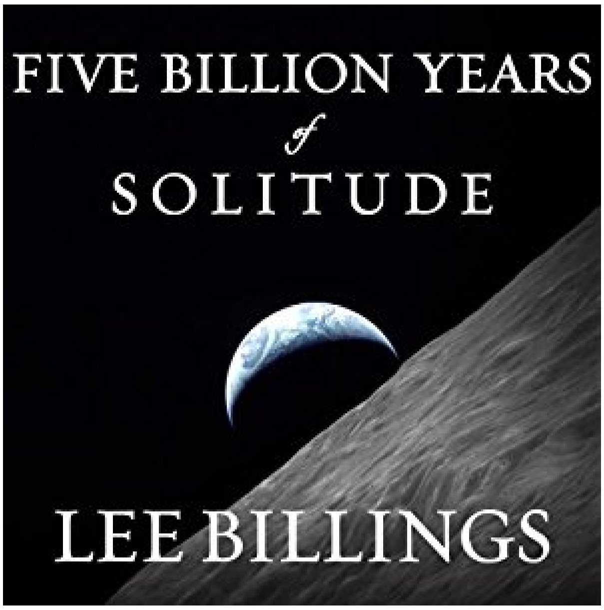
Five Billion Years Of Solitude: The Search For Life Among The Stars



Synopsis

Since its formation nearly five billion years ago, our planet has been the sole living world in a vast and silent universe. Now, Earth’s isolation is coming to an end. Over the past two decades, astronomers have discovered thousands of "exoplanets" orbiting other stars, including some that could be similar to our own world. Studying those distant planets for signs of life will be crucial to understanding life’s intricate mysteries right here on Earth. In a firsthand account of this unfolding revolution, Lee Billings draws on interviews with top researchers. He reveals how the search for other Earth-like planets is not only a scientific pursuit, but also a reflection of our culture’s timeless hopes, dreams, and fears. This is a compelling story of the pioneers seeking the meaning of life in the infinite depths of space.

