Dear Cheap Astronomy - Episode 009, The Future.

Question 1:

Dear Cheap Astronomy – Is there anything in all this recent fuss about asteroid mining.

Well yes and no. The economics of asteroid mining is complex. For example, we know there are several expensive and relatively rare metals out there like platinum. However, if you suddenly landed several tonnes of platinum on Earth, the price would plummet. But maybe the economic return will be about the new technologies we could create if platinum group metals were readily available in large amounts. Who knows? It’s hard to predict what might happen until we get out there and start doing it.

In any case, there are a substantial number of problems to be overcome before we can start landing several tonnes of platinum on Earth. First you are not going to find asteroids that are made of one hundred per cent platinum. So, do you extract the valuable material you want in space, requiring a space-based extraction factory? Otherwise, you will need to land the unprocessed asteroid for extraction on Earth. This is tricky, since the Earth’s gravity and its atmosphere are going to accelerate and then incinerate a lot of material you send down here. Also, since over 70% of the Earth’s surface is ocean there is a significant risk of sinking your whole payload under several kilometres of water. And let’s face it no-one is going to let you crash-land an asteroid on Earth in the first place.

So, that line of thinking pretty much mandates the need for a space-based extraction factory from which you can then carefully manage the return to Earth of a much less massive extract of pure platinum or whatever.

It all sounds terribly expensive, right? Well, here’s the Cheap Astronomy plan. Something that distinguishes Earth from the other, alleged, 4.5 billion Earth-like planets in the Milky Way is that we have a large Moon in orbit around us. Geologically-speaking, the Moon is virtually inert and it lacks an atmosphere – which is perfect.

The enormous economic potential of the Moon does not lie in its natural resources, which are mainly silicon oxide, a bit of ice and some scattered helium nuclei – none of which are really worth getting out of bed in the morning. The enormous economic potential of the Moon is that it is a gravity well, with no atmosphere, permanently-located a mere 3-days travel time from Earth. Wow. Any alien civilisations that listen to this podcast would be drooling at the thought - or whatever it is they do that is equivalent to drooling.

You see, rather than trying to tackle the nightmarish legal issues surrounding bringing asteroids back to Earth, we can just send robot probes into space to start altering the trajectory of valuable-looking asteroids so that they crash on the Moon. Once we have landed a couple of tonnes of platinum, someone is going to decide that it’s about time we established a Moon base.

To supply the Moon base we can also land icy comets for water, from which we can extract oxygen using solar-powered hydrolysis units. And the generous amount of sunlight will allow us to grow plants from Earth and there’s plenty of silicon lying around to make glasshouses. Really the only stuff you may find it hard to source are complex hydrocarbons from which we make plastics and things – and currently we are burning up these complex hydrocarbons at a furious rate.

If we are going to have a space-based future we may need to cut all that out. Once we begin to mine space, we may come to realise that life, even fossilised life, is the Universe's most limited resource.

Question 2:

Dear Cheap Astronomy - If a human crew left Earth to explore the galaxy and their descendants returned to Earth 100,000 years later, could they still be considered human? (Rene).

Thanks Rene. To be considered a new species, members of that new species must have changed to such an extent that they are no longer able to mate with members of their old species and produce viable offspring. The viable offspring issue is important, since you can mate members of different species, like a donkey and a horse, but their progeny, a mule, is sterile. Well, at least the male mule is sterile – rarely female mules can apparently still have offspring by mating with a donkey again. So, even this supposedly-technical definition has some grey areas.

Anyway, 100,000 years isn't a lot of time for substantial genetic drift to occur between two isolated groups of the same species. And remember, we are dealing with humans. When you are dealing with humans, the naive interpretation of natural selection – that is, survival of the fittest – doesn't always apply, since most human communities will put effort into ensuring that each member of the community can prosper and that each member has the opportunity to have children, regardless of anyone's supposed 'fitness'.

In a long-term space colinization scenario, the most likely driver of genetic drift will be the isolation of a small group of space colonists. This is classically demonstrated across the Galapagos Islands, where what were presumably the same species of (say) finches and tortoises became separated and those isolated population's adaption to their local ecological niche, drove a relatively-rapid genetic drift.

A similar thing might happen with space colonies – after they become isolated from the huge genetic melting pot that is planet Earth, with its over 7 billion human inhabitants and its airplanes.

Furthermore, those small groups of space colonists will face a range of epigenetic factors that may have a substantial impact. Firstly, we have to consider whether human females could bring an embryo to term in microgravity. They probably can, since various trials of launching pregnant rats into space have all resulted in successful births, although the birthing experience apparently took its toll on the mother, rather than the babies.

But imagine human-babies, space-children, who grow up from birth in microgravity. Their vestibular system would never develop the balancing skills to be able to stand upright. After all, the whole concept of standing upright only makes sense in a gravitationally-dominated environment.

Also, growing up in a place that is not gravitationally-dominated would mean that the legs of those children would never develop significant musculature or bone density. But, so what?

This wouldn’t be an issue for a person who will spend their life in microgravity. The growing space-children would just tuck those spindly appendages out of the way, as they began to learn to propel themselves expertly about their microgravity environment with their opposable-thumbed hands.

Of course, if these generational space colonists ever did return to Earth it’s unlikely that a resident of Earth would want to mate with such helpless, spindly-legged bean bag occupants. Equally, it’s unlikely that a space colonist would want to mate with any visiting astronauts from Earth, who possessed two disturbingly-bulging vestigial limbs and who were incapable of the simple act of orientating themselves in three dimensions.

So, even if a substantial genetic drift has not happened after 100,000 years of separation, the space colonists and the Earthlings may just not wish to contemplate, you know, doing it. Therefore, technically, they could, at this point, be considered different species.