Chapter 10

The End of Copernican Mediocrity: How Modern Astrophysics has Reinvigorated the Spiritual Dimension

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Copernican Mediocrity

The Copernican principle of mediocrity was aptly summarized by Goethe in the nineteenth century: 'No sooner was the earth recognized as being round and self-contained than it was obligated to relinquish the colossal privilege of being the center of the universe.' As Carl Sagan put it in the twentieth century: 'We find that we live on an insignificant planet, of a humdrum star, lost in a galaxy, tucked away in some forgotten corner of a universe, in which there are far more galaxies than people' (1980, 4). His claim is that humanity must be an ordinary, commonplace species since our situation is so ordinary. There is the additional implication too, seemingly validated by Darwin, that humanity not only is ordinary, it is also meaningless, simply the evolutionary result of the quasi-random interactions of atoms. Physicist Stephen Hawking expressed the thought this way, his confidence based on the remarkable successes of science from cosmology to genomics: 'We are so insignificant that I can't believe the whole universe exists for our benefit' (Hawking 1995). His belief is not uncommon among scientists and the public, but it often derives from a world view that presupposes such insignificance.

But are we? Modern physics and astronomy have revolutionized the way we conceive of the universe, its size, birth, evolution and content. While its dramatic findings have typically been used to reaffirm Copernican mediocrity, an objective look at just two of the most dramatic recent results – inflationary big bang cosmology and exo-planets (planets around other stars) – suggests the opposite. The universe, far from being a collection of accidents, seems (surprisingly) to nurture intelligent life in a framework that is not in the least bit random. This notion, the Anthropic Principle, has been explored for over fifty years and is acknowledged, often grudgingly, by many physicists. The term itself was coined by the physicist Brandon Carter in 1973 and has encountered resistance because of the implication that humanity has something to do with it; 'fine-tuning' is often used instead to discuss the extremely unlikely physical situation in which we find ourselves. Humanity as well, far from being an ordinary lifeform, appears to be extraordinary and could be unique for all intents and purposes given the vast distances between stars and the finite speed of communication or travel. This second result is called the Misanthropic Principle and expresses the observation that in a universe whose physical parameters are spectacularly well suited for life, the environments and circumstances necessary for intelligence to develop are comparatively rare. At least for all practical purposes we are alone. A rational and honest conclusion, therefore, is that humanity is special yet lives in a cosmos that is somehow architecturally suited to produce intelligent beings. We are thus faced with the intellectual challenges of understanding what this could possibly mean and the ethical imperatives that result from being in such a privileged position. For all intents and purposes, as I will review in this chapter, ours is an extraordinary and salubrious cosmic condition, one that is probably cosmically rare and of possible significance. We therefore have an ethical imperative to protect the Earth and its inhabitants.

The first three words of the Hebrew Bible, 'In the beginning God created', have been the source of discussion, debate and doubt for millennia, but arguably the most puzzling word until recently was the first one – 'In the beginning.' Was there even a beginning? Perhaps an eternal Greek cosmos is more perfect and a more accurate description? How did it come to be and what are its cosmological features? Even Einstein thought the universe was unchanging and introduced a 'cosmological constant' into his equations to conform with that picture. Today, however, there are no doubts about this first word: The big bang picture, although still replete with incompletely understood knobs (like inflation) and other important puzzles, has been fantastically successful at explaining increasingly precise observations. No, today all the doubt is about the third Hebrew word, God (*Elohim*). Just as science has gradually enabled us to better understand that first word so too, I suggest, does science today offer us new perspectives on the third word, God. One step towards reconsidering that word – and our relationship to the Divine – is encompassed in recognizing and coming to grips with the end of Copernican mediocrity and its two signposts: cosmic fine-tuning and the probable specialness of humanity.

