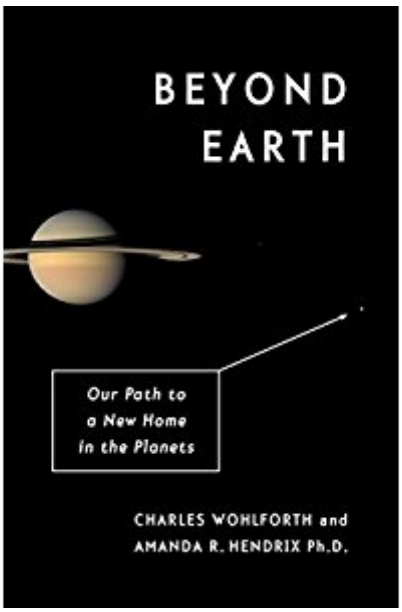
Beyond Earth: Our Path To A New Home In The Planets



Synopsis

From a leading planetary scientist and an award-winning science writer: a propulsive account of the developments and initiatives that have transformed the dream of space colonization into something that may well be achievable. We are at the cusp of a golden age in space science, as increasingly more entrepreneurs - Elon Musk, Richard Branson, Jeff Bezos - are seduced by the commercial potential of human access to space. But Beyond Earth does not offer another wide-eyed technology fantasy: instead it is grounded not only in the human capacity for invention and the appeal of adventure but also in the bureaucratic, political, and scientific realities that present obstacles to space travel - realities that have hampered NASA’s efforts ever since the Challenger fiasco. In Beyond Earth, the authors offer groundbreaking research and argue persuasively that not Mars but Titan - a moon of Saturn with a nitrogen atmosphere, a weather cycle, and an inexhaustible supply of cheap energy, where we will be able to fly like birds in the minimal gravitational field - offers the most realistic and thrilling prospect of life without support from Earth.

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Customer Reviews

Beyond Earth is an interesting project but with some major problems in its science. To make these easier to find, first allow me to mention four other books having to do with long-duration spaceflight that the beginner will benefit from more:Ã Â The High Frontier: Human Colonies in Space,Prospects for Interstellar Travel),The Starflight Handbook, andÃ Â Entering Space: Creating a Spacefaring Civilization. The first two are rather expensive, but that’s because they’re classics and for good

reason.I really wanted to like this book because there is a dearth of literature on settlement of the Solar system's periphery. But Beyond Earth has too many science problems, the biggest one having to do with the idea of burning Titan's atmospheric methane (5% CH4) for power production. (since Dr. Hendrix provides the scientific expertise for the book, I will address her contributions to it directly). It should be obvious that without free oxygen available, it will be rather difficult to combust methane. Dr. Hendrix suggests that electricity supplied by a nuclear fission reactor can be used to crack water to supply the oxygen. Well, yes, this will work, BUT seems a needlessly complex way to supply power when it can be tapped directly from the fission reactor. Keep in mind that at each step (electrolyzing water and burning methane) there will be losses and inefficiencies that the Titan colony can hardly afford. And burning methane will produce CO2, not a good thing unless one needs to make dry ice bricks.The entire idea of relying on nuclear fission to power the colony itself needs to be thought out better. In my reading experience, all authors fail to emphasize that at Saturn's distance, if the heat supply gives out, then the colonists will FREEZE SOLID. I'm talking meat popsicles! This is something that must always be kept in mind when considering the reliability of the colony's heat supply. The authors cite the experience of the US Navy's nuclear submarine fleet to support their contention that nuclear fission plants can be relied on. But these vessels go out on patrols only for a duration of 6-9 months at a time, get depot-level maintenance when in port between patrols, and rely on a vast infrastructure of supporting industry. The Titan colony needs power continuously, in perpetuity. Then there is the little problem of obtaining fission fuel (uranium or plutonium). Obviously this will have to be imported because it is practically nonexistent at Saturn. Lastly, in order to expand the colony on a permanent basis, nuclear reactors will need to be imported from Earth for a very long time. Without that vast industrial infrastructure, nuclear just does not scale easily.The book fails to mention solar power as a viable alternative or supplement. This is probably because of the thick haze that blankets Titan. Solar power could be gathered by orbital powersats and beamed down (Dr. Hendrix mentions that there are some radiofrequencies that will penetrate the atmosphere down to the surface). For those who doubt that solar is a workable option at Saturn's distance from the sun, I would refer them to Dyson'sÃ Â Infinite in All DirectionsÃ Â in which he describes a civilization in the Kuiper Belt that gathers the faint sunlight with arrays of metal mirrors many miles long. Keep in mind that a mirror deployed in space can be foil-thin (even atoms-thin). The gathered sunlight can be focused on a turbogenerator for electricity production, or the mirrors can be used to concentrate sunlight on photovoltaic cells. Gathering sunlight at Saturn is much more expensive than at Earth (Saturn's sunlight is 1.35 percent the intensity of Earth's sunlight, or 18.36 watts per square meter averaged over the Saturian year) but it can work, and it is

