

Expectations For A Final Theory?

October 25 2005

Martin Rees is Professor of Cosmology and Astrophysics at the University of Cambridge and Britain's Astronomer Royal. He is the author of numerous popular science books, including the bestselling *Just Six Numbers: The Deep Forces That Shape the Universe*.

Astrobiology Magazine caught up with Rees at the recent Division of Planetary Sciences conference in Cambridge, England, where he gave the opening address.

He was kind enough to grant us a follow-up to the interview with him that we published earlier this year. Here, he ponders the effect of interplanetary travel on human evolution, the origin of life on Earth, and the limits of human intelligence.

Astrobiology Magazine (AM): As president of the British Astrobiology Society, what do you think are the most important questions in astrobiology today?

Martin Rees (MR): I think it's important to pursue the planetary exploration programs that are now going on. Also, the question of the origin of life is important. I suspect we will get stronger guidance as to the likelihood of life elsewhere by understanding how life began here on Earth. So I'm strongly in favor of all attempts to solve that question.

Complexity is another question. If there is simple life, is the emergence of complex life likely or unlikely? Also, for post-human evolution; if humans ever head beyond the Earth and establish independent

communities, how quickly will those communities diverge so that they're no longer human? I think it wouldn't take very long, using modern genetics, and they would be likely to adapt themselves to the alien and hostile environment.

AM: Do you have a favorite theory for the origin of life on Earth?

MR: Being a physicist rather than a biologist, I don't feel qualified to comment on that. But maybe the computer simulations will prove more important than real laboratory experiments. With computers, you can simulate evolution faster than it can actually happen.

AM: Last time we spoke, we touched upon your concept of six numbers, and how these six numbers would lead to certain governing rules of the universe. So I wonder what you think about the theory of convergence in the natural world, and by extrapolation, the idea that these rules were born of 'intelligent design'.

MR: I don't think we can ever address that scientifically. I think the important question is whether we will ever have equations or formulae which pin down the values of the strength of the forces, the mass of the electron, the mass of the proton, et cetera. Another question is whether the fundamental laws of nature are at a deeper level, so that what we have traditionally thought of as the laws of nature are merely, in a sense, bylaws in our cosmic patch. Our cosmic patch would be larger than the Hubble volume, but nonetheless not the entirety of physical reality.

I recently hosted a conference entitled, 'Expectations for a Final Theory'. This conference was a gathering of experts in string theory and other aspects of fundamental physics. The aim was to discuss the question of whether the basic theory is going to determine uniquely the basic numbers of physics and cosmology, or whether this theory will allow an enormous number of Big Bangs governed by different fundamental laws.

This is one of the key questions confronting physics in the coming decades. We would like very much to know whether there could, in principle, be a Big Bang governed by different laws, perhaps less biophilic laws, or whether somehow the laws of Nature are unique.

I'm very glad that for us in Europe, intelligent design is not a serious issue. It dismays me that in a country like the United States, which in many respects is technically advanced, that this should be an issue in serious public policy. In Europe we're very glad indeed that we have a more educated public, which even though many people are religious, realizes that there's no conflict between religion and science. So I think it is puzzling and dismaying to us that there is fundamentalism in the United States and the Middle East, both of which are equally damaging.

AM: I've heard that you're working on a new book.

MR: I am; it's called 'What we still don't know'. It's going to be on the questions confronting 21st century science. The origin of life is one, the existence of aliens is another, the nature of fundamental theory is another, and complexity is a fourth. It also addresses the question of whether limits to science will come from us having reached bedrock, as it were, or if, on the other hand, it'll come from the limits of human brains, which will achieve their limit before we've actually probed the depths of the human condition.

AM: Do you think there is a limit to how far our intelligence can take us?

MR: I certainly think that humans are not the limit of evolutionary complexity. There may indeed be post-human entities, either organic or silicon-based, which can in some respects surpass what a human can do. I think it would be rather surprising if our mental capacities were matched to understanding all the keys levels of reality. The chimpanzees

certainly aren't, so why should ours be either? So there may be levels that will have to await some post-human emergence.

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