I should conclude this section by adding a point emphasized by the historian of science Dennis R. Danielson: Copernicus and his contemporaries did *not* think his sun-centric system pushed humanity out of a position of glory into one of irrelevance. To the contrary, up until Copernicus, the Greek and Christian views held that the earth was located, as Giovanni Pico put it (c. 1494), 'in the excrementary and filthy parts of the lower world', the very bottom of Aristotle's and Dante's cosmic barrel, where gross, imperfect, mortal beings reside. By putting the Sun at the centre, Copernicus was seen, according to Danielson, as effectively elevating humanity to a place closer to the heavens. During the post-Newtonian era, perhaps partly to appease the religious establishment, philosophers changed their tune: the centre was special and the preferred place to be and Copernicus demoted us to ordinary beings displaced from this 'lofty throne'. The lesson here is that the conventional wisdom, whether about Copernicus's world view, life as a commonplace cosmic accident or Divine purpose, is sometimes in need of reappraisal.

The Misanthropic Principle

The Misanthropic Principle expresses the idea that the multiplicity of possible environments in our cosmos are so varied and uncooperative (or hostile) either always, or at some time during the roughly three to four billion years that intelligent life needs to emerge, that it is extremely unlikely for *intelligent* life to evolve and thrive. It contrasts with the Anthropic Principle, the observation that the physical constants in the cosmos are remarkably finely tuned to make it perfect for hosting intelligent life. Scientists, as a way of guesstimating how abundant intelligent life might be, try to identify all the varied processes needed for an extraterrestrial civilization in the universe and then assign a probability to the chances of each one happening. The most common version of this accounting method is called the Drake Equation, a set of multiplicative factors used to track the various phenomena thought to be necessary to yield intelligent life. However, the Drake Equation is not the mathematical formulation of any physical process.

I review the current science behind the Drake Equation estimates in detailed discussions in my paper, 'Alone in the Universe' in *American Scientist* (2011, 99, 320–7) and more recently in *Zygon* (2016, 51, 497–519). The starting point is the customary one that considers only life capable of conscious, independent thought and an ability to communicate between stars. Primitive life may yet be discovered on Mars; perhaps even multicellular animals will be found on a nearby extrasolar planet. While these revolutionary discoveries would help us reconstruct how life on Earth evolved, unless a species can communicate with us we will be alone – with no one to teach or learn from, no one to save us from ourselves or, in the fanciful extrapolations of sci-fi novels and endless film makers, no one to do battle with. I entitled my paper 'Alone in the Universe' to emphasize this existential solitude. Extraterrestrial intelligence (ETI) implies life able to communicate between stars. We have so far had no confirmed contact with ETI, and as Enrico Fermi famously observed: If they really are common, then where are they?

The most uncertain terms in the Drake Equation estimates for ETI are the three biological ones: the probability that life develops on a suitable planet, that it evolves to be intelligent, and that it survives a long time. All of these involve some element of chance, but the first term seems especially stochastic. In 1970, the biologist Jacques Monod (*Chance and Necessity*) observed that 'Man knows at last that he is alone in the Universe's unfeeling immensity, out of which he emerged only by chance' (180). Stephen Jay Gould, in *Wonderful Life: The Burgess Shale and the Nature of History*, similarly argued that evolution on Earth took a very unlikely path. The Nobel Prize–winning cell biologist Christian de Duve (*Life Evolving*) agrees with them and the role of chance, but argues that chemistry and biology are somehow driven towards making life – but only when the conditions are exactly right. Jonthan Losos, in his new book *Improbable Destinies: Fate, Chance, and the Future of Evolution* (2017), updates Monod's case. Spiegel and Turner (2011) used a Bayesian statistical analysis to estimate the likelihood that life can form from inanimate matter using priors based on the few known facts, and conclude it is highly unlikely. Geneticists have meanwhile discovered that the evolution of DNA was circuitous, and probably the result of many fortuitous accidents. So while it is true that the same physical processes operate everywhere, some sequences of events are astronomically less likely to happen than others. The evolution of intelligent beings could certainly be such a sequence.

