first European university to adopt the strategy was that of Glasgow in October 2014 and others have followed. In the United States the numbers continue to multiply. There have been dissenting voices, at Harvard for example, which declined to divest, citing claims that the financial impact on the companies would be negligible and that institutions taking such action would risk diminishing their influence with the industries concerned. This is, however, a movement in which individuals and their institutions can feel they are doing something for the good of the planet. Where religious institutions have been pro-active in this ambition it seems inappropriate to think of religion silenced by science.

There is, however, a complication. It concerns the degree to which the Christian faith historically encouraged the exploitation of natural resources. In a well-known essay the American historian Lynne White Jr. argued that the Judaeo-Christian tradition, with its biblical doctrine that God had given Adam dominion over nature, could easily provide justification for an anthropocentric domination of nature (White 1967). If White's thesis is correct, there is a sense in which Christian environmental activists today are perhaps atoning for attitudes that contributed to our current crisis. It is

in this respect that the story becomes more complex. Peter Harrison has shown that White's thesis is not entirely correct because there is little evidence from medieval exegesis that the Genesis text had been interpreted as a licence for exploitation. But nor is it entirely incorrect. This is because, during the seventeenth century, new interpretations of the Genesis text did appear that were more congenial to the vision of power over nature that we associate with Francis Bacon (Harrison 1999 and 2007). This was also a time when there seemed no limits to the gifts to be found in creation and little sense that they might one day be exhausted. It is striking that, in his Encyclical Letter *Laudato si'* (2015), Pope Francis specifically warned against viewing humanity as having «dominion» over the Earth when it is imperative that everything be seen as interconnected and all creation a kind of universal family.

Before he died, the cosmologist Stephen Hawking became so concerned about the prospects for our planet, that he warned we must prepare for the migration of a human population to another home in space: first within the solar system, then to destinations among distant stars. As the Christian ethicist John Hart shrewdly observed, Hawking's space pioneers would be humans who have already devastated their home planet. How or why would they act differently in space or on other worlds? (Hart 2013: 8). Would they not treat existing inhabitants in the same destructive way as European colonisers had treated indigenous peoples? As soon as we contemplate the possibility of extra-terrestrial life,

we generate a host of moral and theological questions. Most of the questions are not new. The prospect of life on other worlds has been discussed since antiquity (Dick 1982; Crowe 1986). By the middle years of the nineteenth century, there were even estimates of the total population of our solar system, the Scottish natural philosopher Thomas Dick coming up with the wonderfully precise figure of 21,891,974,404,480 (Crowe 1986: 199). Today, astro-biology has become a fascinating, innovative discipline.

The prospect of life on other worlds

If there is one scientific development that has contributed something new to the discussion of extra-terrestrial life, it is surely the discovery, from 1995, of exo-planets. Their existence, for a long time a subject of speculation, has been verified. A pioneer in this field, Didier Queloz, was one of the winners of the Nobel Prize for physics awarded just before I gave this lecture. Thousands of exo-planets have now been detected and there are predictions of many millions if not billions. The number of earth-like planets that we know about is rapidly growing. Exciting news is eagerly awaited of others with pre-conditions for life closer to those on Earth than any before. A few months ago we learned about exoplanet K2-18b whose predicted temperature range provided the right conditions for liquid water and complex organic molecules. On the basis of naturalistic assumptions, such

discoveries raise the probability of life of some kind elsewhere in the universe. Extensive debate about the implications for humanity has led to a call for public consultation about how we should respond if a message bearing marks of intelligence were to be received on Earth. In that space for consultation there would again be the opportunity for religious leaders to turn to their faith traditions for insight. This is not an arena where religion has been defeated by science.

Some might think it is. After all, was Giordano Bruno not burned at the stake in Rome in 1600 for, among other things, proposing an infinite plurality of worlds in an infinite universe? Even here the story is more complex than we might think. Although Bruno was aware of the sun-centred astronomy of Copernicus, his primary arguments came from scholastic philosophy and theology. He argued, for example, that an infinitely powerful God could express infinite power only in the creation of infinite worlds. It was his refusal to retract that argument, his rejection of the Trinity, and his irreverent remarks about Jesus Christ, that led to his downfall (Brooke 2014: 99-100; Gatti 1999; Shackelford 2009; Westman and McGuire 1977). Crucially, among both Catholic and Protestant thinkers there were numerous arguments both for and against ET. To streamline a defeat for theology in the name of science obscures a fascinating history and the theological resources that have fed into debate.

