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Is the truth out there? Creatures, cosmos and new creation (Part one)

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1. The scope of this lecture

In this lecture we will examine some of the implications of modern scientific cosmology for Christian faith. In particular we will consider the issues of the age and size of the universe and of the possibility of there being intelligent life elsewhere in the universe – extraterrestrial intelligence (ETI).[1] In the first half of the lecture I will be reviewing the findings of modern cosmology on these topics, comparing them with what was previously held. In the second half I will first ask whether these findings threaten the truth of the Christian faith and then explore what implications they might have for the four 'acts' of the cosmic drama – creation, fall/sin, redemption, and future hope or eschatology. In other words, our topic is 'Creatures, Cosmos and New Creation' – or perhaps it could have been called 'Life, the Universe and [the end of] Everything'. The answer may prove to be more complicated than '42'. I have found this a fascinating topic to study and, to quote one scholar, it has served as 'a pretext for reading science fiction during working hours.'[2]

If that is what are going to consider, what are we *not* considering this evening? Some may be relieved to hear that I will have nothing to say about the theory of evolution, that being a topic that has received more than enough attention of late. I will also not be considering the question of the 'anthropic principle', the manner in which our universe is fine-tuned to be friendly to life. That topic has been thoroughly examined by a number of distinguished authors, among them Alister McGrath in his 2009 Gifford Lectures – just one year before he reached

1 This, together with Part Two which will appear in the next issue, is a lightly revised version of the annual Laing Lecture, given at London School of Theology on 9 February 2012. In a few places the tone of the oral presentation, including its informality, has deliberately been retained. For the title I am indebted to David Ginns and Ben McNamara, a former and a present student. I am also grateful to David Wilkinson from St John's College, Durham, for introducing me to the literature on this topic and to Rodney Holder and Denis Alexander of the Faraday Institute for Science and Religion, Cambridge, for commenting on a draft of this lecture.

2 Stephen R. L. Clark, 'Deep Time: Does It Matter?' in George F. R. Ellis (ed.), *The Far-Future Universe: Eschatology from a Cosmic Perspective* (Philadelphia and London: Templeton Foundation Press, 2002), 178.

the pinnacle of his academic career, which was of course giving the 2010 Laing Lecture![3] Finally, I will be avoiding some of the more speculative ideas of contemporary physics, such as multiple dimensions or multiple parallel universes contained within a multiverse. Casting the net too wide would necessitate either multiple lectures or a multilecture that carried on till midnight, the very thought of which would be a suitable theme for a horror movie.

2. Relating theology and science

How to relate Christian faith to scientific discoveries is a vital issue, as most people today see science as the source of rational objective truth. So Christian theology in general and the doctrine of creation in particular must relate to it or else be seen as myth or a fairy tale. This issue is important especially for teenagers from Christian homes learning science at school, who are likely to ask how what they are taught as fact at school ties in with what they have learned of faith at home and at church. There are two dangers to avoid in handling this issue.[4]

The first is to treat the Bible as a science text book. The biblical authors were not scientists and the questions that they were answering were not those asked by scientists today. Galileo, in his *Letter to the Grand Duchess Christina* famously cited Cardinal Baronius for the statement that the Bible was written 'to teach us how one goes to heaven, not how heaven goes.'[5] So, for example, Scripture uses descriptive language in speaking about God's creation – e.g. speaking of the Sun 'rising'. From a scientific perspective this statement is not true, but it describes accurately how things appear from our perspective. Scientists today still refer to sunrise and sunset, even though they believe that it is the Earth that rotates round the Sun. Commenting on Genesis 1:6, Calvin remarked that 'nothing is here treated of but the visible form of the world. He who would learn astronomy, and other recondite arts, let him go elsewhere.'[6] There is no problem, so long as such biblical statements are not presented as if they were scientific theories. If the Bible is offered as a rival scientific text it is bound to lose as it was written in a pre-scientific age with other than scientific interests in mind. Augustine warned about the danger of Christians pontificating from ignorance on scientific matters:

Usually, even a non-Christian knows something about the earth, the heav-

3 A. E. McGrath, *A Fine-Tuned Universe: The Quest for God in Science and Theology* (Louisville, KT: Westminster John Knox, 2009). For a brief summary of the issue, see Rodney D. Holder, 'Is the Universe Designed?' (Faraday Paper 10, 2007), drawing on his *God, the Multiverse and Everything: Modern Cosmology and the Argument from Design* (Aldershot: Ashgate, 2004).

4 For a recent account, avoiding both dangers, see Alvin Plantinga, *Where the Conflict Really Lies: Science, Religion, and Naturalism* (New York: OUP, 2011).

5 Stillman Drake, *Discoveries and Opinions of Galileo* (New York: Doubleday Anchor Books, 1957), 186.

6 J. Calvin, *Commentaries on the First Book of Moses called Genesis*, 2 vols (Grand Rapids: Eerdmans, 1948 reprint), 1:79.

> ens, and the other elements of this world, about the motion and orbit of the stars and even their size and relative positions, about the predictable eclipses of the sun and moon, the cycles of the years and the seasons, about the kinds of animals, shrubs, stones, and so forth, and this knowledge he holds to as being certain from reason and experience. Now, it is a disgraceful and dangerous thing for an infidel to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics; and we should take all means to prevent such an embarrassing situation, in which people show up vast ignorance in a Christian and laugh it to scorn.[7]

Some have reacted against this danger by going too far in the other direction, the second danger of not allowing the Bible to make any scientific claims at all.[8] It is true that the Bible was not intended to be a science text book, but that does not mean that it teaches nothing of relevance to modern science.[9] In particular, it does teach about how both the universe and life came into existence, albeit in a non-scientific way. For example, it teaches that the universe is not eternal but was brought into being by God 'in the beginning'. Science and theology have different interests, but they are describing the same reality and this means that their claims will at times overlap. So while Christian theology has no stake in most of the claims of modern science, the two disciplines are not completely unrelated and theology does have an interest in some scientific claims. The one single reality is being explored from two different perspectives, with two different sets of questions, albeit with some common interests. The Bible and Christian faith refer to the meaning and purpose of life, which fall outside the scope of science, even if individual scientists may choose to express opinions about it.

