

Hi, this is Janet for Cheap Astronomy, www.cheapastro.com and this is *Escaping LEO*.

So, here we are. It's now 45 years since astronauts last left low earth orbit, also known as LEO, aboard Apollo 17. Ever since then, US and Russian astronauts have continued flying to space and lately they've been rubbing shoulders with Canadians, Europeans and Japanese astronauts – and lately everyone's been launching from Kazakhstan because that the only place we can currently launch *people* from.

Nonetheless, there are a lot of things we've got better at over the last 45 years. For example, even though we can't completely halt the musculoskeletal degradation that happens in microgravity, we have found ways to allow astronauts to live and work productively in space for a year or more. But, having found that astronauts are able to live and work in space for a year or more, maybe we shouldn't have them spend all that time just going round and around the Earth. As interesting as our own planet is, there's a whole Solar System out there. As Carl Sagan once said: *Those other worlds, promising untold opportunities, beckon.*

We have been to the Moon, to discover it's mostly magnificent desolation with a bit of water and a bit of Helium 3, although the meagre amounts of either would first have to be extracted and then refined and even then those products are only really useful to generate rocket fuel to go somewhere else, or to use as consumables to make it a tiny bit cheaper to remain on the Moon. But, there's no way you'd bother shipping anything from the Moon back to Earth – that would be like shipping ice to Antarctica.

This is why we have been struggling for so long to escape LEO again. Unless you're a total space nerd, it can be difficult to see any sense in spending billions of dollars to go and sit on a cold rock with no atmosphere. A voyage to Mars would mean spending even more billions to go and sit on another cold rock with *almost* no atmosphere.

There should be more mining opportunities on Mars than on the Moon, since there is a wider variety of elements and a wider variety of minerals and ores. But you would still need some serious extraction and refinement equipment to get at those minerals and ores – and it would still be the case that it's too ludicrously expensive to bother shipping anything back to Earth.

It is sadly the case that the primal urge to see what's over the next hill generally doesn't drive big budget spending on space exploration. The Apollo missions were funded by an extraordinary proportion of the US budget, a commitment that we've never seen before or since – and which was largely a knee-jerk reaction to Russia's early success in space, bolstered by wanting to deliver on the ambition of a recently-assassinated president. The Space Shuttle program was more of the same, showing up the Russians, as well as delivering on some Department of Defence objectives – although the Hubble Space Telescope was a welcome moment of investment in pure scientific endeavour. Twenty seven years and five servicing missions later, the telescope is still going strong.

Anyhow, we are just making the point that piloted space exploration is darned expensive – and although no-one wants to pull out of it altogether, it's not exactly moving forward by leaps and bounds either. Carl Sagan was right that space exploration offers untold opportunities, but the trouble with untold opportunities is that you can't tell anyone what they are. You always have to

start your pitch for a new space mission by telling the purse-string holders that you have no idea what you are going to discover until you get out there.

And let's face it, even if you found a gold mine – gold is dense and heavy, so it's expensive to fly back to Earth and once you got it back, you'd flood the market and the unit price of gold would plummet. So, most people who had previously made a living out of gold would be really wishing that you'd just found a dust bowl out there – and you'd probably find yourself agreeing with them for all the profit you'd made.

So, what's the solution? Well, you need to convince the purse-string holders that you can bring back something from space that's light and easy to capture and it's something that will meet an inexhaustible demand back on Earth. And that something is Hollywood, cameras and action. We've already gone out there with cameras to take photos where no-one has ever taken photos before. But, what we should do next is to not only fly the cameras, but fly astronauts along with them – and continue the fine human tradition of making documentaries about ourselves, while we go out and explore the cosmos.

So, onboard cameras will capture each astronaut's reactions during the tense moments as the crew deals with crisis situations, or heart-warming moments as the crew share a laugh over a rehydrated dinner or wonderous moments as the crew get their first glimpse of a strange new world. And of course, when the crew actually land on a strange new world, they will unload state-of-the-art, high resolution cameras from the cargo bay. To bring those along, they might have had to leave a few science instruments behind, but we have to make some sacrifices if we really want to escape LEO again.

This Cheap Astronomy plan is based on blockbuster movie economics, where all the money is paid upfront and the payback only comes after all the filming is done and edited and the final product is packaged up for distribution. And that final product will have to wait for the end of the mission. Broadcasting even a few seconds of live-streamed video back to Earth is way beyond the data-carrying capacity of radio-based comms. Getting anything close to live-streaming awaits the development of wider-bandwidth optical comms. Even then there are probably more mission-critical things we could do with optical comms than live-streaming what the astronauts had for dinner. For example, live-streaming all the telemetry readouts from the ship's many sub-systems might contribute more to ensuring the success of the mission.

But, there's no problem storing video on board – and indeed that fits better with the blockbuster movie economics. What's the point in leaking a lot of raw footage for free when you can bring it all back to Earth and get it professionally edited and packaged up with other footage shot on Earth – like all the drama in mission control, as well as reaction comments from astronauts' families, celebrities... even presidents.

So, ninety per cent of these future space missions would still involve the flying, the equipment maintenance and the general business of staying alive, but it would be all done in the knowledge that consumers and governments and advertisers are paying good money for good quality video that will let everyone become armchair astronauts as they retrospectively watch, analyse and critique the performance of the astronauts. I mean, come on – billions of dollars are currently spent each year on

making programs where you get to watch people cook dinner or renovate their house – are you telling me that a space mission would not make good ratings?

And maybe, eventually, as we go out making movies about ourselves, we might actually stumble upon one of Carl Sagan's untold opportunities. Unfortunately we can't describe in this podcast what those untold opportunities actually are *because no-one has discovered them yet*. Of course, when we do discover such an untold thing we'll be able to create a whole extra episode about how various celebrities reacted to the news and maybe even capture a President's reaction – who is likely to say how great it was that we finally found one of those untold things – although, for him or her, it was always about the primal urge to see what's over the next hill... yeah, right.

Anyway, whatever you think of our cheap idea, it's been 45 years since we left LEO. So, if you have a better idea that will drive massive investment in space exploration, please let us know – indeed, let *everyone* know. Because, however we are going to do it, it really is time that we got back out there.

Thanks for listening. This is Janet for Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website where we want to make you a star in the stars. No ads, no profit, just good science. Bye.