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Examining Popular Science Fiction:

The Planets of Star Wars

Star Wars. The impact of the name alone is a testament to the cultural influence that director George Lucas' film epics have garnered in the years since their original release in 1977. Now, thirty years later, *Star Wars* has developed an entire industry upon itself, spawned five sequels, numerous stories in print and otherwise, created a generation of interest in science and the universe, and single-handedly lifted the science fiction genre into mainstream and universal appeal. When considering what might be classified as "popular" science fiction, *Star Wars* undoubtedly comes to mind as the paramount example of the term.

The Planets of Star Wars

Good Evening. In tonight's broadcast of *Examining Popular Science Fiction* we will be utilizing modern scientific knowledge about the nature of the universe in order to take a closer look at two major planets from the *Star Wars* films: Hoth, and Bespin. The purpose of this analysis is to provide a broader perspective of the films you know and love, and to discover that there are more similarities to ideas that we create and reality than you might think. Because the lore and mythos surrounding the films has been expanded to such an enormous scale, for integrity and accuracy's sake we will only be using the three special edition versions of the *Star Wars* trilogy as source material. Conclusions about each planet are drawn from direct observations from the

films themselves. Because the biology of the alien species in *Star Wars* is impossible to identify, we will be looking at the planets from the perspective of our human protagonists. Even if the alien species differ to an extraordinary degree, they must necessarily be able to survive in an environment that is suited for human life. With that in mind, while looking at each planet, two distinct questions must be answered: Is the planet habitable for humans, or could it have been? What is the likelihood of a planet identical or similar in the *non*fictional universe?

The Fundamentals

To answer these questions, two key concepts must first be explained before exploring the planets: the necessary conditions for life as we know it as well as the general composition and process of Terrestrial planet formation. Both Hoth and Bespin share similar characteristics in this sense, and this knowledge will be used to approach the contradictions present in each individual case from a unified perspective.

To provide an environment suitable for life a planet must satisfy three conditions. "It must have a source of molecules from which to build living cells ... a source of energy to fuel metabolism ... [and] a liquid medium-most likely water-for transporting molecules of life" (Bennett 241). What this means is that the planet must contain organic molecules which are the building blocks of life, energy from which chemical reactions needed to sustain life require, and in this particular case, liquid water. All three conditions must be met, as one alone cannot support the development of life. Because we are trying to decide whether these planets could support our human heroes, two additional

conditions must be met. The planet must have "a temperature of about 300 [degrees Kelvin] to allow for liquid water" (Elowitz), and must also provide atmospheric pressure necessary to sustain this condition. Too much or too little and our heroes would be in a very dangerous situation.

Judging by the entry and exit shots of the planets in the *Star Wars* films, and the scale of the spaceship and the relative planet, the planets appear to be Earth-like in size when compared to similar photographs taken from orbit near Earth. While this does not indicate relative mass, we can conclude that each planet in the *Star Wars* films can be classified as a Terrestrial planet. Unlike their gas giant Jovian cousins, terrestrial planets are rocky and have a distinct surface; despite whether or not they can be seen through the atmosphere (I'm looking at you Bespin). Terrestrial planets form by a process of accretion where over time, molecules and atoms slowly accumulate by colliding and "sticking" together to form planets. The relative amount of a given atom in the universe closely follows an inverse relationship with its atomic "weight." The "heavier" the element, the less abundant it is in the universe. This is why hydrogen makes up the majority of the mass in the universe. This is related to the materials available in solar nebulae for the composition of planets in star systems. Solar nebulae are generally composed of 98 percent hydrogen and helium gas, ~1.4 percent hydrogen compounds (such as water vapor, methane, and ammonia), ~0.4 percent various minerals or rock, and ~0.2 percent metals (such as iron, nickel, aluminum, and silicon) (Bennett 76). This idea is fundamental when deciding the likelihood of finding planets in the universe that are similar to the ones found in the *Star Wars* films.

Now that we have covered the basics to our approach on analyzing the planets of

Star Wars, let's do some exploring!