So how should theology relate to science? There is no question of either discipline supplanting the other, though some fundamentalist atheists talk as if this were the case, as do some fundamentalist Christians. Nor should the relationship between the two disciplines be too close. The relationship should remain at the level of a tentative alliance, because scientific ideas are constantly changing.[10] As has been said, 'Religion must learn to live with whatever cosmology, whatever theory, science provides: but on no account must it ever marry any of

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7 *St. Augustine, the Literal Meaning of Genesis*. vol. 1, Ancient Christian Writers vol. 41 (New York: Paulist Press, 1982), 42-43 (1:19:39).

8 Stephen Jay Gould, *Rocks of Ages* (London: Jonathan Cape, 2001) argues that science and religion are 'Non-Overlapping Magisteria'. He restricts religion to the realm of 'human purposes, meanings, and values' (4), to 'questions of ultimate meaning and moral value' (6).

9 Some wrongly claim that Genesis 1 says nothing about the past, only about today. Others have argued that creation and judgement both refer not to distant events but to our present experience of eternal truth as 'the epiphany of the eternal present' (Clark, 'Deep Time,' 180).

10 Jürgen Moltmann, *God in Creation* (London: SCM, 1985), 192-93. C. S. Lewis noted, 'the endless fluctuations of scientific theory which seem today so much friendlier to us than in the last [19th] century may turn against us tomorrow' ('Dogma and the Universe' in *God in the Dock* [Grand Rapids: Eerdmans, 1970], 44).

them.'[11] In this instance cohabitation is preferable to marriage! Modern science is not infallible, but it is the best that we have at this stage and theology needs to coexist with it, without necessarily accepting every single claim made by scientists. Science advances by progressive approximations to the truth and does not offer us final, absolute truth. As we consider modern cosmology this evening, we need not assume that every claim made is totally correct. The Soviet physicist Lev Landau once remarked that cosmologists are 'often in error but never in doubt'! The Astronomer Royal, Martin Rees, complains that popularising cosmologists who fail to distinguish between established results and speculation undermine the credibility of the discipline and will cause journalists to 'become as sceptical in assessing scientific claims as they already are in assessing politicians'.[12] He himself takes a more humble approach, arguing that the universe may in fact be beyond our comprehension. 'Some aspects of reality – a unified theory of physics or a full understanding of consciousness – might elude us simply because they're beyond human brains, just as surely as Einstein's ideas would baffle a chimpanzee.'[13] A similar idea was earlier expressed by the geneticist J. B. S. Haldane: 'Now my own suspicion is that the Universe is not only queerer than we suppose, but queerer than we can suppose.'[14] Recognising this does not prevent us from striving to the full extent of our ability to understand as much as we can.

3. Modern cosmology

a. The age of the universe

Until recent times most people assumed that the world was just a few thousand years old.[15] Not all would have been as confident as archbishop James Ussher, who famously calculated that the creation of the universe took place on the evening of 22 October, 4004 BC.[16] It is easy to laugh at this now, but at the time it was a substantial scholarly achievement, coordinating biblical data with the

11 Donald MacLeod, 'Creation and Scientific Explanation,' *SJT* 36 (1983), 306, quoting P. Carvin.

12 Martin J. Rees, 'Life in Our Universe and Others: A Cosmological Perspective' in S. J. Dick (ed.), *Many Worlds: The New Universe, Extraterrestrial Life, and the Theological Implications* (Philadelphia & London: Templeton Foundation Press, 2000), 71-72. He argues similarly in *Our Final Century* (London: Heinemann, 2003), 149.

13 http://www.dailymail.co.uk/sciencetech/article-1286257/Limitations-human-brain-mean-understand-secrets-universe.html.

14 *Possible Worlds and Other Essays* (London: Chatto & Windus, 1927), 227.

15 For exceptions in ancient times, see Robert S. White, 'The Age of the Earth' (Faraday Paper 8, 2007).

16 John Jarick, 'The Fall of the House (of Cards) of Ussher: Why the World as We Know It Did Not End at Sunset on 22 October 1997' in Christopher Rowland and John Barton (eds.), *Apocalyptic in History and Tradition* (Sheffield: Sheffield Academic Press, 2002), 241. Also, James Barr, 'Why the World Was Created in 4004 B.C.: Archbishop Ussher and Biblical Chronology,' *Bulletin of the John Rylands Library* 67 (1985), 575-608. Ussher's was one of a number of similar estimates made at that time.

best information then available. Since his time the picture has changed considerably, especially thanks to geology in the nineteenth century[17] and cosmology in the twentieth.

Modern cosmology estimates that the universe is some 13.7 billion years old. The Earth is relatively young – less than 4.6 billion years old.[18] The simplest forms of life are some 3.8 billion years old, the genus *homo* is up to 2.5 million years old and anatomically modern humans (*Homo sapiens sapiens*) are a mere 190,000 years old. About 10,000 years ago civilization began with the development of agriculture.[19] If we think of the history of the universe so far as being a single year, the Big Bang took place on January 1st, the Earth was formed at the beginning of September, the simplest forms of life began around September 21st, the genus *Homo* began sometime after 10.30 pm on the final day, 'anatomically modern humans' began after 11.52 pm and civilization not until the final 23 seconds. We have been listening out for radio waves from the rest of the universe for just the last tenth of a second of the year.