An exciting new development in the discussion about ETI comes from the discoveries of exoplanet research, and indeed a key term in the Drake Equation is the frequency of exoplanets capable of nurturing ETI. It has been recognized for a long time, summarized for example by Ward and Browlee in their book, *Rare Earth: Why Complex Life Is Uncommon in the Universe*, that it takes vastly more than liquid water and a pleasant environment to give birth even to simple life, much less to complex life or ETI. At a minimum it also takes an environment stable for billions of years plus all the right ingredients (the abundances of elements, for example, are not uniform across the universe). Since the time of the Greeks, we have expected planets to be common. Until just a few decades ago most scientists and textbooks agreed that practically all moderate mass stars hosted exoplanetary systems like our solar system, with an earth-like planet capable of bearing intelligent species. As Goldsmith and Owen put it in their 1993 textbook, 'Nothing in our theories for the origin and evolution of our sun is unique to the solar system. … The chances seem good that one of these inner planets will orbit its star at the right distance [to host life]. … We say one in every two to be conservative' (Goldsmith and Owen 1993, 384). The news is that the latest results of astronomy show otherwise. So far over 4200 exoplanets have been detected; many of them have had their masses, radii and other properties measured. The single most remarkable discovery about exoplanets is their exotic variety. Many are located in highly elliptical orbits around unstable stars, making evolution over billions of years difficult if not impossible. Other systems contain giant planets that may have drifted inward, disrupting other planets; the majority of exoplanets seem to be around low mass stars whose X-ray emission and stellar winds are usually inhospitable, and there are many other, unanticipated properties.

The discovery of earth-*sized* exoplanets is a remarkable technical achievement worth special comment since so many people assume earth-sized means earth-*like*. It doesn't by any stretch. So far about a dozen earth-sized exoplanets have been found and many more will added to the list once the NASA's TESS satellite is launched in 2018. Some of these are in environments (temperatures, stability, etc.) making them suitable for life. At the start of 2018, there were eight candidates whose sizes are less than about two earth-radii, that have rocky cores (thought to be a key prerequisite for life), and that are also located at a distance from their star at which any surface water could be liquid (the so-called habitable zone, although no surface water has yet been detected). But even on most of these select bodies the emergence of life (not to mention its evolution to intelligence) faces severe difficulties: a few are bathed in extreme X-rays from their stars (a common problem), and none have evidence of an oxygenated atmosphere. This is not to mention many of the other issues that impede life on planets, earth-sized or otherwise, even life that might take on weird, non-carbon-based forms (see Smith 2011; 2016). The bottom line for ETI appears to be that they are probably much rarer than previously imagined. There are, on top of this, some unbreakable physical realities to confront if we want to find them, in particular the finite speed of light.

Still, some aliens might be nearby. The Sun lies in a cavity of interstellar gas called the Local Bubble that extends over roughly 600 light years. It in turn is located in Gould's Belt, a spur of stars, star clusters and molecular clouds between two of the Milky Way galaxy's spiral arms, stretching from the Orion nebula to the Ophiucus-Scorpius clouds and on to the Perseus clusters – a distance of about 1,250 light years in its longest dimension. It takes a light signal 1250 years to traverse it; our earliest broadcasts have only made it out to about 100 light years. What might be the chances of chatting with alien neighbours if we wait and listen for the next 2500 years, long enough for our message to reach the farthest neighbourhood and their reply to return to us? If a human generation is twenty-five years, then in over one hundred generations we could converse with all aliens throughout this neighbourhood. The approximate number of stars per cubic light year in this volume here is 0.004, to within a factor of two, or about 30 million stars of all types in a volume of radius 1,250 light years. The combined chances for ETI existing, therefore, need to be better than about one in thirty million. If the stars are too big or too small, if the planets' orbits or obliquities are wrong, their sizes or chemical compositions unsuited, their surfaces ill-equipped, their geologic and meteoritic history too inauspicious, then we are alone. Then add in the biological uncertainties, which are much less well understood: If the chemistry needed to generate life is too intricate or too slow, if evolution from proteins to intelligence is too often aborted or misdirected, or if civilizations die off quickly, then, too, we are alone. If we choose to examine a volume one hundred times smaller than that enclosed within a 1250 light years radius, that is accessible within a single generation, we will have a yes-or-no answer much sooner, but the chances of success go down by a factor of a million because the number of stars is proportional to the volume of space and scales with time (distance) cube. If we expand the search volume to improve the chances of finding other beings, the wait time goes up correspondingly. For a very long time, then, it seems likely that we will be alone. It does not matter whether or not aliens thrive in the distant reaches of space – they might or they might not. What matters is whether we can communicate them – until then we are just guessing.

