

Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *Cheap Astronomy – Live in north-eastern USA*.

Firstly it should be noted that I took off to the northeast of the USA not long after Cheap Astronomy's fifth birthday. That's five years of having never missed a week and hey here we are doing episode 189. For the record, Cheap Astronomy did actually operate in real time up until episode 100 at the end of 2010, only after that did the episode progression start going a bit weird. Anyway. It's been five years we've never missed a week – not too shabby.

Anyhow, I went to Washington DC. It's quite possible I saw the President too, there were some motorcycles and a black limo. But, I wasn't there to see presidents. For example, I actually visited Arlington cemetery and because everyone wandered off to see JFK's grave, I was quite alone before the monuments to the Challenger and Columbia astronauts – which are not really graves since there were no bodies to bury. Don't get me wrong though, I am sorry some nutter shot your president (indeed, presidents).

My Arlington excursion kind of made sense since my next stop was of course the National Aerospace Museum. And if you are ever contemplating doing the same trip, be aware there are actually two aerospace museums. You have to go to the one in the National Mall to see the Apollo 11 command module – and whole bunch of other of other stuff. But you really should also go to the other site near Dulles airport, which is essentially an airport hanger full of historic planes and space vehicles, and it's this site that has the Discovery orbiter.

The airport hanger part of the national aerospace museum, is called the Steven Udvar-Hazy Center after the chap whose \$66 million grant enabled the centre to open in 2006. The Americans, it must be said, aren't total slackers when it comes to museums. The Udvar-Hazy Center collection includes the Lockheed SR-71 Blackbird, an AirFrance Concorde and some historical icons like the B-29 Enola Gay.

And Discovery? It looks like it's seen some action and it looks functional, its whole geometry precision-designed to manage glided descent to an unpowered landing, but carrying massive launch engines and orbital manoeuvring modules as well. It really is a space plane – and one that flew a lot over a respectable 27 year mission life. It flew the most missions of any shuttle orbiter and launched the Hubble Space Telescope. It was the third orbiter commissioned after Columbia and Challenger and is hence now the oldest intact orbiter.

It's not going to change your life to see Discovery, but I struggle to think how anyone could regret the trip if they did and afterwards you are kind of driven to go and research some more background material. For example...(sound byte)

Yeah, there were these little doors – two of them which represent the only other significant breaks in the orbiter's tiled heat shield apart from the landing wheel bays. These are of course the umbilical doors, the connection points where backyard swimming pool per minute volumes of fuel were drawn from the disposable main tank to fire a shuttle orbiter's launch engines. Once aloft the tank was jettisoned and the doors were closed.

So anyway, if you go to DC you really should go to Udvar-Hazy, but if you go to DC you would be nuts not to go the main National Aerospace Museum in the National Mall. When you walk into the main museum, the Apollo 11 command module is right there near the entrance. You can take a selfie, tick your bucket list then go on to enjoy the rest of the museum.

Again, it should be said that the American's are not slackers when it comes to museums. For example, you can't display the real Hubble Space Telescope, since it's still in space - so

you'd think a scale model would be an informative way to highlight some of the key instruments and functions. But no, at the Smithsonian there's a full scale model which is freaking huge. And, I kind of liked that. Here's one of the great icons of humanity's scientific endeavours to date – and by the way it's American and by the way it's freaking huge.

So that was DC in a nutshell. Of course, if you do ever come here and you've happened to have started a podcast about five years earlier, I recommend you announce your imminent arrival to your small, but highly discerning audience. My generous host John introduced me to one of DC's finest bars, the Old Ebbitt Grill, where we had seafood and beers, while discussing the Universe at large. If this tired old podcast deserved a five year birthday party, I reckon that was it. Thanks John.

Then came the New York City leg of the trip. Astronomically speaking, New York's big ticket items are the Hayden Planetarium – which is part of the awesome American Museum of Natural History – and the Intrepid Air and Space Museum on the Hudson River.

Intrepid is a decommissioned aircraft carrier standing off a pier in midtown Manhattan. Here you can walk through a submarine docked to the side, climb up to the bridge (above the flight deck) and of course check out the space shuttle orbiter prototype, Enterprise, which never went into space, but did glide to Earth with no engines from off the top of a modified 747 – and it did this five times. For the record, that was three with the tail cone on and twice with it off in order to check that the profile of some mocked-up engines attached at the rear wouldn't significantly affect its flight performance, which they didn't.

I have to admit to an inordinate fondness for Enterprise because I did an early podcast on it, Cheap Astronomy Episode 8. Again, it's very unlikely that seeing it is going to change your life, any more than seeing Discovery would – and if you had to make a choice, you should go see Discovery. But if you have the time I doubt very much you'd regret an afternoon on the Intrepid.

And Hayden Planetarium? My limited US travel experience inevitably led me to compare it with Griffith Observatory in LA – and I'd have to say Griffith seems the better public outreach museum. Hayden's museum components had an interesting focus on cosmology, but this bordered on the esoteric at times and most of the hands-on stuff was less than engaging. When I went into the actual planetarium to see a show, Dark Universe, it was really just Imax on the ceiling, never really using a display of the observable night sky to any effect, which is usually what traditional planetariums are all about. It mostly confirmed my view that you can't expect to hold the general public's interest in the fact that we continue not to know what 95% of the Universe is.

This may be why most visitors to the Natural History museum go straight to fourth floor of the natural history museum and check out the dinosaurs. It may also be why I spent most of my time in the geological science galleries, checking out meteors and moon rocks.

Did you know that that the Apollo astronauts collected four types of moon rocks:

(One) Anorthosite represented the original crust of the Moon;

(Two) Lunar basalt comes from magma upwelling from beneath the surface after gigantic crust-penetrating meteor impacts;

(Three) Breccia is another type of rock, though really just anorthosite or basalt that been 'shocked' – that is, impacted by a large meteor. Much the same rock is found around impact sites on Earth;

(Four) The lunar regolith – which is composed of particles of all of the above types of rock, as well as these interesting round glass particles, which are the solidified remains of ancient lava fountains.

And OK, I admit I checked out the dinosaurs too – which were awesome.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website with a bucket list full of science museums. No ads, no profit, just good science. Bye.

A quick post-script. On my last night in New York City, I went back to the Hayden Planetarium and attended an evening science talk, well after the museum had closed. This was a presentation held inside the planetarium where a human operator used Digital Universe software to do a real planetarium show... and it was fabulous – and a lot cheaper than the main show in the daytime.