dependable and easily scalable. The only question is how electricity can be transported to Titan’s surface. If microwave beams cannot be used then the energy would have to be transported down to Titan via a chemical intermediary.Then there’s the so-called Q-Drive which Dr. Hendrix proposes to use for propulsion to Titan. Her description is lacking in technical detail, only that "quantum particles" are produced somehow from the quantum vacuum, and ejected as reaction mass. This supposedly permits the spacecraft to accelerate without propellant -- the reaction mass is "manufactured" in flight. I did some research on this and I was led to the Wikipedia article titled "Quantum Vacuum Thruster". It seems there is some controversy if this concept is for real or not. I’ve studied a little physics and my opinion is the Q-Drive resembles the fabled "perpetual motion devices" that patent examiners sometimes let slip through their approval process. Seems like the authors are trying to get something for nothing, and the beginner student of physics learns very quickly that never happens. You can’t even break even. Little things like "entropy" and "conservation laws" always get in the way. The author Mauldin of the book I mentioned at the startÃ Â Prospects for Interstellar Travel)Ã Â laments that it seems so unfair we have to work so hard building up a decent speed and then have to expend more time and energy braking at the destination, and then the spacecraft winds up with the same momentum state that it started with! Bummer but that’s reality, folks! Strange, I recall reading in Beyond Earth that the authors said they were going to limit their technical discussions to established science. I’ll just finish by remarking that I believe that the "Q" in Q-Drive really stands for "quack".What’s really galling is that there are so many other valid ideas for fast space propulsion that they could have put in the book. Maybe they felt they just had to be different. Or that their friend Sonny White is so enthusiastic about this wondrous Q-Drive that they just had to put it in. Too bad for the reading public, I hope no innocent schoolchildren or some wide-eyed teenager finds this book in a library and gets disillusioned when they find out it was all a bunch of hokum.The authors take pains to disparage all locations other than Titan as worthy destinations for human colonization. They dismiss Mars simply because it is bombarded by cosmic radiation and meteoroids due to its thin atmosphere. Colonists there will have to shelter in hardened shelters, or underground (or lava tubes, which the authors can be commended for mentioning). This is not an insurmountable obstacle, and would be far easier to deal with than Titan’s killer cold. Titan residents are going to be spending nearly all their lives in their hot-air-balloon habs. Perhaps the authors should have interviewed some Antarctic researchers and inquired how much they enjoyed being outside their shelters (oh I forgot, the Antarctic scientists evacuate for the winter! Bummer the Titan people can only retreat to orbit). Back to Mars: it’s got plenty of rocks, metals, oxygen and water. it’s warm, solar energy is freely available, and Mars is far closer to the metal-rich asteroid