The age of the universe is miniscule compared with what may lie ahead. According to Brian Cox, TV's pin-up cosmologist, it will be 10,000 trillion, trillion, trillion, trillion, trillion, trillion, trillion, trillion years (i.e. 10^{100} years) before the second law of thermodynamics triumphs and the universe finally runs down.[20]

b. The size of the universe

The latest estimate is that there are more than a hundred billion galaxies in the universe and that the average galaxy contains more than a hundred billion stars. The lowest estimate for the total number of stars in the *visible* universe is a 'mere' 10 billion trillion (10^{22}) and it could be much more.[21] As for distances, the furthest objects whose light we can receive are some 46 billion light years away.[22] This is the distance covered in 46 billion years by light travelling at almost six trillion miles per year, i.e. some 270 billion trillion (2.7×10^{23}) miles. That is just the *observable* universe. The entire universe may prove to be considerably larger. Even if these figures should turn out not to be entirely accurate, the universe is

17 For changes before then, see Ezio Vaccari, 'European Views on Terrestrial Chronology from Descartes to the Mid-eighteenth Century' in C. L. E. Lewis & S. J. Knell (eds.), *The Age of the Earth: from 4004BC to AD2002* (London: Geological Society, 2001), 25-37.

18 http://www.astro.ucla.edu/~wright/age.html.

19 http://www.newscientist.com/article/dn17453-timeline-the-evolution-of-life.html; http://www.newscientist.com/article/dn9989-timeline-human-evolution.html.

20 TV series Wonders of the Universe, 1st programme.

21 http://www.universetoday.com/24328/how-many-stars.

22 By contrast, in 1903 it was estimated by A. R. Wallace that the diameter of the universe was a mere 3,600 light years, with the Sun near the centre (S. J. Dick, 'Cosmotheology: Theological Implications of the New Universe' in S. J. Dick (ed.), *Many Worlds: The New Universe, Extraterrestrial Life, and the Theological Implications* [Philadelphia & London: Templeton Foundation Press, 2000], 191-92).

clearly rather a large place. Furthermore, this universe is still in the process of expansion. Scientists once speculated that the universe might end by collapsing into a 'Big Crunch'. Research now indicates that this will not happen but that the universe is expanding at an ever faster rate. The 2011 Nobel Prize in Physics was awarded to three scientists for showing this.[23]

How large was the universe believed to be in the New Testament times? Larger than is often supposed. The second-century Greek astronomer Claudius Ptolemy, building upon earlier achievements, estimated the moon to be just over a quarter of a million miles distant, which is remarkably accurate.[24] He was less accurate in estimating the distance of the Sun to be a little under 5 million miles, while in reality it is over 93. According to Eusebius of Caesarea, the third century BC Greek scholar Eratosthenes came within 2% of the correct figure.[25] Ptolemy calculated that the distance of the stars was 20,000 times the radius of the Earth – i.e. some 80 million miles away.[26] So for the solar system, ancient science calculated distances which were at best remarkably accurate, at worst not ridiculously wrong. When it comes to the distance of the stars, however, no one until relatively recently had the faintest idea how far away they were.

c. Extraterrestrial intelligence?

If the universe is this vast, does it contain other intelligent life? Extraterrestrial intelligence has, of course, long been the stuff of science fiction. Earlier accounts often involved life on other planets (especially Mars) or even on the moon. H.G. Wells was a pioneer with his *War of the Worlds* (1898) and *The First Men in the Moon* (1901). C.S. Lewis wrote about life on Mars in his *Out of the Silent Planet* (1938) and on *Venus in his Voyage to Venus (Perelandra)* (1943).[27] When I was at school I remember greatly enjoying the radio series *Journey into Space: The Red Planet* (1954-55), in which a space fleet sent to Mars discovers a planet populated by people abducted from Earth and serving the Martian(s),[28] and reading about the adventures of Dan Dare in *The Eagle* comic. I also avidly devoured science fiction novels, by writers such as John Wyndham, who wrote a number

23 http://www.guardian.co.uk/science/2011/oct/04/nobel-prize-physics-universe-accelerating. Cf. Rees, 'Life in Our Universe and Others,' 69-70.

24 Ptolemy's estimate was some 409,250 kilometres. Its maximum distance is 405,700 kilometres.

25 *Praeparatio Evangelica* 15:53.

26 Bernard R. Goldstein, ed., T*he Arabic Version of Ptolemy's Planetary Hypotheses*, Transactions of the American Philosophical Society, 57: 4 (1967), 9–12. There is a medieval text which states that the stars are 117 million miles away (C. S. Lewis, *The Problem of Pain* [London: Geoffrey Bless, 1940], 3-4).

27 On ETI in sci-fi, see Steven J. Dick, *The Biological Universe: The Twentieth-Century Extraterrestrial Life Debate and the Limits of Science* (Cambridge: CUP, 1996), 222-66; idem, *Life on Other Worlds: The 20th-Century Extraterrestrial Life Debate* (Cambridge: CUP, 1998), 106-36.

28 Andrew Faulds, who played the hero, Jet Morgan, went on to serve as an MP for over 30 years.

of stories about life upon Mars, including 'Time to Rest', 'Dumb Martian' and 'Sleepers of Mars'. As well as books, ETI has also proved a popular theme for films and Wikipedia has a *List of Films Featuring Extraterrestrials*, which extends to nine pages. Part of my arduous research for this lecture has been watching twelve of these films.

