[music]

[00:00:22] Jordan: Hi, I'm Jordan.

[00:00:24] Kit: I'm Kit.

[00:00:25] Jordan: Welcome to *Starry Time*, where stars plus lines--

[00:00:29] Kit: Equals starries.

[00:00:31] Jordan: For this month, we will be exploring the constellation of Cepheus the King.

[00:00:38] Kit: In this week's episode, we'll be focused on the astronomy and other cosmic background of this constellation.

[00:00:44] Jordan: Cepheus the King is one of the 88 modern IAU constellations.

[00:00:50] Kit: Like his wife Cassiopeia, Cepheus is one of the great-

[00:00:55] Jordan: Great, great, great, great, great, great, great, great, great, great.

[00:01:00] Kit: -48 constellations identified by Ptolemy.

[00:01:04] Jordan: It is a mid-sized constellation that comes in at about 588 square degrees, and it's the 27th largest constellation in the night sky.

[00:01:15] Kit: Yes. So it's slightly larger than Cassiopeia, because sexism, and it's considerably larger than Corona Australis, which is only 128 square degrees, which is what kicked off Season 2.

[00:01:27] Jordan: Well, that makes sense. The crown should only be 1/6th the size of the King. So, everything checks out so far.

[00:01:35] Kit: We've got a little bit of background there, but let's talk about what the constellation looks like, and how we might go about finding it. What were some of your first impressions when you looked up the constellation Cepheus, Jordan?

[00:01:47] Jordan: When I looked at it I see a house, 110%, or a fort. This one seems like one of the clearest ones that just looks like a roof on top of a box. Maybe it could be a dog house, maybe it could be a house down the street from where you grew up. Yes, if you have anything more creative than that, I'd love to hear it. What did you see?

[00:02:11] Kit: Well, since I know it's supposed to be a person, I kind of saw like a head wearing a hat, but then also like a little bit of a pipe, because there's that weird side section that comes out. I kind of got like person in, like head in hat with pipe, which is not-- even though I know it's a person, it's definitely not that. That's not what the drawing is.

[00:02:35] Jordan: Cepheus is part of the Cassiopeia story. So, naturally, it's located relatively close to Cassiopeia itself. It's part of what's called the Perseus Family of constellations, and we'll be getting into a few others of this group later in the season.

[00:02:50] Kit: Like Cassiopeia, Cepheus is a circumpolar constellation, and it's visible between latitudes 90 and negative 10 degrees. It's visible all year round in the Northern Hemisphere.

[00:03:01] Jordan: Now that we know where to find this constellation, let's talk about the stars that comprise it. Cepheus is comprised of seven main stars, and only one has a visible magnitude brighter than 3.0.

[00:03:15] Kit: That star, the brightest star in Cepheus, is known as, drum roll, please.

[00:03:21] Jordan: [drum roll]

[00:03:24] Kit: Amazing. Alpha Cephei.

[00:03:28] Jordan: Holy bear strike again. You're on a roll, my friend. Maybe he's just like us. He didn't want people to think that he was into astrology, so he just kind of got a little sloppy with his zodiac measurements, but then now it's got a little bit off the beaten path. He was a little bit more studious with making sure his star charts were accurate. That's my personal theory.

[00:03:51] Kit: I mean, he's three for three this season.

[00:03:54] Jordan: He's been training. He's been in the pool with his telescope, getting those reps in.

[00:03:59] Kit: [laughs] The Jaylen Brown of astronomy.

[00:04:02] Jordan: Keep working on your left hand.

[00:04:04] Kit: Alpha Cephei has an apparent magnitude of 2.51 and has the official name of Alderamin, coming from an Arabic phrase meaning the right arm, so not the left arm. It is an A spectral type blue white star, just now moving off of the main sequence into the subgiant phase. So it's probably on its way of becoming a red giant.

[00:04:28] Jordan: Well, once you're becoming a subgiant, you might as well go all the way. Just go straight to red giant. Why go halfway?

[00:04:36] Kit: Just keep going. Alpha Cephei is only 49 light years from Earth, and it's actually moving closer to us.

[00:04:45] Jordan: Excuse me, it's coming closer?

[00:04:48] Kit: Right. At a rate of about 16 kilometers per second.

[00:04:52] Jordan: Whoa, look out Sun.

