

## Our place in the Universe

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It seems to me that in a good lecture course you should be getting not just a collection of facts, no matter how well ordered, but someone's view of the subject. To add a bit more of the personal touch, I've spent an evening writing this short piece on 'What is mankind's place in the universe?'

In truth I have no idea how many people wonder what our place in the universe is. In this age when people spend much of their lives with music playing in their ears or a TV flickering before their eyes, I doubt at times if much wondering goes on. Maybe it's just me who can't concentrate when the background's high. In times past, our place in the universe was dictated to us by religious orthodoxy, and wondering could be dangerous. Sweeping aside these pessimistic reflections, I'm sure a great many of us these days do wonder and I believe it helps to come up with a personal answer. Hopefully, the age when we had to believe in religious doctrine of any persuasion is passing. I've nothing against choosing to believe it but everything against being required to believe it. Tentative independent thought is no longer frightened by threats of being sent to hell as the inevitable consequence. Modern education is about independence of thought so for those who might be interested, what does the lecturer on astronomy and cosmology think about our place in the universe?

I guess the first thing to say is that independence of thought is a fine ideal but a bit of an illusion. I haven't solved the problem myself. The best that can be said is that I've looked at the evidence, weighed up the probabilities and come to a conclusion. Perhaps it's a mistake to come to a conclusion. So much has been said on the subject and there are so many counter views to any one position that coming to a conclusion is the easy way out. Be that as it may, I've done it.

Others have used the same words and I fully agree with the sentiment: I feel completely at home in the universe. I feel part of the universe and don't feel that in any way the universe is a house and garden created for mankind. I never cease to be astonished how nature has moulded the atoms of the periodic table into the world we see around us. The process starts in interstellar space where atoms are brought together into simple molecules. By the time planets, moons, comets and asteroids exist, a wide variety of ices and rocks have been formed. That variety is tiny compared with the variety of life on the Earth. Life has a level of complexity hugely greater than that found in simple molecules, or the rocks and minerals that make up solid planets, but nonetheless it is an inevitable product of the interaction of atoms. I strongly suspect that life forms wherever the chemical and physical conditions are within range, given a few hundred million years. (This view isn't merely wishful thinking but is based on current ideas of the origin of life). Life doesn't need to 'come from elsewhere'. Indeed, postulating that life comes from elsewhere doesn't really solve the problem of the origin of life. There hasn't been hugely more time for life to form elsewhere in the universe than there has been for it to form here: perhaps a factor of two longer, but that's about all. It's true that there are a great many places elsewhere, and that increases the chances of it happening somewhere, but if it formed elsewhere then it has to have got from there to here, which intrinsically is not very likely, and we're back to multiplying probabilities again.

Intelligent life is another step onwards from simple life. In fact it's a great many steps. I take it that birds, cats, dogs, monkeys and apes are fully conscious and intelligent life. Likewise for many other animals. Indeed, to survive for years as a quick-moving, self-propelled organism

in the complex, competitive natural world of today then memory, consciousness and some intelligence seem to me absolute pre-requisites. Yet many, many people seem reluctant to credit other animals with any of these abilities. I think the evidence is gradually burying the old view, but that is another story for another time.

Intelligence is an emergent property of complex life-forms, as is consciousness, which makes it difficult to say that some life is intelligent and other life is not. The artificial intelligence community would argue that you don't even need life to show intelligent behaviour. Although we can't get inside the mind of any other animal, all the evidence points to the fact that only mankind has the intelligence and achievement to understand the laws of nature and make complex artificial structures. In this sense alone, mankind is different from all other life we know of.