The SETI programme (Search for Extraterrestrial Intelligence), which undertakes extensive searches for signals, fully acknowledges this science but argues that 'the only significant test of the existence of extraterrestrial intelligence is an experimental one' (Tarter 1983, 359). I support SETI in principle – if we don't look for them we won't find them. But it is a risky endeavour, and non-professionals especially need to be reminded of the enormous limitations imposed by the finite speed of light. Even if there were a network of advanced civilizations living on the other side of our galaxy, they much are too far away from Earth to converse with, and to be 'alone' is to be without anyone to talk to. There is one important new feature of SETI to mention. When it started over fifty years ago, SETI searches used what today we would consider relatively basic technology and probably could not even have spotted the Earth from a distance of 100 human generations of light-travel time. Today, technology is not the limit. SETI both has very much better sensitivity and new sources of funding like the Breakthrough Initiative that hopefully will provide steady support. According to the programme's goals, the Initiative could detect a civilization around the 1,000 nearest stars if it transmits towards us even with only the power of common aircraft radar, and it could detect a civilization transmitting from the centre of the Milky Way (more than twenty-five thousand light years distant) if it broadcast with more than twelve times the output of our current interplanetary radars. We have seen nothing yet, but in much sooner than a thousand-year wait time even null results should enable us to reach statistically significant conclusions about any ETI that are transmitting signals.

Even if the formation of life were inevitable on every planet in the universe with liquid water, and even if the Milky Way galaxy has millions of water-bearing earth-sized planets, *for all practical purposes* we and our descendants for at least 100 generations are living in solitude. We are most probably alone. To recognize this state is to have a renewed appreciation for our good fortune and to acknowledge that life on Earth is precious and deserves supreme respect. Humanity is not mediocre.

The Anthropic Principle

The Anthropic Principle has been contemplated for decades, since theoretical physicist Paul Dirac first called attention to the curious balance between large cosmic numbers. We live on a planet with liquid water, located at just right distance from the sun so that the surface temperature enables water from being completely frozen or totally evaporated – the so-called habitable zone of the solar system. The Earth is hospitable for many other reasons as well: It has a conducive chemical makeup, tectonic plates to rejuvenate its oxygen-rich atmosphere, a tilted axis for seasons, a large moon to stabilize its tilt, and many more wonderful properties. No place else in our solar system is even close to being like it or capable of hosting intelligent life. We seem to be fabulously lucky. But the universe is a big place, with trillions and trillions of stars. Probably a paradise like Earth will randomly happen somewhere. In this way of thinking, we are not lucky at all – we are here because this is where we can be. It's about randomness and having lots of choices.

Now consider the universe. Its fundamental constants take particular values – the speed of light or the strength of the nuclear forces, for example – but why these values? We have no idea. But we do know that if those numbers – which in principle could take any values large or small – were much different from what they are, we would not be here. If, for example, the electromagnetic strength were only a few per cent different, then water would not be a good solvent nor an essential ingredient of life. If the nuclear force were tens of per cent weaker then atoms of carbon – critical for constructing complex molecules and life – would be much rarer. The most extreme example of fine-tuning is the expanding universe itself. Physicists estimate that if the balance between cosmic effects were different by only 1 part in 10-to-the-power 120 (!) we would not be here. Barrow and Tipler's exhaustive 1986 book, *The Anthropic Principle*, is one of many detailing these amazing 'coincidences' about the physical structure of the universe and its miraculous suitability for life. Geraint Lewis and Luke Barnes, in *A Fortunate Universe: Life in a Finely Tuned Cosmos*, re-examine Barrow and Tipler's arguments and offer some new ones. Meanwhile, the idea remains controversial in many circles, and there is disagreement about exactly how fine-tuned the constants really are. Fred Adams of the University of Michigan, for example, has recently calculated some much less restrictive scenarios. But at least for now there is strong evidence for fine-tuning, raising the question: Why? Why is the universe so perfect?