Hoth

Hoth is the ice world of the *Star Wars* saga. Taking a cue from Tatooine as a planet that is too hot, Lucas provides us with a planet that is too cold. Assuming that the ice covering the planet is water ice, and the fact that the ice covers the entire planet the chances that surface temperature stabilizing at around 300 degrees Kelvin are slim to none. There is a great amount of potential for water closer to the geothermal core of Hoth, buried beneath the surface. However, the environment on the surface of Hoth is at the very least inhospitable and more than likely incapable of supporting human life. That is not to say that it is not possible, water is abundant in solid form, and the planet's star appears to be a comfortable distance from Hoth. The strongest complication lies in evidence for the presence of organic compounds. We see the Tauntaun and Wampa aliens on Hoth, but unless their physiology differs significantly from our own, complex life forms surviving in an environment where our human characters are hiding from the Empire would have to deal with the same complications. This evidence has to be taken at face value, and the definite possibility that these particular creatures be discounted in our analysis acknowledged. The planet Hoth does however far more closely resemble the idea of an ancient "Snowball" Earth. In this situation rapid cooling takes place faster than greenhouse gases can counteract and the oceans freeze over completely. In the case of our own planet it is possible that global temperatures dropped as low as minus fifty degrees Celsius (Bennett 137). If Hoth were in a similar stage, the environment would be by no means deadly to humans staying in the short term, but is rather detrimental to the long term survival of surface dwelling organisms (like the Tauntaun and Wampa). As a result, the

situation seen on Hoth in *The Empire Strikes Back is* far more likely than that of Tatooine.

When asking for an example of the possibility of Hoth-like frozen worlds in our own universe, the answer is equally as positive. Although they would not be able to sustain human life at minus 330 degrees Farenheit, icy "super-Earths" are likely to be found near about thirty-five percent of all stars (Icy Super Earth Found).

Bespin

Bespin, home to Cloud City, is the only planet in the *Star Wars* films that we do not catch a glimpse of the surface due to the entire sequence taking place high up in the atmosphere. It would be easy at first glance to classify Bespin as a gas giant, but due to the relative size as discussed before, and the chances of any of the characters surviving the encounter with incredible gravitational forces, Bespin is much more akin to the planet Venus or Saturn's moon Titan. This similarity lies within the thick gaseous atmospheres of both Venus and Titan. However, if Bespin were truly alike to either there would be no possible chance for human survival in either environment. This is because of the extreme temperatures: superheated on Venus and well below freezing on Titan. If we assume that our heroes survive their visit to Bespin we may also conclude that atmospheric pressure even in the case of thick gases may be more like Earth. Unfortunately, this conclusion is shortsighted due to the lack of information available. Unlike Hoth or Tatooine, the planet's nearest star is never seen. So chances are that it is possible that Bespin lies within the habitable zone of its own star, or is able to generate sufficient geothermal heat to regulate a stable environment. At the same time, no significant evidence of liquid water is seen throughout the film. That does not discount

the possibility, but it does not support or deny it either. When questioning the possibility of organic molecules, we take a look at the color of the approach shot to Bespin. From space, Bespin appears to have a very *Titanesque* orange hue. That could support the idea that it has a similar chemical construction in the atmosphere. If this were the case, it would be very possible to have an abundance of hydrocarbon molecules and organic compounds derived from the process of photolysis, or the breakdown of methane compounds left over from planet formation by ultraviolet light. In this case the atmosphere would be extremely poisonous to humans, and in the presence of the oxygen necessary for human life, an explosive combination. Likenesses aside the answer to whether Bespin could support human life are indeterminable. On the other hand, with multiple examples of terrestrial bodies with thick atmospheres within our own solar system, the likelihood of finding a Bespin-like planet are very high.

Conclusion

With the exception of Hoth, the results of our analysis on whether or not Lucas' fictional planets could support human life were inconclusive and highly unlikely, the prospect of finding similar planets in our real universe turned out very promising. Perhaps Lucas knew more about the universe than he was letting on, or possibly the nature of the universe itself has the uncanny ability to keep up with whatever our imaginations can throw at it. Stay tuned for more information on next week's exciting episode of *Examining Popular Science Fiction.*

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