[00:04:55] Kit: Yes, coming for us. So we should definitely do an asterism on wandering stars. I'll definitely add that to the list, because often, when we talk about things in space, we're thinking about the expansion of the universe, which is obviously happening, but in this case we're talking about a wandering star. The other interesting thing about Alpha Cephei is that it will eventually become a North Star, which is the title that's currently held by--

[00:05:21] Jordan: The one and only, Polaris.

[00:05:24] Kit: Yes, exactly. The North Star, though does shift over time, and it's because of the procession of the equinoxes, and that is in turn related to the wibbly, wobbly, earthy worthy axial rotation.

[00:05:37] Jordan: All right, great. Well, should I-- I'm thinking about taking a sea voyage soon, should I set a timer for when I switch from Polaris over to Alpha Cephei, or what's the time frame here?

[00:05:49] Kit: We're not really expecting it until 7,500 CE, and the last time that this star was the North Star was in around 18,000 BCE. So, that's the brightest star in the constellation. Now let's move on to our next segment, Bayer's variable star, where we follow the Greek alphabet to learn more about the Bayer designated stars in the night sky.

[00:06:14] Jordan: If memory/my notes recall correctly, are we at the Greek letter Ita at this point? Eta. How do you say it?

[00:06:25] Kit: Eta. I think it's Eta. I don't know, but I'm going to go with Eta.

[00:06:29] Jordan: Eta sounds fancier than Ita. So, I think you're probably right.

[00:06:34] Kit: It would be bad if your notes were wrong and then we were actually on Theta. Can you even imagine what would happen if we skipped a letter?

[00:06:42] Jordan: All I can think of is the shame I would feel. The isolation I would need to undertake. The reclusion that I would need to endure in order to have penance for this mistake. Besides that, I don't want to consider the consequences at all. No, I shan't. Eta Cephei is located outside of the lines of the constellation. It is 46.5 light years from Earth, and has a visible magnitude of 3.43. It's an orange hued subgiant star, and evolving into a giant star. It's about 2.5 billion years old. It has a radius that is four times that of our Sun.

[00:07:25] Kit: Yes. So, it's a bigger but younger star than our Sun, which makes sense since more massive stars die sooner than smaller stars.

[00:07:35] Jordan: Yes. Honestly, not a ton more to say about Eta Cephei. There's been some research into whether it has a Jovian like planet, like Jupiter or Saturn, but we still haven't confirmed anything like that yet.

[00:07:48] Kit: Yes, there's not a ton to say about it, but I have got plenty to say for Gold Star.

[00:07:54] Jordan: All right. Great sell. We'll take a quick break and then we'll wrap up with our final segment today, Gold Star.

[music]

[00:08:11] Jordan: Welcome back. This segment is called Gold Star. In this segment, we alternate picking the star or space object in our constellation of the month that captures our mind, our heart, our soul. This month it's up to you, Kit. Where'd you go with this one?

[00:08:29] Kit: As is usually the case, there were some hard choices to be made with this one.

[00:08:35] Jordan: That truly is the agony and the ecstasy, the burden and the joy of your month picking Gold Star.

[00:08:43] Kit: Very true. There was just a lot of cool things to choose from. There are three red supergiants, one of which, Herschel's Garnet Star, is a runaway star. That was interesting. There is Kruger 60, which is a binary star system of red dwarfs that's only 13 light years away. So it's very close to us. There is the somewhat famous Fireworks Galaxy, or NGC 6946. Yes, in that one we've observed 10 supernovae, which is a lot.

[00:09:23] Jordan: Yes.

[00:09:23] Kit: Yes. There's also a nebula with a large protostar, and probably the most interesting or the most attractive options that I saw was a very luminous quasar, that's a blazar.

[00:09:37] Jordan: Wow. You're right. There are a lot of good choices here. We got supergiants, we got fireworks galaxies, we have super close red dwarf star binary systems, but at the end of day, it's hard to argue with the blazar. Maybe it's pronounced blazer. Either way, we did talk about it a little bit in our Gold Star segment on Cancer, where you introduced us to the galaxy OJ 287.

[00:10:02] Kit: Yes, I love those binary black holes, but I didn't even choose this. I'm just sort of like, you know, as usual, shoehorning extra things into Gold Star, because they're so cool. Because-

[00:10:14] Jordan: To be fair, Eta Cephei left a little bit to be desired, which we can blame on Bayer and the Greek alphabet.

[00:10:21] Kit: Yes, of course, we can. What is cool about this blazar is that the host galaxy has a supermassive black hole which is 40 billion solar masses, and it is 22 billion light years away. So that means that it formed relatively soon after the Big Bang.

