

Argentina, December 14th 2020 Solar Eclipse



Total Solar Eclipse 2020

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The wonderful photograph of the solar corona was taken by combining 55 images taken with a Nikon Z6 camera with Nikkor 80-400 lens by Andreas Moller, processed by Miloslav Druckmüller. Left, The horses decide they are not a threat and decide to eat the seating. Crossed-finger pinholes and shadows which are sharp in one direction, fuzzy at right angles. Original observing site, so windy that the portaloos was blown into a stream. Centre, Mike Frost, in disguise, bagged another eclipse. Right, Eventual observing site, much more sheltered.

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Against The Odds - A Patagonian Eclipse

By Mike Frost

Nick James and I are writing an account of the 2020 total eclipse to appear in the BAA Journal. This version is loosely based on my first draft.

The total solar eclipse of 2020 December 14th began in the southern Pacific Ocean. First landfall was on the Chilean coast near Champulli. The track of totality crossed the Chilean "Lake District" around Villarica, then swept across the Andes into the northern Patagonian provinces of Argentina, leaving land for the final time east of the Argentinian resort of San Antonio, and concluding in the southern Atlantic Ocean.

Last year I witnessed a stunning eclipse over the Andes, seen from Bellavista in Argentina's northern province of San Juan. The 2019 eclipse was popular, with thousands traveling to South America to see it, and similar numbers were expected for 2020. However, as we all know, the global pandemic changed plans completely. Both Argentina and Chile had high infection rates and imposed strict lockdowns, with a total ban on foreign visitors from March onwards. The restrictions on travel worldwide meant that most tour companies cancelled their eclipse plans.

Nevertheless, a window of opportunity began to inch open. As the southern-hemisphere summer approached, infection rates were falling in both countries and the authorities began, nervously, to contemplate re-admitting visitors. Chile re-opened its borders to foreigners at the beginning of December. The authorities in Argentina were a little slower, but several tour companies, both in Argentina and outside, negotiated for tours to enter, specifically to view the eclipse. Eventually an agreement was reached to allow up to 180 foreign visitors to enter Argentina, and 94 of these permits were taken up.

I was a guest astronomer on one of two tours organised by Astro-Trails, attended by 40 of the 94 lucky permit holders. Visiting conditions were very strictly regulated; tour members had to have had a negative PCR corona virus test within 72 hours of traveling to Buenos Aires. Two companies offered to provide the test locally, and I picked a clinic in Leicester. For "test to travel" they promised to provide results within 48 hours. At 1:30 AM on the day I was due to fly, 21 hours before my flight, they texted me to tell there was a problem with my test and please could I return at 8:00 that morning for a re-test. Fortunately, the text woke me up, otherwise I might have missed the entire trip. I did make it back to Leicester at 8:00 AM and they had a negative result to me by 2:00 PM. Not good for my stress levels, though!

Heathrow, not surprisingly, was very quiet. I think this was lack of flights rather than lack of passengers, though, as our flight was completely full. Having spent the last nine months studiously avoiding going anywhere near anyone, it was very disconcerting to spend 14 hours sat wedged between two complete strangers. Apart from when we ate, masks were compulsory from when I left my car to when I arrived in my hotel room in Buenos Aires about twenty hours later.

Getting through passport control at Buenos Aires wasn't too difficult, despite us being the first foreign tourists into Argentina in nine months. In addition to negative Covid test results, we all carried with us permits (in Spanish and

English) from the government, authorising us to enter Argentina and travel to Neuquen province. We heard that some tourists without these permits had been refused entry, although that might have been before they left their home country; some of the Americans on our tour reported that they had to fight to be allowed onto their flights, as it was assumed that they wouldn't be allowed into Argentina.

The evening we got to our hotel we were all re-tested – the swab up my nose nearly came out of my ear - and all tests came back negative. Some people had extra PCR tests during their stay, and everyone on the other tour had to take a saliva test on return to Buenos Aires as they had been away from the city for more than 72 hours. One or two people stayed in their hotel rooms and took room service throughout their stay. Most of the rest of us ventured out of the hotel gingerly and sensibly. We had a city tour of Buenos Aires which, including lunch, was almost entirely outside, except for the cathedral. Buenos Aires was quiet; the Playa de Mayo square at the city centre, by the Casa Rosada, usually throngs with tourists but was instead eerily quiet, home to just a few demonstrators. In the bohemian suburb of Boca, the souvenir sellers were delighted to hear English again; it caused a stir. There are rather more tango dancers outside in Buenos Aires at present! At Recoleta, one of our tour group danced a tango with a beautiful Argentinian tango-busker. I'd have loved to do the same (she was very beautiful) but "tango dancing" and "social distancing" are not phrases which sit together very well, and as guest astronomer I felt I had to show an example.

Throughout our stay, we couldn't get on a tour bus without having a temperature check and hand-sanitising (often photographed, as evidence that we were in compliance with rules). Masks were of course compulsory.

The day after the Buenos Aires tour, the party split into two tours. My group flew to Neuquén, the largest city in Patagonia, whilst the second group, headed by Nick James, were based in the beautiful tourist resort of Bariloche, in the foothills of the Andes. Ordinarily, we would hold an eclipse briefing the night before the eclipse, but for this tour Nick, Sheridan Williams and I recorded a briefing for viewing in advance (Sheridan was unable to tour).

