Reviews

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Unique, but not exceptional

NASA

Life on Earth
The specialness of our "Blue Marble" contrasts with our conviction that we are not privileged observers.

The Copernicus Complex: the Quest for Our Cosmic (In)significance
Caleb Scharf
2014 Allen Lane
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It is remarkable to think that less than a century ago, humans had no concept of the enormity of the cosmic world around us. A few hundred years before that, we also had no concept of the minuscule scale of the microscopic world within us. Over a comparatively short period of time, therefore, the world as we understand it has grown tremendously in scale, both small and large. But how has this broader understanding reshaped our search for meaning and our perception of humanity's role in the cosmos?

In *The Copernicus Complex: the Quest for Our Cosmic (In)significance*, author Caleb Scharf takes us on a thought-provoking journey through the history of human perspectives on the universe, as well as our modern understanding of our place in it. As its title implies, this book is an exploration of the Copernican principle, which states, roughly, that humans should not expect to find ourselves in a special place in the universe – we are not privileged observers. But in many ways, the book is also a rebellion against this idea. Having been knocked off our pedestal (where we'd been comfortable in our delusion of being the central beings in the universe), Scharf argues that we've taken the principle of mediocrity too far, to the extent that any hint that we're special is seen as a hubristic violation of the Copernican dictum. Yet there are ways in which our Earth and our existence really are special, and Scharf encourages us to "find a way to see past our own mediocrity".

These days, it is hard to imagine just what an enormous leap it was to declare that the Earth spins and moves through space, or what a shock it was to discover that the seemingly smooth Milky Way was made of stars. Much of Scharf's book is spent explaining the amazing depth of knowledge we now have about the formation of the solar system, planets, stars, galaxies and even the very matter we are made from. Throughout this story, though, Scharf places scientific discoveries alongside developments in philosophy and the human side of scientific endeavour. His descriptions even explore occasions when human imagination has beaten science, and he smoothly juxtaposes discussions of fictional worlds such as Narnia and *Star Wars* with hard-core astrophysics.

The result is a book that (if I may borrow a phrase from Douglas Adams) speaks to the "fundamental interconnectedness of all things". When describing how computers can calculate planetary trajectories around stars, for example, Scharf links the silicon in the computers to the reactions in the stars whose orbits the computers are calculating. Throughout the book, readers get a beautiful sense of the circularity of existence.

One of my favourite aspects of this book was the way Scharf explores all dimensions of our place in the universe. Most popular treatments of cosmology look up and say "Wow, look how big!" Scharf's book does this, too; however, it also looks down through the microscope and says "Wow, look how small!" The book opens with the story of Antonie van Leeuwenhoek, the 17th-century Dutch scientist who looked through a primitive microscope at a drop of water and saw creatures living inside it. At the same time telescopes were revealing the scope of the cosmos, microscopes were revealing the surprising world of life on tiny scales, and in substances such as water that we had always assumed were devoid of life. For me, it provokes a question: When we find life on distant planets, will it be more surprising than discovering life through a microscope? Or less?

Scharf doesn't stop after exploring the extremes of size. He also explores the extremes of time and even the extremes of life. Our significance, he argues, hinges not only on where we stand in the spectrum of life on this planet, but also on our place among the potential life that might exist somewhere else in the universe. But just how fertile is the universe exactly? Are we alone, or only one among many? And if other life exists, how different from us can it be before it ceases to be "like us"?

An answer to this question would do more than anything else to reveal how (in)significant we really are.

Scharf's book is an amazingly thorough, yet accessible, exposition of our knowledge of the formation of the universe and the evolution of everything in it. He doesn't shirk on the detail, but it never feels like you're being inundated with minutiae. Rather you feel as if you're being led by the hand through the forest, discovering new trees and lush vistas at every turn in a series of "wow" moments where each step on the journey nevertheless feels like a logical consequence of the one before.

As I neared the end of the book, I worried that I would be presented with some wishy-washy conclusions or rampant extrapolations. But my concerns were unfounded. Instead, the punchline of Scharf's exploration of our place in the cosmos reminded me of an anonymous quotation that has haunted me ever since I read it when I was a teenager: "You are absolutely unique, just like everybody else." Or, as Scharf puts it, we are "special but not significant, unique but not exceptional". With these phrases Scharf succinctly summarizes the intrinsic conflict between the fact that some of our circumstances are indeed special (in the sense that, had they been otherwise, life as we know could never have existed) and the fact that, according to the Copernican principle, we should expect to be generic.