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Customer Reviews

About a third of the way into his new book Five Billion Years of Solitude (Current, 2013), Lee Billings describes a time capsule that was sealed in July of 1963 near the Cabrillo Freeway in San Diego, though it has since been moved. Within it was a book that looked a century ahead, with contributions from politicians, astronauts, military figures and others about the world of the future. Copies of the book, titled 2063 A.D. are available, and within them one can find the musings of Nobel-laureate Harold Urey, who worried about our use of energy and noted that largely because of the need for electricity, US fossil fuel consumption had increased eightfold between 1900 and 1955.Was the trend sustainable over the long haul? Urey doubted it, and he was hardly alone, for the need for energy seems to impose sharp limits on what a society can do. Billings notes the work of Tom Murphy (UC San Diego), who works with a long-term 2.3 percent increase in energy usage per year, yielding a factor-of-ten increase every century. Things happen quickly over time -- by 2112 the world is consuming 120 terawatts, a number that rises to 1200 by 2212. Cover every bit of land with photovoltaic solar arrays and assume 20 percent efficiency and you can supply the world of 2287, which will need something on the order of 7,000 terawatts.You can see where this is going, and Billings is expert at connecting the march of numbers with real events and the people who can explain them. First, here is what happens once we've got all that land covered with solar-power arrays:"From there, increasing the efficiency of the photovoltaics to a miraculous 100 percent and covering the oceans as well as the continents would allow the 2.3 percent annual growth in energy use to persist for another 125 years, taking our steadily growing civilization into A.D. 2412 before it outpaced the total amount of sunlight falling upon the Earth. Another energy source, nuclear fusion, could potentially sustain an annual 2.3 percent growth rate for some centuries beyond this, at least until the waste heat from the vast amount of power being produced evaporated the oceans and turned Earth's crust to glowing slag. For a planet-bound civilization, the boiling point of water and the melting points of rock and metal place insurmountable limits upon the expansion of energy use."A grim prospect, but perhaps an informative one. Talking to planet hunter Gregory Laughlin (UC-Santa Cruz), Billings brings up the search for extraterrestrial intelligence, a bit out of Laughlin's wheelhouse considering that he spends most of his days teasing out the faint signatures of distant exoplanets, leaving SETI to those who specialize in it. Intriguingly, though, Laughlin tells him that if a SETI detection ever does come, it will likely be extragalactic.That, of course, is a mind-boggling thought, but it follows directly out of the energy constraints above.After all, Freeman Dyson came up with `Dyson spheres' in their various configurations as a way of solving the energy problem, at least for a time. A Dyson sphere or `shell' operates through a cloud of energy collectors completely surrounding the parent star, perhaps constructed by dismantling entire planets. A galaxy in which Dyson sphere building on a massive scale was occurring would be an interesting one indeed, gradually dimming in the optical while infrared from the enclosing shells became more and more apparent. There have been, in fact, searches made to look for signatures like these, though so far to little effect. James Annis (FermiLab) has studied 137 galaxies looking for candidates for this kind of engineering, and we are on the cusp of further studies looking for what Andrei Kardashev once described as Type III civilizations.A Dyson sphere, according to Billings, would capture about 400 billion petawatts of power, equalling the Sun's output, but even here that 2.3 percent growth in energy use catches up with us. A single Dyson sphere can no longer meet its builders' energy needs after a millennium at this rate, while within about 2500 years, we would be using the energy of an entire galaxy. Billings asks whether the fact that we don't see stars or galaxies dimming into the infrared may not be telling us something profound about our own expectations of exponential growth. That ever increasing upturn in our charts of the future may, over time, be the result of a temporary historical anomaly.Although I've focused on a specific question out of Five Billion Years of Solitude, it's a deliberate attempt to get at the jewel-like complexity of the larger work. Open to a page at random and you will find the kind of issues we kick around here on Centauri Dreams under discussion by some of the top minds in the field. Moreover, Billings has a twin purpose. He's out to illustrate the vistas being opened to us by our exoplanet explorations (and by astrophysics at large) while putting us in touch with many of the remarkable individuals who ply this trade, some of whom may be the first to identify a planet like our own around another star, and perhaps the first to find unmistakable signs of life in its atmosphere.Thus we meet Frank Drake, whose Project Ozma launched the SETI effort and whose Drake Equation has helped us understand the factors involved in searching for life. Billings' account of the small SETI conference convened at the Green Bank observatory in West Virginia in 1961 gives us the origins of the equation and its reception among an audience that included such stellar figures as Philip Morrison, Bernard Oliver, John Lilly, a young Carl Sagan and Harold Urey himself, whose Nobel had come from his discovery of deuterium. The Green Bank conference was all about whether SETI made sense, whether there was a serious possibility of detecting signals from an extraterrestrial civilization, and we've been parsing the problem ever since.Billings is expert at finding the telling detail, which in Drake's case may be his love of orchids (he maintains over 200 hanging in pots and strewn over tables in the greenhouses outside his Santa Cruz home). Even more striking, though, is the stump of a giant redwood that he used to explain growth over time to his children, counting tree rings that extended back 2000 years. What I love about Five Billion Years of Solitude is the way Billings can work with an object like this and its multi-millennial reach while then extracting the larger cosmological message. In the passage that follows, he moves with panache from Earth years to galactic time-frames:"Over the course of the tree's 2,000-year existence, the Milky Way had fallen nearly five trillion miles closer to its nearest neighboring spiral galaxy, Andromeda, yet the distance between the two galaxies remained so great that a collision would not occur until perhaps 3 billion years in the future. In 2,000 years, the Sun had scarcely budged in its 250-million-year orbit about the galactic center, and, considering its life span of billions of years, hadn't aged a day. Since their formation 4.6 billion years ago, our Sun and its planets have made perhaps eighteen galactic orbits-- our solar system is eighteen "galactic years" old. When it was seventeen, redwood trees did not yet exist on Earth. When it was sixteen, simple organisms were taking their first tentative excursions from the sea to colonize the land. In fact, fossil evidence testified that for about fifteen of its eighteen galactic years, our planet had played host to little more than unicellular microbes and multicellular bacterial colonies, and was utterly devoid of anything so complicated as grass, trees, or animals, let alone beings capable of solving differential equations, building rockets, painting landscapes, writing symphonies, or feeling love."This is fine stuff, and you will find passages to equal it throughout the book. Along the way, Billings speaks not only to Drake and Gregory Laughlin, but to Geoff Marcy, to Jim Kasting. He talks paleoclimatology with sedimentary geologist Mike Arthur (Pennsylvania State) and ponders space telescope breakthroughs with Matt Mountain, who directs the Space Telescope Science Institute. With Terrestrial Planet Finder in its confusing multiplicity of forms still on ice and starshade proposals for JWST still in the realm of theory rather than practice, Wesley Traub (JPL) explains the maddening frustrations of trying to design cutting-edge equipment. We may not see a true Terrestrial Planet Finder until the 2030s, but that doesn't mean the effort stops. We still have missions like TESS (Transiting Exoplanet Survey Satellite) in the works.Billings' conversations with Sara Seager (MIT) offer a wonderful segue from crisis into opportunity. Seager began as a cosmologist but swiftly switched to working on exoplanets with Dimitar Sasselov at Harvard. Moving increasingly toward questions of astrobiology and how to characterize habitable planets, she has been a tireless conference organizer and advocate for exoplanetary studies at a time of budgetary crisis. Her "The Next 40 Years of Exoplanets" conference at MIT's Media Lab in May of 2011 was in several respects a call to arms, and Billings was there to hear her exhortation: "So I convened all of you here, and that's why we're recording this, because we want to make an impact and we want to make that happen. We are on the verge of being those people, not individually but collectively, who will be remembered for starting the entire future of other Earth-like worlds. That's why we're here."I wasn't at the MIT conference but did follow most of it via online streaming, and I still recall Geoff Marcy's anger at the lack of progress that had been exemplified by the failure to follow through with Terrestrial Planet Finder, the interferometric version in particular. It was at this conference that Marcy called for an Alpha Centauri probe "even if it takes a few hundred years or a thousand years to get there." Such a mission would, he believed, energize and engage young people and jolt a moribund NASA into new life, and it would draw amply on international resources.But Seager's announcement that she was going to be devoting a substantial part of her time to the commercial spaceflight industry surprised many in the audience. Seager has a get-the-job-done approach that focuses on solutions no matter how far afield they may take her. As depicted in Billings' shrewd and graceful prose, she is a complex, driven scholar with a taste for outdoor adventure and a habit of endless invention. If NASA won't build a TPF, why not build Seager's ExoplanetSat, on the model of one tiny satellite with telescope and solar panels focusing in on a single star at a time. Fly them in their hundreds on the cheap. Get things done.You get to know these people through Billings' words, and he's adept at capturing their voice for extended quotations, letting them have the lead in describing their own work. In addition to the character portraits that inevitably emerge, the book is studded with the tools and concepts of exoplanetology. It is a poignant and inspiring look at an emerging discipline that mixes the human triumphs and foibles of key scientists (watch them fight over who discovered what) with a scholarly rigor -- someone just coming upon the exoplanet field will find everything from planet detection to spectroscopy, habitability, geology and climate laid out with precision. I am hard pressed to think of any book I have read so voraciously, and with such continuing admiration.