There are so far only three answers from science. One is just dumb luck. The second answer, proffered and defended by some theoretical physicists, is that there are an infinite number of universes – a 'multiverse' – spanning all logical possibilities. We just live in the one we can; no big deal. The third answer touches on philosophy, and comes from quantum mechanics. Matter is composed of wave functions of probability that only become 'real entities' when they are measured by a conscious observer. The quantum mechanical pioneer John Wheeler famously proposed that the universe *had* to evolve conscious beings in order to become real, and this notion (sometimes called the Participatory Anthropic Principle) is very much alive in modern texts. Moreover, consciousness and its origins are mysteries in their own right. Complex systems, for example, can produce unexpected phenomena through what are called 'emergent' processes. Consciousness, some physicists propose, is just such an emergent phenomenon. Emergent phenomena are real, but emergence still remains an after-the-fact justification rather than an explanation for how consciousness arose, with more work needed to make it convincing. The arguments by philosopher and theologian John Haught (*Is Nature Enough?*) provide one cogent view of the explanatory limits of emergence.

I admit to not being a fan of any of these three. It seems a cop-out to say we are just lucky, and as a physicist trained to give preference to simple solutions, a multiverse strikes me as way too extreme. The quantum mechanical route is possible, but uncomfortably mysterious – yet there are quite a few mysteries still in quantum mechanics so of the three it has potential. The point is that if some process – perhaps quantum mechanics but maybe something else – steers the universe toward producing intelligence, then we humans are representatives of that endpoint. It suggests that we play some cosmic role. Finally, if we might be the *only* such intelligent beings around (or that we will know about for millennia or longer) then we not only are not mediocre, but are cosmically special. Many people will reject this notion. The remarkable successes of science and the fact that the same laws of physics apply throughout the universe have persuaded them that whatever processes that produced intelligence on Earth must be operating everywhere, and therefore life must be everywhere. I certainly agree with the first part, but as noted earlier some outcomes can be astronomically less likely than others.

The End of Copernican Mediocrity

People with an unwavering faith in the existence of ubiquitous extraterrestrial civilizations and the conviction that humanity cannot be special might assert that we are mediocre, but beliefs and convictions are not proofs. There are many examples of famous scientists making claims founded on personal beliefs that we now see as ridiculous. Percival Lowell, for example, known for his search for Pluto and studies of the canals of Mars from his Flagstaff observatory, wrote in his 1908 book, *Mars as the Abode of Life*: 'From all we have learned of its constitution on the one hand or of its distribution on the other we know life to be as inevitable a phase of planetary evolution as is quartz or feldspar or nitrogenous soil. Each and all of them are only manifestations of chemical affinity' (1908, 37). No one today thinks this. Every schoolchild knows that Mars has no artificial canals and no aliens either. Lowell was by no means unique. Before him, in 1803, the eminent French astronomer Jerome Lalande had confidently written, 'Is it rational to suppose the existence of living and thinking beings is confined to the earth? From what is such a privilege derived but from the groveling minds of persons who can never rise above the objects of their immediate sensations?' (Lalande, quoted in Fontenelle 1803, viii). More recently, Harlow Shapley (1885–1972), the distinguished director of my own institution, the Harvard College Observatory, wrote of 'intimations of man's inconsequentiality' in a vast cosmos and of 'our [firm] belief in the cosmos-wide occurrence of life' (Shapley 1963, 3, 77). Lowell's confident assumption and Lalande's rhetorical logic were unproven, and their arrogant assertions were just wishful thinking. Michael Crowe has reviewed how the assumption of the existence of cosmic aliens, perhaps originating with the Greeks, was pervasive by the seventeenth century among both scientists and theologians (Crowe 1997; 2008).