Among Protestant reformers there were certainly some who appealed to Scripture to banish multiple

worlds. For Philip Melanchthon, in charge of Luther's educational programme, the Bible clearly taught that, after the labour of creation, God had rested on the seventh day. Work had not begun on other worlds. Melanchthon's resistance also sprang from his reflections on Christ's death and resurrection: «it must not be imagined that there are many worlds, because it must not be imagined that Christ died and was resurrected more often» (cited by Dick 1982: 89). And yet by the middle of the seventeenth century there were Protestants who took their Bible seriously and at the same time voted for extra-terrestrials. One was the Oxford mathematician and founding Fellow of the Royal Society John Wilkins, who provides a nice illustration of how Melanchthon's problem might be handled: The existence of life on other worlds did not necessarily mean that it was intelligent life; even if it were intelligent, this did not mean that it was necessarily human; even if it were human-like this did not mean that it had experienced a Fall comparable to that of Adam; but even if it had, why should Christ's death not be sufficient for its salvation? For Wilkins, the silence of Scripture on a plurality of worlds was a licence to consider the possibility, not to exclude it (Dick 1982: 99; McColley 1938).

A debate in the middle years of the nineteenth century shows how the possibility of life on other worlds was a divisive rather than a destructive issue within Christian natural theology. The antagonists were the Scottish physicist David Brewster and the Cambridge mathematician and philosopher of science

William Whewell, who first coined the word «scientist» in the early 1830s. Whewell prospered in Cambridge where he became Master of Trinity College; but he annoyed Brewster who always welcomed an opportunity to attack the education on offer at the English universities of Oxford and Cambridge. Brewster launched his attack after reading Whewell's critique of the idea of extra-terrestrial life. Whewell, an Anglican priest, thought the idea had become too fashionable without adequate scientific support. Brewster, an evangelical physicist, believed the universe only made sense if the vast number of invisible stars, known since the time of Galileo, had planets orbiting them. Otherwise what reason could the Creator have for creating them, given that they were invisible to the human eye? They must be shining on other worlds; otherwise there was no economy in creation. There was much more to this debate. Whewell was probably concerned that those who promoted the idea of extra-terrestrials were playing into the hands of those who were developing naturalistic theories of evolution (Brooke 1977). He worried too that enthusiasts like Brewster were by-passing questions about the uniqueness of the Incarnation (Crowe 1986: 265-355). Brewster retaliated by pointing to passages in the Bible that could favour plurality, passages such as Christ's declaration that «in my Father's house are many mansions», and that he had «other sheep... not of this fold».

Late in life, Darwin's contemporary Alfred Russel Wallace, who independently of Darwin recognised the

agency of natural selection in the transformation of species, wrote an essay and book entitled *Man's Place in the Universe* (2003), adding an intriguing appendix in 2004. We might expect that, as an evolutionary biologist, Wallace would have favoured the existence of ET. If the same pre-conditions for evolution existed on other worlds, surely humanoid life would have evolved there? That is the argument often heard today. But no! Wallace pointed out that, on Darwin's theory, the course of evolution depended on so many unpredictable events, the appearance of so many chance variations and the divergent branching of ancestral lines, that it was *improbable* that identical or closely related life forms would have evolved. Advocates of ET were failing to take account of the «enormous rate at which improbability increases with each additional condition which is itself improbable» (Wallace 2004: 326-327; Crowe 1986: 531). A similar argument was used more recently by the Harvard biologist Stephen J. Gould when he argued that, were the tape of evolution to be played over again, the probability of intelligent beings like ourselves emerging would be very low – a view contested by the Christian paleobiologist Simon Conway Morris who has illustrated the convergent rather than the divergent patterns in evolutionary transformation (Gould 1991: 288-289; Conway Morris 1998 and 2003; Conway Morris and Gould 1998/1999: 48-55).

In such debates it is possible to see the way in which metaphysical, religious and anti-religious pre-conceptions may influence the interpretation placed

on scientific data (Brooke 2016: 197-198) suggesting that debates about ET cannot be reduced to a simple battle between science and religion. The facts do not fit that model. There are surprises and complexities to unravel.