Unfortunately for science fiction, the last fifty years of exploration and observation have conclusively excluded the possibility of ETI in our solar system. A hundred years ago it was possible for Percival Lowell and others to speculate about who built the 'canals' on Mars,[29] but now we know that they are not canals and that there is no intelligent life today on the Red Planet. There is speculation about whether *any* sort of life may exist or may have existed there, but it is pretty clear that there is no intelligent life there now and to date there is no evidence that there ever has been. More recent sci-fi has had to propose origins outside of our solar system for ET.

It is not only science fiction that talks of visitations by aliens. Many believe in the existence of unidentified flying objects (UFOs).[30] Serious interest in these dates back to the 1940s, and especially the alleged recovery of an alien vehicle and its occupants by the US military at Roswell, New Mexico, in 1947. Alongside belief in UFOs there are often vigorous conspiracy theories, maintaining that the government is covering up what it knows. In November 2011 the White House was forced to comment on the topic, in response to petitions on the freedom of information website 'We the People'. Phil Larson, a space policy expert, penned the response:

> The U.S. government has no evidence that any life exists outside our planet, or that an extraterrestrial presence has contacted or engaged any member of the human race. In addition, there is no credible information to suggest that any evidence is being hidden from the public's eye.[31]

To the committed conspiracy theorist the very fact that the White House denies any such contact is irrefutable proof that it has actually taken place! The purpose of this lecture is to relate Christian theology to serious science, not to UFOlogy.[32]

Others, most notoriously Erich Von Däniken,[33] have claimed that aliens visited us in the past, attributing to them phenomena as diverse as the construction of Stonehenge and the vision of Ezekiel. I will not devote any further space

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29 Dick, *Biological Universe*, 62-105; *Life on Other Worlds*, 26-43.

30 For more on UFOs, see Dick, *Biological Universe*, 267-320; *Life on Other Worlds,* 137-68; David Wilkinson, *Alone in the Universe? The X files, aliens and God* (Crowborough: Monarch, 1997) ch. 6; Paul Davies, *The Eerie Silence: Searching for Ourselves in the Universe* (London: Penguin, 2011), 19-22.

31 https://wwws.whitehouse.gov/petitions#!/response/searching-et-no-evidence-yet.

32 In a recent online interview it is stated that serious scientists engaged in the 'Search for Extra-Terrestrial Intelligence … detest … hate and abominate UFOs and UFOlogy': http://www.spacedaily.com/reports/Civilizations_beyond_Earth_Extraterrestrial_Life_and_Society_999.html (from Sydney, Australia, 22 November 2011).

33 Starting with *The Chariots of the Gods?* (1968).

to this as such claims have already been amply refuted.[34]

The question of extra-terrestrial life has of late received considerable attention from scientists, and falls into what is now known as astrobiology[35] or, more precisely, exobiology. The quest is primarily being pursued in three ways.

(1) The term 'Search for Extra-Terrestrial Intelligence' (SETI) refers to the use of radio telescopes to listen for any communication from outer space. The systematic search began just over fifty years ago, following the stimulus of a 1959 article entitled 'Searching for Interstellar Communications'.[36] NASA joined in the search from 1970 to 1993, at which point the baton was passed on to the privately funded SETI Institute.[37] To date no communication from aliens has been received. ET may have phoned home from here, but to date he has not phoned us from his own home. One problem, as has been noted, is that the search has been conducted on the assumption that ETI will use 1980s human technology, a rash assumption to say the least.

(2) The search for 'exoplanets' – planets outside our solar system. Initially astronomers looked for evidence of stars 'wobbling' as a result of the gravitational force of rotating planets. This search began to yield results in the mid 1990s, but the problem is that it is only gas giants like Jupiter (over 300 times the mass of Earth) that cause their suns to wobble sufficiently for us to be able to detect them. Smaller Earth-like planets have too little effect.[38] More recently, in 2006 a European satellite was launched with a telescope called CoRoT – 'Convection, Rotation and Planetary Transits'.[39] This aims to detect planets by observing the drop in brightness of a star as the planet passes in front of it and has found planets of similar size to Earth.[40]

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34 For more on this theme, see Wilkinson, *Alone in the Universe?*, ch. 7.

35 Baruch S. Blumberg, 'Astrobiology, Space and the Future Age of Discovery', *Philosophical Transactions of the Royal Society: A* 369 (1936) (13:2:2011), 508-15; http://astrobiology.arc.nasa.gov/roadmap. Astrobiology addresses three questions, the second of which is relevant to us: 'Does life exist elsewhere in the universe?' The European Space Agency has a Cosmic Vision plan which seeks to answer the question 'Does life arise on suitable planets almost automatically? Or is the spontaneous formation of life something that occurs rarely on a galactic or cosmological scale?' (Malcolm Fridlund, 'Extra-terrestrial Life in the European Space Agency's Cosmic Vision Plan and Beyond', *Philosophical Transactions of the Royal Society: A* 369 [1936] [13:2:2011], 583).

36 For the history of the search, see Frank Drake, 'The Search for Extra-Terrestrial Intelligence', *Philosophical Transactions of the Royal Society: A* 369 (1936) (13:2:2011), 633-43.

37 http://www.seti.org/; http://planetary.org/explore/topics/seti/seti_history_00.html; Wilkinson, *Alone in the Universe?*, ch. 4.

38 Wilkinson, *Alone in the Universe?*, 39-40; Rees, 'Life in Our Universe and Others', 64-65. A radio telescope in Australia recently discovered a planet composed of diamond, which is unfortunately 4,000 light years distant (*Times* 26 August 2011, 27).