Throughout the book, readers get a beautiful sense of the circularity of existence

Crucially, Scharf also tackles the important question of not only what we know, but what is knowable. If our species had developed under an atmosphere clogged with opaque gas, he notes, we would never have seen any stars, and it would have been much harder (though not impossible) for us to discover the nature of the universe around us. Indeed, if we had developed at another time and place in the evolution of the universe, we might have had still more fundamental limitations on our knowledge. In the distant future, the universe will have expanded so much that our descendants, if we have any, will no longer be able to see any other galaxies, and the afterglow from the Big Bang will have faded into nothingness. At that point, it will be pretty much impossible for an intelligent being to learn that it exists in an expanding universe that originated in a Big Bang. All of which makes one wonder: what questions are we neglecting to ask because our circumstances have never prompted them? This may be the ultimate limit to discovering our cosmic (in)significance.

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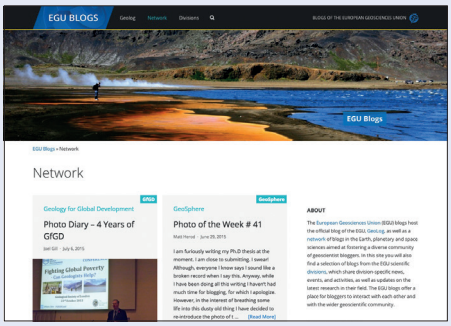
Web life: EGU Network Blogs



URL: http://blogs.egu.eu/network

So what is the site about?

The European Geosciences Union (EGU) is the professional body for, erm, European geoscientists, so naturally its blog network is home to a bunch of blogs about geoscience. The network began in 2012 with just three blogs: *GeoSphere* (general geosciences), *Green Tea and Velociraptors* (palaeontology) and *Geology for Global Development* (social and policy issues relating to geology and natural risks). Since then, it has added five others, including several with close links to physics.

Who is behind it?

Most of the bloggers in the EGU network are early-career researchers or PhD students. The author of *GeoSphere*, for example, is Matt Herod, a PhD candidate in isotope geochemistry at the University of Ottawa, Canada. One of the newer blogs on the network, *Polluting the Internet*, is written by an atmospheric scientist, Will Morgan, who is now a postdoc at the University of Manchester. Two other EGU blogs, *Geology Jenga* (interdisciplinary topics) and *Between a Rock and a Hard Place* (planetary and earth sciences), have multiple authors, all of whom are (or were until recently) PhD students in the geosciences. The exception to the rule is *An Atom's-Eye View of the Planet*, which focuses on how atomic-scale behaviour helps determine the Earth's physical and chemical properties. Its author is Simon Redfern, a professor of mineral physics at the University of Cambridge.

How often are these blogs updated?

Individually, not that often, which is why we've grouped them together rather than writing about each of them separately. Collectively, though, the EGU authors usually produce one or two posts a week, and the main network page pulls in the most recent posts from all eight blogs. Hence, if there are lots of areas of geoscience that tickle your fancy (or if you don't mind scrolling past the ones that don't), the network page is the one to add to your bookmarks. And remember, quantity isn't everything: the network's least-active blog, *Four Degrees*, has been updated less than once a month since its 2013 founding, but each post is a long, richly illustrated and copiously cited essay on an important topic in environmental science, energy or policy.

Can you give me a sample quote?

From a December 2014 post on *GeoSphere* about "a very near miss by the Italian justice system" regarding a group of geochemists from the University of Siena who carried out an environmental study of two military firing ranges: "One of the goals...was to determine if DU [depleted uranium munitions] had been used. On the face of it the task seems simple enough: analyse soil, plants and water for uranium and its isotopic ratio and other potential contaminants from the munitions range (of which are there many). However, the complicating factor in all of this is the fact that adjacent to the firing range is an abandoned mine site called Baccu Locci. So the real question then becomes, which is it? Mine waste or DU or other military contaminants? Their findings were that there was no contamination from DU in the region. These results met with extreme opposition from the local prosecutor who acted on the advice of a nuclear physicist from the University of Brescia who felt that geochemistry was not the proper way to investigate this problem and that the University of Siena scientists were hiding something. The geochemists were charged with two crimes in connection with their results."