Five Billion Years of Solitude really means 4.6 billion years of solitude, because that's how old the Earth is, and it is the only planet in the universe that we know for sure has life. Our planet has spent 4.6 billion years in solitude.This book is about all aspects of humanity's search for life in the universe. It's a technical/scientific book told by Billings like a thriller. I love scientific subjects, and speculation about extraterrestrial life and exoplanets has always fascinated me.Billings tells about the gyrations of NASA when trying to squeeze as much of its various projects out of limited dollars, the fickle behavior of short-lived congress that supplies the funds, and the lack of vision of most of our presidents, save John F. Kennedy.He also tells the personal stories of the major players, the superstars of this burgeoning new scientific field, introducing a new key character almost every chapter. This gives a sometimes dry and scientific story a human touch that draws the reader in.However, the reader must be interested in science, astronomy, and astrobiology, at least, to be able to work through this book. For me, it was perfect.Five Billion Years of Solitude is a completely up to date (2013) study of the search for extraterrestrial life and all that this pertains, from mundane things like budgets for space telescopes, to human stories of the people involved and the competition of the planet finders, to the hard science of how one finds a planet around a star dozens of light years away where the star outshines the planet by a billion to one.Some of the reviewers here blasted the book for inaccuracies, sloppiness and unfocused writing. I suspect that those reviewers are hard scientists, and I am sure they will find plenty of "glossing over" of scientific detail. I don't believe this book was meant to be a textbook on finding life in the universe, or an article for a scientific journal. I sense the book was written exactly for people like me: Science-minded amateurs, folks fascinated with and in awe of astronomy, philosophical minds that grapple with the place of humanity in the universe. I learned a lot of details of subjects that I knew nothing about before and had only read about in the occasional article in Time magazine. For me, it was an excellent introduction and an inspiration to read more on the subject and buy other books.An eminently readable book I would recommend to anyone with an interest in science.