belt. It has two natural satellites which will be advantageous as stepping-stones for exploration (via telepresence) and establishment of a colony. Mars has an eerily earthlike 24 hour rotational day/night cycle. Mars has nearly three times Titan's gravity (38 percent of a gee rather than 14%). Since nobody knows just how much gravity is necessary for long-term human health and reproduction, this last factor is probably a decisive advantage for Mars over Titan.The moons of Jupiter are also probably more viable than Titan. The outermost Big Three (Europa,Ganymede,Callisto) all are now known to have underground oceans of liquid water. Since it's liquid we can be sure things are pretty warm down there. The icy roof provides excellent radiation shielding. And contrary to what they said in Beyond Earth, there IS plenty of rock/metal in the Galilean moons. The mean density of Io is 3.5 g/cm3 and Europa is 3.0 g/cm3, so there is plenty of something there much denser than water (1.0 g/cm3). (Io is minable at its poles). Even Callisto has a mean density of 1.83 g/cm3, and as a bonus it's almost completely undifferentiated, so there are lots of the heavy elements near its surface. The only real problem with the Jovian moons is the low gravity, about that of our Moon (though it helps keep the water pressure to a manageable level).Another thing I wish the authors had made room for was material on the other moons of Saturn. Saturn does have a most handsome collection of medium size moons far smaller than Titan and the Galilean giants, but still far bigger than the space rocks of Jupiter in the 10-300 km range. The Titan colonists will have a great many mining opportunities on these low-gee motherlodes for the metals which they will need so badly.The authors of Beyond Earth do not even consider the possibility of space stations as colonies as described in Gerard O'Neill'sÃ Â The High Frontier: Human Colonies in Space. Yes, building city-size habitats in free space will be expensive and difficult. But this solves ALL the problems of a permanent colony in space. Any level of gravity can be provided for, as much shielding against space radiation can be provided for, as much area and volume as needed can be provided for. Lesser gravity and near-zero gravity will assist many manufacturing activities. Access to abundant solar energy and the material resources of the Belt is fast, easy, and inexpensive. It was a gross oversight to ignore the possibilities of space habitats. After publication of O'Neill's book, Isaac Asimov termed this perspective "planetary chauvinism". And it's a mistake when considering the possibilities of solar colonization..Lastly, a thing that I found annoying was the author's subscription to the too-popular conceit that the universe absolutely must be teeming with alien intelligences. I myself could have done without the prattle about the Fermi paradox. There are plenty of reasons why the Earth may be the only home for intelligent life (personally, I believe even this statement is debatable at best). 'Nuff said on this topic, I will simply refer the reader to the outstandingÃ Â Rare Earth: Why Complex Life is Uncommon in the

Universe.I rate Beyond Earth two stars because it does contain some interesting material on the politics of space development. The color photos are nice. The authors were right to point out that there is much unknown about the long-term hazards of space travel, and that more research into it should be furthered. Importantly, they make clear it's a far better idea to clean up the mess we are making of our Earth than to undertake space colonization on an involuntary, forced basis. After all, it may prove impossible for all we know. As for the idea that the only plausible impetus for expanding out into the solar system would be global environmental catastrophe, the authors could have saved quite a few pages by simply stating the rationale that Elon Musk of SpaceX has for his effort to establish a permanent human presence on Mars -- it's just not a good survival strategy for the human species to keep all our eggs in one planetary basket. It's just something we gotta do, no matter what. Big rocks do fall out of the sky from time to time. But don't fret so much kids, the dinosaurs didn't see it coming either.

The basic premise and writing is good, but it is a bit too slanted in order to support nearly exclusively the authors' proposition that Titan, rather than Mars, should be colonized by humans in the future. Some actual facts are kind of 'overlooked' so that they would not impinge the authors' pet project. Also, the idea of writing sub-chapters showing what the future could bring was not a bad one, but too often described oversimplistic scenarios, or scenarios that are not very believable, in order to support the authors' views. Overall, not a bad book but not a great one either.

Interesting ide with titan but the author got it all wrong. He believes you can extract unlimited energy by burning the local hydrocarbones with oxygen extracted by electrolyting water. Makes no sense at all. The energy requiered to do the electrolysys process is the same or higher than what you gain from burbing that fuel. The hydrocarbones on titan is of no use to us energy wise. Taking away to main speaking point of the whole titan argument renders the book completely useless. Sorry but that is the science

I really enjoyed this book and found it quite informative. There were a few places where I thought it dragged a bit. I recommend it to anyone interested in the idea of a space colony

An excellent blend of documentary about the present state of space travel and future supposition of what travel to another world would actually be like with few pollyannic flourishes. The back story of the two sisters, one the mission commander and one at mission control, is also well done.