There's no doubt that we are special in achieving what no other animal has achieved but in truth we're not biologically much different from many other species. It helps that we stand tall on our hind legs, have dexterous fingers and thumbs, a comparatively big brain and can control the sounds we make to follow an intricate language devised by the brain. I think that similar advantages could easily come to some other animals, say cats – I like cats - given only a few million years of evolution, or perhaps a few tens of millions of years. OK, cats may not yet be recognised tool users in the animal kingdom, have tribal societies and a complex spoken language, or even show much capacity for what we call logical reasoning but the molecular ingredients for advanced intelligence are probably almost all there. You can choose your own species that might reasonably acquire human-like intelligence in a few tens of millions of years and you may well be right. In fact you're almost certain to be right, for once humanity has discovered the tiny genetic differences that have given humans 'human intelligence' our descendants won't be able to resist the temptation to make other species similarly intelligent through genetic engineering. I'm not thinking millions of years here but a much shorter time span, though not in our lifetimes. It will be a funny world when many different animals can reason like ourselves and make sense of a good book about Wave Mechanics or General Relativity. We shouldn't forget that it's not just humans who are the product of 4 billion years of evolution but every living thing around us. Our descendants in a few millennia may look back and think it very weird that at one time humans were the only species alive who could 'think', in the sense of philosophise, discover complex mathematics, invent stories about imaginary characters, devise musical instruments and play their own music on them, and make a pretty good attempt at understanding the universe. What a responsibility for one species. In my view our intelligence is a natural evolutionary step, not something given from outside.

If intelligent life is inevitable in the Universe, then why don't we see more of it? I discuss this in our course PX2512 (cosmology section, chapter 5) and in a separate short essay on "*Why do we seem to be alone?*". In a nutshell, the universe is a vast place generally unfit for life and it is relatively young in terms of the time needed to generate intelligent life. There are reasons to believe that here on Earth we have experienced fast-track development from primitive life to the kind of intelligence mankind has, due to a number of fortunate circumstances. Other such life is therefore not going to be thick amongst the stars. It is easy to write stories about galactic space travel by fully formed beings such as ourselves but incredibly difficult to see how such travel over the enormity and inhospitability of space could be achieved within the laws of physics, at least as we have found them. To close one loophole, we have found that the laws of physics seem to be the same over the whole observable universe. For several reasons, I'm not surprised that we've had no encounters with aliens. It will take more than a few unexplained events to convince me that there have been any. The passing years of apparently endless blank

hissing recorded in the SETI receivers is some evidence that intelligent life is thin on the ground of extra-solar planets.

What, then, of mankind's place in the universe? Are we the only advanced life looking out on the stars? Almost certainly not. Are we the only guardians of advanced life in this part of the galaxy? Probably - and so we should be particularly careful not to shoot ourselves in the foot, or the head. How far away do I think the nearest advanced life is? I'm tossing dice here but I'd be surprised if it were closer than 1000 light years. What's the value of life? What you do with your life. And the meaning of life? What gives life meaning is the knowledge that we are participating in the greatest adventure of them all, the evolution of the universe. Aren't human beings given eternal life after death? No. I did say that this was a personal view of our place in the universe. We're not going to get another shot at life so that's a pretty good incentive to make the best of it we can. Of course, the effects of our lives live on after death and what we have achieved influences the future but our personal lives end with death, as with all lives in nature. Mankind, though, lives on, just a little bit differently because we have lived. What gives life meaning is what we do with our lives.

It's worth reflecting that millions of different combinations of genes were jostling to get the lives that you and I have. The odds on any one of us being born were millions to one against. It was luck, along with a contribution from survival of the fittest sperm, that you and I are alive as individuals. We won the biggest lottery we'll ever take part in. A billion euros couldn't buy for the competing gene combinations the prize we got: - life. If you factor in the chances of the events happening that led up to that moment of union, the chance of any one of us in particular being alive is unbelievably small. But here we are, nonetheless. It's our world now, not some might-have-been's. We should make the most of it. And you want meaning, too? I believe we even got that as well, not thanks to genes but to the cumulative knowledge of the whole of mankind.

In the twenty-first century mankind has an amazingly privileged view of nature and the universe at large. The more I learn of it, the more stunning it seems to me. I'll certainly regret the personal loss of this view in due course just before I'm carried feet first into the mortuary but I'm pretty sure that succeeding generations won't let the view fade. I believe that mankind has over the past century begun to see for the very first time the true extent of the universe we are in, from its sub-atomic particles to the structure of matter in the universe at large. We have reached the stage of cracking open our eggshell, struggling out, standing up and looking around. The human adventure has begun. It gives my life meaning to be part of it. I hope it gives yours, too.

**JSR**