The simplest and most rational explanation for both the Anthropic and Misanthropic Principles, consistent with the observations so far, is that humanity is not mediocre. Indeed, the evidence to date suggests we could be exceptional – at least as far as we will know for a very long time and, since we live in an ageing universe in which galaxies are moving apart at an accelerating rate, perhaps forever.

Three Dilemmas

The Misanthropic Principle raises three acute dilemmas that have not yet been carefully explored: epistemological, theological and ethical (Smith 2016). The epistemological dilemma is clear: Not knowing about the existence of something does not mean it does not exist. Until we hear a clear signal from beyond, or until our science has progressed far enough to provide some kind of all-embracing and conclusive answer (although the nature of such absolute evidence is hard to imagine), humanity is left in an existential quandary. In this environment of necessary ignorance, how should scientists and theologians respond to the many people for whom the prospect of being 'alone', without hope for salvation or comfort from a super-intelligent species abiding in heaven, is frightening? Having been the Chair of Astronomy at the National Air and Space Museum for ten years and having interacted with tens of thousands of visitors, I would stress to my scientific colleagues the importance of not overstating (or worse – misrepresenting) the significance of exoplanet discoveries. The temptation is great to inject a few tease words about 'life' into every report of a new planet found in its habitable zone. Yes, it makes the boring technical details seem more exciting. But it is vitally important not to 'cry wolf' too often lest the astronomy community and science as a discipline lose credibility. The excitement of exploring and analysing strange new worlds is more than justification enough.

I might add that we moderns now understand that unknowability is fundamentally allowed by the character of our universe. Chaotic systems, for example, even relatively simple ones like our solar system, do not allow practical predictions of outcomes arbitrarily far into the future. Although the physical laws are well known, the equations explicit, and cause and effect rules are clearly understood, the outcomes are unknowable. Other fundamental unknowables are events occurring beyond the cosmic 'horizon', the farthest light allows us to see in the universe in its lifetime (13.8 billion years). This applies even if these events have already happened. Moreover, in our outwardly accelerating universe more and more space is crossing over that dark horizon. Most non-intuitive of all – although quantum mechanics allows us to calculate precisely how a wavefunction will evolve, it does not allow us to know how it will eventually materialize. Not being able to know whether or not we are alone in the universe has a similar flavour, however it not only touches us on a personal level, it teases us with the possibility that we could someday find a positive answer.

The second problem is theological. For the community of spiritual believers, the conclusion that we could be special might on first glance appear to be reassuring. For at least the past century, however, theologians of many religions, and especially Christianity, have worked hard to include the idea of extraterrestrial life into normative religious thought. Their consensus opinion can be summarized by Bishop Krister Stendahl who phrased it, 'It seems always great to me, when God's world gets a little bigger [that] I get a somewhat more true view of my place and my smallness in that universe.' God's power is glorified, not diminished, by an abundance of life. If, however, humanity is singular, the theological community must adopt a much different perspective on Divine potency and the world, not to mention on the significance of humanity and the implications for human fulfilment. I very much admire the humility of Bishop Stendahl, but it is also humbling to think that we are, perhaps, special beings. Moreover, if we might be unique (at least as far we will probably know for millennia) then we must reconsider the possibility that we are not an accident but were created by some kind of intent, even for some purpose.