39 http://smsc.cnes.fr/COROT.

40 Fridlund, 'Extra-terrestrial Life,' 583-84, 587-88.

The Kepler Mission is searching for exoplanets on a large scale.[41] On 6 March 2009 the Kepler spacecraft was launched. This contains a large photometric telescope that measures variations in the brightness of stars, looking for those which are caused by the transit of a planet in front of the star. Over 150,000 stars (between 600 and 3000 light years distant) are being continuously monitored (without any break) for between three and a half and six years. The instruments used need to be very sensitive as the drop in brightness is extremely small. 'The size of the effect for an Earth [passing in front of a star] is similar to the dimming one might see if a flea were to crawl across a car's headlight viewed from several miles away.'[42] The planet's existence is confirmed after three transits are observed, the gap between transits being the same.

Thanks to these and other searches many exoplanets have been discovered. Prior to the Kepler Mission there were about 500 known exoplanets.[43] That number is increasing all the time. Scientists distinguish between 'confirmed' exoplanets, based on multiple observation, and 'candidate' exoplanets for the proof of whose existance further confirmation is required.[44] In July 2012 NASA claimed 729 confirmed and 2,321 candidate exoplanets, yielding a total of over 3,000, while others give higher figures.[45] New planets are being discovered on an almost daily basis. Significant numbers of these are roughly Earth-sized and the indications are that a good number of these lie in the habitable zone of their stars.[46]

The term 'habitable zone' alludes to what is called the 'Goldilocks Principle', based on the story of Goldilocks and the Three Bears. Goldilocks samples their three bowls of porridge, finding one too hot, one too cold but the third just right. Likewise, some planets are too hot to sustain life, others too cold, while some are just right. In December 2011 the Kepler mission confirmed the discovery of the first possible planet in the habitable zone of a Sun-like star, Kepler 22b with a diameter of 2.4 times that of Earth.[47]

The European Southern Observatory has been using a 'High Accuracy Radial velocity Planet Searcher' (HARPS) to search for planets in the habitable zones of 'red dwarf' stars, which account for some 80% of the stars in our galaxy. In March 2012 they announced their estimate that about 40% of these have super-Earths (planets with mass between one and ten times of Earth's) in their habitable zones, which would mean tens of billions of such planets in our galaxy alone,

41 http://kepler.nasa.gov/Mission/QuickGuide.
42 http://kepler.nasa.gov/Mission/QuickGuide/faq.
43 http://www.jpl.nasa.gov/news/news.cfm?release=2012-026.
44 For an explanation of this, see http://planetquest.jpl.nasa.gov/page/whatsTheDifference.
45 http://planetquest.jpl.nasa.gov. For a higher figure of 777, see http://phl.upr.edu/projects/habitable-exoplanets-catalog.
46 http://phl.upr.edu/projects/habitable-exoplanets-catalog.
47 http://www.nasa.gov/home/hqnews/2011/dec/HQ_11-408_Kepler_Habitable_Planet.html; http://kepler.nasa.gov/news/index.cfm?FuseAction=ShowNews&NewsID=165.

about a hundred of these being no more than about 30 light years from us. On the other hand, the habitable zone round a red dwarf (which is cooler than our Sun) is quite close to the star, so such planets are likely to receive major doses of ultraviolet radiation and X-rays.[48]

Once suitable planets in habitable zones have been detected, other telescopes will examine them further to see whether they might be suitable for life. The aim will be to observe them directly and to perform a spectroscopic analysis of their atmospheres in search of biomarker gasses, those which indicate the possibility or probability of life. Given the vast distances involved and their proximity to bright stars, this is indeed a challenging task. The European Southern Observatory is building the 'European Extremely Large Telescope' in the Chilean Atacama Desert. This will be the largest such telescope in the world, collecting some fifteen times as much light as the present largest telescope.[49] In 2008 the Hubble Space Telescope took the first visible-light photo of an exoplanet, of a planet larger than Jupiter orbiting the star Fomalhaut, some 25 light years away.[50]

So NASA and others are fulfilling the first part of the ongoing mission of the starship Enterprise: 'to explore strange new worlds' (preferably not too dissimilar from earth) and 'to seek out new life forms and new civilizations'. What about the final part: 'to boldly go where no one has gone before'?[51] The problem is, of course, the huge distance of even the nearest stars. Nonetheless, in October 2011 there took place a '100 Year Starship Public Symposium' to discuss the goal of landing humans on a planet outside the Solar System within a century. NASA and the US Defence Advanced Research Project Agency were involved in the discussions.[52] Stephen Hawking is less optimistic, doubting whether we will be able to establish a self-sustaining colony within the Solar System within the next 100 years.[53]

(3) Is there life on Mars? In the 1970s NASA's Viking project photographed the planet and deposited two landers that analysed Martian soil.[54] This is now being followed by a Mars Science Laboratory mission. On 26 November 2011 NASA launched a car-sized 'rover', called Curiosity, which landed on Mars on 6 August 2012. Its prime task will be, by chemical analysis, to ascertain whether the Red Planet is or ever has been an environment capable of supporting life.[55] Other possible locations for life in our Solar System are moons of Jupiter (Europa) and

48 http://www.eso.org/public/news/eso1214. To be precise, closer to us than 10 parsecs = about 32.6 light years.

49 http://www.eso.org/public/teles-instr/e-elt.html.

50 http://www.nasa.gov/mission_pages/hubble/science/fomalhaut.html; http://astro.berkeley.edu/~kalas/disksite/library/kalas08a.pdf.

51 This is the version of the famous statement as it appears at the end of the 2009 film *Star Trek*.

52 http://www.100yss.org/index.html.