[00:10:43] Jordan: Primordial as it gets. Are you sure this isn't your Gold Star choice, Kit?

[00:10:49] Kit: I do love it, and I have dedicated considerable attention here, but we've talked about quasars and blazars before, and so in the end, I sort of reluctantly decided to give my Gold Star to another.

[00:11:03] Jordan: Wow, wow, wow, wow. Kit, sounds like you might be settling here. Are you starting to feel a little worn out on your quasars and blazars?

[00:11:15] Kit: I mean, black holes will always be my first love, but I wanted to give my Gold Star to Delta Cephei, which is a quadruple star system.

[00:11:26] Jordan: Whoa, whoa, whoa, whoa. That's four whoas for quadruple star system. Didn't even know that was possible. So, yes, tell me more. It's got to be something special here about this star system if it's overtaking one of the very first black holes that ever existed.

[00:11:41] Kit: It is. We've talked a little bit about this before, but in the Delta Cephei system, there's a Cepheid variable star. Now, as this name suggests, they're variable stars, which means they brighten and they dim, but unlike other types of variable stars, these ones brighten and dim in a regular interval, and there's a connection between their brightness and the period of dimming, which was an association discovered by Henrietta Swan Leavitt. What was discovered was that the longer the interval of the dimming, the brighter the Cepheid star.

[00:12:18] Jordan: We all remember Henrietta Swan Leavitt is an American astronomer, graduate of Radcliffe College and Harvard Observatory, who worked as a "human computer" around the turn of the century. Love a good Henrietta Swan Leavitt shout out. I guess this is pretty cool, but what's so important about these types of variable stars that would make them win your Gold Star, again, over your first love, black holes?

[00:12:46] Kit: So, after this association was discovered, Danish astronomer Ejnar Hertzsprung.

[00:12:54] Jordan: Wait, wait, wait, wait. No way. Hertzsprung, from my favorite, and the name I always remember properly, the Hertzsprung-Russell diagram guy?

[00:13:05] Kit: Yes.

[00:13:05] Jordan: The same Hertzsprung?

[00:13:07] Kit: Yes, the same Hertzsprung.

[00:13:10] Jordan: Dang. All the big players are coming out for this quadruple system. Tell me more.

[00:13:15] Kit: Hertzsprung used this association to measure the distance to several Cepheid stars. The basic idea here is that if we know how bright the star actually is, based on this period-luminosity relationship, we can compare its absolute brightness to what we see on Earth to determine the distance. Since objects that appear dimmer to us are further away from us.

[00:13:38] Jordan: Yes, that's really important, because that works basically as a measuring stick, or a yardstick of sorts, where astronomers can use the physical properties of stars that they find in order to help figure out what their distance is.

[00:13:51] Kit: Exactly. Delta Cephei was the second of these stars detected by astronomers in the 1700s.

[00:13:58] Jordan: Wait, second. Why did it get this name then? I'm confused.

[00:14:03] Kit: Right. Why do we call them Cepheid variable stars when the first one discovered was Eta Aquilae? Eta Aquilae was discovered only a few months before Delta Cephei, by Edward Pigott. Edward was a distant cousin and friend of John Goodricke, who was the person who discovered the Delta Cephei star. I don't know why we don't call them Aquilae variable stars or quilid variant stars. I'm not sure how the Latin works there, but maybe John was better at marketing. Maybe Edward let John have it because John Goodricke died two years after the discovery. So maybe it was one of those like, "I want my cousin/friend to live on."

I definitely, 100% made that up. So that's-- [chuckles] I did read that it might be called a Cepheid variable star because the Delta Cephei was studied more extensively later in astronomy, and so it became more of the prototype star. So, it might just be for historical reasons. I don't know the reason why, but I thought it was an interesting confluence of events. Is that how you say that word?

[00:15:24] Jordan: I think that's absolutely right. I like your story of it being a dedicative or a dedication to a cousin and friend. That at least has some real emotional resonance to it. Whether or not it's made up completely, well, ain't everything when it comes to the stars?

[00:15:42] Kit: For sure. If you're listening out there, and you know why, please feel free to let me know. I'm curious to find out, but I don't know, and I couldn't find the answer. What I do know is that Cepheid variable stars come in a variety of classes and types, which I'm not going to detail here, but perhaps we'll talk about in the future.

[00:16:05] Jordan: Welcome to the Club Delta Cephei. You might not be as flashy--

[00:16:10] [END OF AUDIO]