For atheists and scientific reductionists, the theological dilemma seems particularly grave (though most people will share some of the angst). We moderns are nearly convinced by the Epicurean argument, a feature of reductionism, that we are a randomly evolved collection of atoms. If we are not – then what? For atheists confronting this disorienting challenge, modern physics and philosophy have offered at least two solutions. The Quantum Mechanical solution mentioned above includes the still incompletely understood implication that the world and its matter are composed of wave functions of probability that only become real entities upon being measured. The so-called Copenhagen Interpretation has consciousness beings as the source of the measurement. The most current alternative quantum mechanical interpretation invokes the principle of decoherence, in which the quantum state is quickly fixed by a multitude of environmental interactions, but other physicists respond that this does not resolve the philosophical issue. Meanwhile modern philosophers of consciousness and the mind like Thomas Nagel have argued, similar to Wheeler, that a still-mysterious, but apparently essential, aspect of nature results in the development of conscious life. The natural processes for generating life may be mysterious but might still produce it frequently. Or it might not. For either group, atheists or theists, true believers in human ordinariness might just decide to hold fast to their current dogmas and adopt a wait-and-see attitude for a few more millennia.

The third dilemma is the ethical one, and I argue that it cannot wait. The Earth itself is under stress, and humanity is confronting growing misery. Shall we turn away while species that have taken 13.8 billion years to develop become extinct, or while our changing climate radically alters the environment for life? If we are merely a collection of evolved atoms, then these issues are of no great concern. The argument would be: There probably is life elsewhere distributed among the stars, abundant and diverse, along with many salubrious, earth-like planets to which we might escape but that anyway may have civilizations of their own of equal value to ours; some of these alien civilizations will survive even if the Earth's doesn't – perhaps that is enough. But what if they are wrong? If the human race – as far as we are likely to know for millennia – is alone, we must face the possibility that the above is not true, and neither we nor our planet are products of common happenstance. The Earth and its life have value. This prospect brings great urgency to the cause of protecting our rare planet and all of its precious inhabitants. We humans are at least unusual, and we are certainly blessed. Since biblical times, blessings carry with them added responsibilities and concomitant consequences. Those responsibilities include the obligation to deal compassionately with other beings and to attend to the welfare of community and its environment.

The Jewish view of the state of being blessed offers some insights into these three dilemmas. The epistemological issue has no practical implications and is not particularly problematic: Whether or not we know about others, we know about our own blessings. Indeed, says the prophet Amos, urging humility: 'Are ye not as children of the Ethiopians unto me, O children of Israel? saith the Lord. Have not I brought up Israel out of the land of Egypt? And the Philistines from Caphtor, and the Syrians from Kir?' (Amos 9.7). There might be other intelligent beings in the cosmos, but our obligations are independent of theirs. The theological issues are similarly unproblematic. The absence of ETI in our sphere of influence only enhances our self-awareness of our peculiar status, and their possible presence does not diminish it. The ethical dilemma is the one for which I think a Jewish perspective is the most helpful. Our exceptional status on Earth, and our new-found awareness of this probable good fortune, should make us more sensitive of our task 'to serve the Earth and to protect it' (Gen. 2.15). 'When you live in the land that flows with milk and honey … you shall therefore obey the voice of God and keep his commands' (Deut. 27.3). The Jewish perspective not only asserts that we should try, it emphasizes that we have the skills to succeed. But is the herculean task of caring for humanity, life and our fragile planet beyond our abilities? Could an atheistic inclination lead to pessimism? Things are what they are, and whether or not humanity perishes makes no particular difference to the cosmos. Why bother? The first-century Rabbi Tarfon offers a famous aphorism that provides a basis for positive motivation rather than despair. It is grounded in the religious notion that we are blessed and therefore obligated to assume responsibility: 'You are not expected to complete the task', he writes, 'but neither are you free to abstain from the effort' (Talmud Avot: 2, 15). And, if perchance we are not alone, then we share in the cosmic goals of making the world better, *tikkun olam,* with all other conscious beings with free will, although we may never know about them for sure.