Partway through the first few chapters of the book, a brilliant pair of anecdotes is offered, contrasting the innovative culture of SpaceX to the bureaucratic culture of NASA. Two engineers are asked if they have done anything that has made it into space. The NASA engineer can relate how, for years, he worked on a spring for part of a rover. But the spring never made it into the final design. The engineer is nevertheless consoled in having made some contribution to the team. Meanwhile, the Space X engineer can hardly understand the question : she designed the 2nd stage of the rocket that has been reliably delivering payloads. It appears that the NASA model has run out of gas, and some exciting new ways of financing and planning space missions are emerging.The book also retells a charming story about a woman who won a futurist contest to predict the state of aviation 30 years in the future. Her predictions were quite accurate. The authors suggest that she was able to make good predictions because she was well-informed about the technology, had a good grasp of the required economics, and had no particular stake in the outcome.These two stories tell us a lot and could be the basis for a great book. If the book had combined the insights from these stories into one focused and coherent message, then it would have met my expectations. But the authors unfortunately spend too much time dwelling on the political and social aspects that would motivate humans to build and populate this colony, about which they have little credibility and make little progress. Instead the book is filled with unnecessary Earth climate scare-mongering, including repeated waves of embarrassing prose detailing the most extreme scenarios ever concocted. The authors cant seem to help winking at the reader about how uncouth and hopeless human nature is, and this pessimism about humanity in general leaves them as either the architects of a future where only the enlightened few should be allowed to pollute the universe, or where humans as an entire species should not be trusted with the future of another planet or moon. They cannot seem to overcome the general pessimism that seems to have infected many of the practitioners in this field.At one point the authors indicate that it is politically risky for professionals to openly discuss the topic of human colonization. Earth is a jealous planet, and to talk of other rivals for human habitation seems to be a taboo. It is for breaking this taboo and providing at least some discussion of this fascinating topic that I applaud the authors. I wish they would be able to feel comfortable just writing about the incredible capabilities humans have to make and plan such a mission, the optimism of a new generation of practitioners in the commercial space industry, and a realistic model for how such a colony could be self-sustaining and robust. I would recommend readers who are interested in the topic, and unable to find better material, to skim over the sections labeled FUTURE and just skip past the global warming hype (which we can all read in a more

nuanced and complete form in other books and journals.)

Beyond Earth: Our Path to a New Home in the Planets Let's Explore the Solar System (Planets): Planets Book for Kids (Children's Astronomy & Space Books) Why Does It Happen?: Planets, Outer Space and the Atmosphere: Planets Book for Kids Stars and Planets: The Most Complete Guide to the Stars, Planets, Galaxies, and Solar System (Princeton Field Guides) Strange New Worlds: The Search for Alien Planets and Life Beyond Our Solar System Exoplanets: Diamond Worlds, Super Earths, Pulsar Planets, and the New Search for Life beyond Our Solar System The Gathering: ITÃ¢â ¬â„¢S OUR EARTH TOO - Book 2 (It's Our Earth Too) Dorset & South Devon Coast Path: (Sw Coast Path Part 3) British Walking Guide With 70 Large-Scale Walking Maps, Places To Stay, Places To Eat (Trailblazer: Sw Coast Path) Exmoor & North Devon Coast Path: (Sw Coast Path Part 1) British Walking Guide With 53 Large-Scale Walking Maps, Places To Stay, Places To Eat (British ... Exmoor & North Devon Coast Path Minehead) Beginner's Home Recording On A Budget: How to Build an Affordable Recording Studio at Home and Get Your Music Heard (Home Recording, Home Recording for ... Songwriting, Home Studio, Acoustic) INTERIOR DESIGN : The Beginner's guide, organise your home, techniques and principles on art of decoration: Customise your home with us (Home design, home construction, home arranging with style) NASA Voyager 1 & 2 Owners' Workshop Manual - 1977 onwards (VGR77-1 to VGR77-3, including Pioneer 10 & 11): An insight into the history, technology, ... sent to study the outer planets and beyond Star War. KID COLORING BOOK: Battle Activity Between Spaceships, Aliens, Astronauts, Planets, Rockets, in Outer Space, Solar System Field, and Beyond... The Total Skywatcher's Manual: 275+ Skills and Tricks for Exploring Stars, Planets, and Beyond Inheritance: How Our Genes Change Our Lives--and Our Lives Change Our Genes The Mind-Gut Connection: How the Hidden Conversation Within Our Bodies Impacts Our Mood, Our Choices, and Our Overall Health Our Solar System (Sun, Moons & Planets) : Second Grade Science Series: 2nd Grade Books (Children's Astronomy & Space Books) The Planets in Our Solar System (Let's-Read-and-Find-Out Science 2) The Copernicus Complex: Our Cosmic Significance in a Universe of Planets and Probabilities Our Sun, Planets and Moons | Children's Science & Nature