53 http://news.bbc.co.uk/today/hi/today/newsid_9672000/9672233.stm.

54 Dick, *Biological Universe*, 146-59; *Life on Other Worlds*, 58-64.

55 http://www.nasa.gov/mission_pages/msl/news/msl20111201.html.

Saturn (Enceladus and Titan).[56] If it could be shown that life has arisen elsewhere *independently* of Earth that would be hugely significant. If life had arisen on two different locations in the one solar system, the chances of life elsewhere in the universe would immediately become vastly greater.[57] In 1996 it was claimed that a meteorite from Mars contained evidence of Martian life, a Close Encounter of the Meteoric Kind. Closer scrutiny has cast doubt on this claim.[58]

The search for ETI mostly proceeds from the assumption that if intelligent life exists, it must be much like us – carbon based creatures on a planet similar to ours.[59] It should be pointed out in passing that this is a rather arrogant assumption – that no life can exist other than that which we might happen to be able to conceive. We have to be prepared for the possibility of some time having to say, 'It's life, Jim, but not as we know it.'[60] Or, as Hamlet might have put it, 'there are more things in the heavens, Horatio, than are dreamt of in your biology.' In 1921 W. D. Matthews warned that any ETI would probably be so alien to us that we might not be able even to recognise it, let alone communicate with it.[61]

How likely is it that ETI exists? There are two stages to answering this question. First, there needs to be a suitable planetary environment. A decade or so ago some cosmologists put forward the 'Rare Earth Hypothesis', arguing that there are very few planets in our galaxy that meet the necessary criteria for life to evolve.[62] Since then the search for exoplanets has proved very fruitful. A study published in January 2012 estimates, on the basis of results so far, that about 10% of stars in our galaxy may have planets in the habitable zone.[63] On the other

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56 Christopher P. McKay, 'The Search for Life in our Solar System and the Implications for Science and Society', *Philosophical Transactions of the Royal Society: A* 369 (1936) (13:2:2011), 596-600.

57 Rees, 'Life in Our Universe and Others', 66. See also Christopher P. McKay, 'Astrobiology: The Search for Life Beyond the Earth' in S. J. Dick (ed.), *Many Worlds: The New Universe, Extraterrestrial Life, and the Theological Implications* (Philadelphia & London: Templeton Foundation Press, 2000), 45-58; McKay, 'The Search for Life in our Solar System', 595.

58 Dick, *Life on Other Worlds*, 65-68. John Leslie, 'Intelligent Life in Our Universe' in S. J. Dick (ed.), *Many Worlds: The New Universe, Extraterrestrial Life, and the Theological Implications* (Philadelphia & London: Templeton Foundation Press, 2000), 119, points to the possibility that life may have been transported either way in a meteorite.

59 For the argument that this must be so, see S. Conway Morris, 'Predicting What Extraterrestrials will be Like: and Preparing for the Worst,' *Philosophical Transactions of the Royal Society: A* 369 (1936) (13:2:2011), 555-71.

60 From the song 'Star Trekkin',' a parody of the Star Trek TV series. It does not feature in the series, but is often misattributed to it. (http://en.wikipedia.org/wiki/Star_Trekkin')

61 Dick, *Biological Universe*, 390-91; *Life on Other Worlds*, 193.

62 Peter D. Ward and Donald Brownlee, *Rare Earth: Why Complex Life Is Uncommon in the Universe* (New York: Copernicus, 2000).

63 http://apnews.excite.com/article/20110219/D9LG45NO0.html, reported in *The Times* 12:1:12, 19. A year earlier Kepler scientists made the far more modest prediction of 'at least 500 million' planets in the habitable zone (http://apnews.excite.com/article/20110219/D9LG45NO0.html).

hand, the viability of life depends upon more than just size and temperature. Having a large moon also helps, and it is essential not to be too close to a supernova whose radiation could kill life. It used to be thought that Jupiter's gravitation protects Earth from impacts, but this is now disputed.[64] So not all planets in the habitable zone may actually be able to sustain life. But if some 10 billion stars in our galaxy have planets in the habitable zone, it is likely that a large number of these would be capable of sustaining life.

A suitable planet is only the first stage. Life then needs to evolve. Biologists are sharply divided on the likelihood of this.[65] In 1995 Christian de Duve published a book entitled, *Vital Dust: Life as a Cosmic Imperative*. Here he argues that 'life is an obligatory manifestation of matter, written into the fabric of the universe, and that there must be many sites of life, perhaps even intelligent life sometimes, in many parts of our galaxy and in others.' This view he has continued to defend.[66] Calvin considered that life is predestined to exist on any planet with a suitable environment – Melvin Calvin the organic chemist, that is.[67]

Others take a very different view. Jacques Monod considered that the antecedent likelihood of life appearing was 'virtually zero', while the chances of *intelligent* life appearing were 'almost nonexistent'. 'The universe was not pregnant with life nor the biosphere with man.' So how come we are here? We are like the gambler whose 'number came up in the Monte Carlo game'.[68]

When considering extraterrestrial life we must distinguish between different possibilities – the existence of life of a very simple form, such as bacteria; the existence of complex forms of life, such as plants and animals; and the existence of intelligent life, such as ourselves. Clearly, intelligent life is far less likely than the simplest forms of life. Nick Lane (no relation!) draws attention to the huge jump between bacteria and complex forms of life, in the sense of eukaryotic cells

64 Simon Conway Morris, 'Does Biology Have an Eschatology, and If So Does It Have Cosmological Implications?' in George F. R. Ellis (ed.), *The Far-Future Universe: Eschatology from a Cosmic Perspective* (Philadelphia and London: Templeton Foundation Press, 2002), 170.