Being Human

> We find ourselves in a bewildering world. We want to make sense of what we see around us and to ask: What is the nature of the universe? What is our place in it and where did it and we come from? Why is it the way it is?
>
> – Stephen Hawking, *A Brief History of Time*

> Where were you when I secreted matter? Speak up if you understand … how the flow was contained or how it burst forth!
>
> – Job 38.4 (translation from Smith 2006)

Today we, unlike Job, can tentatively raise our hands to God. With humility we can respond to this rhetorical question, 'Well, yes, we think we might have an understanding of these things.' Unlike Job, today we can believe in a God *not* because we are ignorant, but because we understand. The 'god of the gaps' is the derogatory term for the deity invoked to explain those features of the world left incomprehensible by gaps in theories. When creation ex nihilo was a mystery to science, God was needed to provide an explanation; likewise God was invoked to explain the near perfection of living creatures when that was a mystery. Stephen Hawking advocated an interesting and more physical variant to this notion – the god of boundary conditions, what he called the 'god of the edges'. He noted that modern physical theories, which strive for completeness, have been excellent at explaining (more or less) all aspects of a complete system like the universe as it is evolving. What they cannot easily do is explain the boundary conditions. 'If there is an edge', he explains, 'somebody has to decide what should happen at the edge. You would really have to invoke God.' (Hawking introduced the idea in the general context of his theory that the universe has no boundary/edge in time, even at the moment of creation.)

I have written about Jewish mystical approaches to cosmology and the creation in *Let There Be Light: Modern Cosmology and Kabbalah, a New Conversation between Science and Religion* (Smith 2006). The Kabbalah is not an alternative to big bang cosmology, although it wonders about many of the same things, but it is a source of new language and a different way to think about related cosmic things, consciousness, for example, balance and ethics. For the Kabbalists, Hawking's variant with its relegation of God to the edges has it backwards. It is the intimate, unbounded *wholeness* of the world that is the salient attribute that signifies God, not its bounded finitude.

Once people realized that the cosmos was not geocentric, they began to think about themselves, humanity and their world in a new way. The modern evidence for the end of Copernican Mediocrity, the Misanthropic Principle, should initiate a similar process of self-reappraisal. We seem to be unusual and possibly even unique, although we are unlikely to know for sure one way or the other for a very long time, perhaps forever. Still, it is possible that we are just an accident, with no particular significance. But conscious life appears to be a remarkable and unanticipated achievement of the universe – not an attribute one would have predicted for an ensemble of atoms. Even if we are not unique (though we may never know for sure one way or the other) we should admit that the bias underlying the modern preference for mediocrity – namely, that we are nothing more than a random accident – may no longer be viable. The Anthropic Principle intimates that some necessary feature of nature endowed the cosmos with this capacity, making it fundamental to the big bang creation and steering it over aeons of evolution to produce conscious beings today. If so, then we are representatives of that teleological endpoint, and serve a cosmic purpose of extraordinary significance. The philosopher Thomas Nagel puts it this way in his 2012 book, *Mind and Cosmos*: 'We have not observed life anywhere but on earth, but no natural fact is cosmologically more significant' (32).

The arguments for or against an end to our cosmic mediocrity necessarily rest on statistics, incomplete data and the admission that there are many things that we still do not understand. Research will continue to make progress in quantum physics, and in the search for basic life on exoplanets too, but the evidence that humanity is precious is likely to remain compelling. Should we not, therefore, treat one another as the priceless beings we seem to be? The Earth, even if turns out not to be unique, is for all intents and purposes a special place – should we not care for it as we would the most precious of our family heirlooms? The implication of the Anthropic Principle is that it matters. The implication of the Misanthropic Principle is that we will have to assume these awesome responsibilities by ourselves, without help from alien insights or technologies. Modern science may have prompted this re-evaluation, but addressing it will require the best of all our human abilities.

We live in an extraordinary time in which seemingly every mystery has become or is becoming intelligible. The 'god of the gaps' – the god of mystery – is no longer the default explanation for even that archetypical riddle: the Creation. But science in our miraculous era, although it refashions the inscrutable into the comprehensible, simultaneously transmutes the mundane into the wonderful. God is a Deity of wonder as much as a Deity of mystery; such is the import of Scientific Understanding, the fabulous – the real – Tree of Knowledge.

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