For my third case-study I turn away from aliens external to the Earth to aliens increasing among us. These are the creatures *we* have made that embody ever higher levels of artificial intelligence.

Accommodating robots

What comes to mind when we think of artificial intelligence? Chess-playing machines that can beat the grandmasters, machines in banks and supermarkets that deprive us of contact with our fellow human beings, the prospect of self-driving cars, the digital technologies of the internet, which allow information to be collected about our likes and dislikes in a new surveillance culture (Zuboff 2019), and for many a depressing sense that, as individuals, we are losing our privacy.

The rise of the robots has become a familiar theme in popular culture, raising anxieties about the prospect of mass unemployment (Ford 2015) and generating doom-laden prophecies about the extermination of the human race. But it is also raising serious questions for scientists and philosophers. We now have machines with a capacity to learn, a chess-playing computer for example, which, by playing itself, becomes increasingly

invincible. Technical progress in machine learning has been swifter than expected (Bostrom 2017: 321) and faster computers are matching (even exceeding) what humans can do in recognising faces, handwriting and speech. Our current machines may exceed our powers only in a limited range of tasks, but philosophers have warned that we need to think hard about the prospect of a more versatile superintelligence and how it might be controlled. Machines able to redesign and improve their own intelligence are as intriguing as they are disturbing. The Oxford philosopher Nick Bostrom writes: «Before the prospect of an intelligence explosion, we humans are like small children playing with a bomb. Such is the mismatch between the power of our plaything and the immaturity of our conduct» (Bostrom 2017: 319). Here is a chilling question asked in *The Times* newspaper on 22 June 2019 with reference to what could lie ahead: How would a weapon programmed to make war independently of human control know how to make peace or when to cease fire?

There are already contexts (in medical diagnosis for example) where humans are no longer the best decision makers. What will it mean for humanity if many of our life choices are left to machines that know us better than we know ourselves? Self-learning technologies are being developed in which their decision-making processes are no longer clear even to their creators. This is a particular concern in the financial sector where algorithms are crunching so much data and so quickly that the human brain is unable to encompass them, or not until it is too

late. The danger is that the directors of financial institutions may not be equipped to understand the risks and the people in charge not remotely specialist enough to comprehend them (Hosking 2019).

There are far bigger issues than these. There is now a science of neuro-technology in which the performance of the brain is enhanced by its coupling with sophisticated machinery. This can be a powerful tool in medical contexts for controlling prosthetic limbs and for improving cognitive function in those suffering from Parkinson's and similar diseases. But are there limits to the genetic and technical enhancement of normal human capabilities? Assuming that such enhancement would be available only to a privileged minority, by what criteria would the beneficiaries be chosen? Would it be morally acceptable for only the rich to benefit? Can we contemplate a society in which there are two categories of human, the normal and the artificially enhanced techno-human? Given such a range of challenging problems, it is not surprising that there have been urgent calls for ethical guidelines. As Bostrom indicates, the challenge is to hold on to our humanity. For that we need to draw on all our human resourcefulness (Bostrom 2017: 320).

And that must surely include insights from the religious traditions? We constantly hear that advances in AI raise fundamental questions about what it means to be human. We may say that robots can never be better than humans at being human. But that leaves the question open. Biologists may say that what makes us

human is what we are made of – our unique DNA. Historians will say that to know what it means to be human we must look at what humans do (Smith 2007), or, for the social anthropologist, how humans relate to one another and organise themselves. But theologians, too, have the opportunity to bring something special to the table. This comes not only from their historic role in defining, evaluating, and reinforcing moral principles. It also comes from a vast literature on what it means to be made in the image of God. This is often explored negatively – by asking, for example, what capacities non-human animals and machines may lack that humans possess. Among the differentia proposed, many of which have been challenged by students of animal behaviour, might be included a capacity to communicate with God, which, it has been suggested, was what the author of Genesis 1: 26 may have had in mind (Barton and Muddiman 2001: 43). Might there be an analogy here with a capacity in future robots to communicate with their creator? Importantly, the *imago dei* doctrine can also be explored positively, by considering human qualities that may resemble, however faintly, the putative attributes of God. Creativity must be one of these. And there is surely great poignancy in the realisation that we have become almost too successful in creating intelligent beings of our own – beings that may eventually embarrass, even renounce their creator, as humans have so often renounced theirs.

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