65 For this division, see Dick, *Biological Universe*, 378-98; *Life on Other Worlds*, 186-99.

66 Christian de Duve, 'Life as a Cosmic Imperative?', *Philosophical Transactions of the Royal Society: A* 369 (1936) (13:2:2011), 620-23. For an assessment of this, see P. C. W. Davies, 'Searching for a Shadow Biosphere on Earth as a Test of the "Cosmic Imperative"', *Philosophical Transactions of the Royal Society: A* 369 (1936) (13:2:2011), 624-32, referring to the search for 'weird life' on Earth, life that has a different ancestry. (On this, see also Davies, *Eerie Silence*, ch. 3.) This would be 'alien life' on Earth itself, confirming de Duve's view. Earlier de Duve expressed his view in 'Lessons of Life' in S. J. Dick (ed.), *Many Worlds: The New Universe, Extraterrestrial Life, and the Theological Implications* (Philadelphia & London: Templeton Foundation Press, 2000), 5-8. Again, the issues are assessed by Paul C. W. Davies, 'Biological Determinism, Information Theory and the Origin of Life' in ibid., 17-25.

67 Dick, *Biological Universe*, 352-57, 380; *Life on Other Worlds*, 172-6, 187.

68 Jacques Monod, *Chance and Necessity* (London: Collins [Fontana], 1974), 136-37. Cf. Clark, 'Deep Time,' 185.

with a nucleus. In two billion years 'on just one occasion a complex cell arose from bacteria', the proof of this being the fact that all complex life on Earth is genetically related and goes back to a common ancestor, called LUCA: 'the last universal common ancestor'.[69] It follows that 'We are lucky to be here at all.'[70] Tim Maudlin, a philosopher of physics, points out that 'on earth, of all the billions of species that have evolved, only one has developed intelligence to the level of producing technology.' He concludes that, in evolutionary terms, intelligence is not all that useful so there is no empirical data to suggest that life on other planets would be very likely to evolve into technological intelligence.[71]

Nick Lane concludes, together with Bill Martin, that 'simple cells on other planets might thrive for aeons without complex life ever arising.'[72] A similar view is taken by Conway Morris: 'They [Aliens] are not there, and we are alone.'[73] Given such long odds, some scientists have speculated that life came to earth from outer space. Francis Crick (co-discoverer of DNA) and Leslie Orgel could not believe that DNA evolved naturally so proposed that aliens planted the seeds of life on earth billions of years ago, a theory known as 'directed panspermia'.[74] This raises the obvious question of how the aliens themselves managed to evolve.

The biological debate proceeds on the assumption that life emerged for purely natural reasons, without any further guiding hand from God. Some scientists who consider the evolution of intelligent life exceedingly unlikely have proposed multiple universes so as to shorten the odds of life occurring *somewhere*.[75] If it is true that the spontaneous evolution of intelligent life is so unlikely that multiple universes have to be postulated to explain it, is it less reasonable to consider God's hand as an explanation?[76] If that is the case, the statistical unlikelihood would not preclude further life in the universe.

In 1961 the astronomer Frank Drake propounded what is known as the 'Drake Equation' (or 'Green Bank Formula'), a formula for calculating the number of civilizations in *our galaxy* capable of communicating across the galaxy.[77] There are three types of variables in this formula. The first type relates to the number of

69 Nick Lane, *Life Ascending: The Ten Great Inventions of Evolution* (London: Profile Books, 2009), 89-90.

70 Ibid., 117.

71 'What Happened before the Big Bang? The New Philosophy of Cosmology' (http://www.theatlantic.com/technology/archive/2012/01/what-happened-before-the-big-bang-the-new-philosophy-of-cosmology/251608).

72 http://www.newscientist.com/article/dn18734-why-complex-life-probably-evolved-only-once.html.

73 Morris, 'Predicting What Extra-terrestrials will be Like', 566.

74 http://www.panspermia-theory.com/index.php?option=com_content&view=category&layout=blog&id=30&Itemid=94.

75 On this see McGrath, *A Fine-Tuned Universe*, 123-24. For the highly speculative nature of such theories, see Holder, 'Is the Universe Designed?'

76 As Alvin Plantinga suggests in *Where the Conflict Really Lies*, 212-18.

77 See Davies, *Eerie Silence*, 77-83; Frank Drake, *Intelligent Life in Space* (New York: Macmillan, 1962).

Earth-like planets in orbit round Sun-like stars. As we have seen, there are probably billions of such planets in the galaxy. The second type relates to the likelihood that on such planets life will emerge and this will lead to intelligent life that is able to communicate across the galaxy. Here, as we have seen, estimates of the likelihood range from virtual certainty (de Duve) to virtual impossibility (Monod). Until that difference is resolved the apparent precision of the formula is merely apparent. To be fair, Drake himself acknowledged that his Equation was simply a way of 'organizing our ignorance'.[78]

The final variable in the 'Drake Equation' is the average lifetime of such a civilization. It has been suggested that intelligent civilisations are short-lived because they self-destruct through war or some other way.[79] In 1983 Brandon Carter claimed that this was likely to be so, on the basis of a so-called 'Doomsday Argument', variations of which have been put forward by others, such as Richard Gott.[80] Grossly simplifying the argument, it is statistically highly improbable that we happen to be among the very earliest people to live, so the chances are that the human race will not have a lengthy future before it. Intuitively such arguments feel like a sleight of hand but, as Martin Rees observes, 'pinpointing an explicit flaw is not a trivial exercise'.[81] He himself considers, for a variety of reasons, that humanity has only a 50-50 chance of surviving the twenty-first century.[82] If the lifetime of intelligent civilisations is indeed short, the chances of two different civilisations being within communicating range at the same time would be very small.

In 1950 Enrico Fermi proposed what is known as the 'Fermi paradox': if aliens exist in our galaxy, 'where are they?'[83] From our current state of development it should 'only' take some 5 to 50 million years for us to colonise the galaxy.[84] In cosmological time, if the universe has existed for a year, it should take something between three and thirty hours to colonise the galaxy. Given that our Sun is a relatively young star, if life is abundant someone should have arrived by now – or at the very least have phoned us. Stephen Webb offers fifty different solutions to the paradox, starting with the suggestion that 'They are here and they call themselves Hungarians'![85] He offers three classes of solutions. The first is that they *are* here but we are failing to notice the evidence or else they are deliberately

78 According to R. Gowdy 'SETI: Search for ExtraTerrestrial Intelligence' (http://www.courses.vcu.edu/PHY-rhg/astron/html/mod/019/s5.html).

79 Davies, *Eerie Silence*, 90-92, 206-207, suggests this possibility.

80 Rees, *Our Final Century*, 135-40; Leslie, 'Intelligent Life in Our Universe', 120-22;

81 Rees, *Our Final Century*, 140.

82 Rees, *Our Final Century*.

83 See http://en.wikipedia.org/wiki/Fermi_paradox; Davies, *Eerie Silence*, 116-21; Wilkinson, *Alone in the Universe?*, ch. 5; Dick, *Biological Universe*, 443-54; *Life on Other Worlds*, 218-21.

84 For some other estimates of the necessary time, see Wilkinson, *Alone in the Universe?*, 77-78.

85 Stephen Webb, *If the Universe is Teeming with Aliens … Where is Everybody?* (New York: Copernicus, 2002).

concealing themselves. Some maintain that aliens have been visiting us, but the government is covering it up. That makes for a brilliant cult TV series (*X Files*) but is not, in my view, to be taken seriously in real life. The second class of solutions postulate that aliens exist but have so far failed to communicate with us. Maybe they are happy to stay at home and mind their own business. We cannot assume that ETI will share our curiosity. Or perhaps everyone is listening for a message but no one is sending them. More plausibly, it may be that they are been signalling us but we have so far failed to detect it. Again, if it is true that intelligent species are short lived, then maybe they did call us – 100,000 years ago. Fermi's argument does not allow for civilisations that might have existed for millions of years before becoming extinct. The third class of solutions comprise proposed reasons why aliens do not exist. Webb himself is of this view.

The Fermi paradox concerns life in *our galaxy*. The evidence certainly suggests that intelligent life is not *currently* abundant there.[86] It tells us rather less about life in the other 100-plus billion galaxies – except perhaps that life is unlikely to be *abundant* there either. But even if intelligent life has emerged in just one in every million galaxies, that would still yield over 100,000 instances. So how likely is it that ETI exists? In my judgement, it is most unlikely to be abundant, but I would by no means exclude the prospect of ETI in our own galaxy, let alone in some of the other 100-plus billion galaxies.[87] But while it may well exist, given the vast distances involved it could be that we will never find *proof* of its existence, let alone communicate with it, let alone meet it face to face. And even if there is ETI close enough for us to access, would it be sufficiently like us for communication to be possible?[88] Any message might not be as clear as 'Greetings, Earthlings' or 'Take me to your leader!'

What would be the practical implications of the discovery of extraterrestrial life? It may turn out to be far less dramatic than is often supposed. 'The first verified exobiological specimen or "Martian microbe" may be a fossil and the first authenticated SETI detection may be as devoid of information as a dial tone on a telephone.'[89] Even a message that we could read from outer space could prove to be something of an anti-climax. If it came from, for example, a relatively close hundred light years away, the ensuing conversation would be somewhat limited by the fact that there would be a two-hundred year interval between sending any message and receiving the reply!

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86 When considering communication from a planet 100,000 light years away, 'currently' means 100,000 years ago.

87 Davies, *Eerie Silence*, 83-86, argues that intelligent life is either abundant (de Duve) or unique to Earth and that a middle position is very unlikely.

88 A point made by G. G. Simpson (Dick, *Biological Universe*, 396; *Life on Other Worlds*, 197).

89 Albert A. Harrison, 'Fear, Pandemonium, Equanimity and Delight: Human Responses to Extra-terrestrial Life', *Philosophical Transactions of the Royal Society: A* 369 (1936) (13:2:2011), 657. On the question of the public impact of the discovery of extraterrestrial life, see ibid., 656-68 and Kathryn Denning, 'Is Life What We Make of It?', *Philosophical Transactions of the Royal Society: A* 369 (1936) (13:2:2011), 669-78.

Abstract

This first part begins by exploring the relationship between theology and science. Neither theology nor science should seek to supplant the other. They have different roles and their relationship should be that of a tentative alliance. The results of modern cosmology are then reviewed. The universe is some 13.7 billion years old and contains over a hundred billion galaxies, the average galaxy containing over a hundred billion stars. The scientific quest for extraterrestrial intelligence (ETI) is then reviewed. It now appears that billions of stars in our galaxy alone may have planets that could sustain life. Biologists are sharply divided as to whether in such circumstances life is inevitable or all but impossible. Also, there is a big jump between life and complex life, and between complex life and intelligent life. The conclusion is that while we cannot exclude the possibility of the current existence of ETI in our galaxy, let alone the rest of the universe, it is unlikely that we will ever have meaningful contact with ETI. The second part will explore the implications of these results for Christian faith and theology.