On eclipse morning the two groups drove to our eclipse viewing site near Piedre del Aguila, Neuquén province. All on board carried the travel permits we had been issued with, in case of police checkpoints (in particular, at the border between the Rio Negro and Neuquén provinces). However, traffic was light, and we were waved through all checkpoints. Piedra del Aguila had been chosen because the probability of cloud was the lowest at any point on the centre-line. It was also close to the point of maximum eclipse, and so the sun was high in the sky, altitude 72 degrees, at time of totality.

Our exact location on the centre-line was at Fortin Nogueyra, an estancia (ranch) on the banks of the Limay River. Most of Neuquén province is arid, undulating scrub land, but a few rivers snake across the terrain and, where

there is water, there is lush vegetation and the opportunity for agriculture and habitation. Fortin Nogueyra was an idyllic location, a horse ranch with paddocks bounded by high trees. We were located on higher ground just beyond the paddocks.

We soon understood why the paddocks were protected by trees. In the summer, Patagonia often has strong winds blowing in from the Andes and eclipse day was no exception, with unrelenting blustery winds of 40-50 mph. Two observing areas had been prepared (one for each tour, optimistically assuming social distancing between tours), with hay bales to sit on, however it was clear straight away that the chosen site was unsuitable. One of the Portaloos had already been blown into a stream. Fortunately, there was no-one in it at the time! We were assured that the nearby paddocks were available for our use, and a quick reconnoitre established that the nearest, shielded by trees, was a much calmer location, suitable for setting up tripods and cameras. Unfortunately, the path to the paddock included crossing the stream on a tree log, but the gauchos from the estancia quickly brought along planks to form a second bridge and carried the bales across for us.

Equipment set up, we waited for first contact. As the Moon made its way across the Sun, we enjoyed lunch, and carried out many of the traditional experiments for partial phases. The farm workers were amused by the colander which I used to project pinhole images of the Sun, and we showed them the way in which shadows distorted and sharpened as the light source became crescent-shaped. A warm sunny day, with the Sun high in the sky, became cooler, and this cooling seemed to trigger the formation of patches of light cloud, which rushed across the sky.

As the crescent split into Bailey's beads, Venus became visible, 25 degrees to the west. We watched out for the onrushing shadow of the Moon from WNW, but the trees made it difficult to see. Instead, our attention was caught by the shadow bands on the ground. A white sheet showed hoped-for bands of narrow width traveling roughly west to east, as predicted, but there also seemed to be much larger bands of light, sweeping across the paddock. It was surmised that we were seeing "cloud bands", where the change in luminosity was due to diminution by passing cloud. Readers will be familiar with cloud shadows crossing the landscape on a day of Sun and patchy cloud; perhaps when almost all the Sun is covered the illumination levels will be more exquisitely sensitive to the amount of cloud between Sun and observer. As in a previous eclipse (Hao Island, 2010) imagers reported seeing shadow bands projected on to the intervening cloud

Totality came on us just as the Sun was still covered with cloud; this produced the most beautiful meteorological corona, a double "rainbow" of light close to and around the Sun, caused by diffraction of sunlight by the water drops in the cloud. In this year of corona virus, a corona created by corona light seemed appropriate! Mercury popped into sight three degrees west of the Sun, and the close conjunction of Jupiter and Saturn was visible 35 degrees away to the east. From our viewing point, trees blocked much of our horizon, but Phillipe Lopez, who chose to observe a short distance away, photographed an all-sky shot with a red glow on the horizon to the north.

The cloud covered the Sun for just under the first 30 seconds of totality and didn't stop viewing of either solar corona or prominences (although it did modify the exposure times needed to photograph these). The corona was close to predictions, a typical solar-minimum corona with well-defined polar brushes and one very long coronal streamer.

Careful processing of coronal images showed a coronal mass ejection (!) close to the Sun and a larger loop. There were prominences all around the Sun, with at least four groups visible to binocular observers; no major detached prominences.

In the latter part of totality, there were further fast-passing patches of cloud. The diamond ring arrived after 126 breathtaking seconds of totality. The Moon's shadow headed off towards the east, appearing to leave in its wake a stream of clouds. There were further shadow bands, similar to those at second contact, although the Sun was free from cloud until about 15 seconds after the end of totality.

We celebrated a glorious total eclipse with champagne. The horses realised our field was full of hay and once they had decided we weren't going to trouble them, began to eat our seating. The temperature began to rise again. The family who owned the estancia came to join us; lovely people, anglophone and anglophile, engaged with the proceedings. Once fourth contact had passed, we made our way back to the busses, paused for a (socially distanced) team photo, and headed back to our hotels.

Careful processing of images revealed that not one, but two, comets were visible during totality. Comet 2020 S3 Erasmus was known to be close to the Sun during totality, and the day before the eclipse, a Kreutz sun-grazing comet was discovered. Both were at around 6th magnitude and Nick James and Andreas Moeller managed to image both.

The choice of the Piedra del Aguila area for the observing site was wise. On the Chilean side of the Andes, there was heavy rain, and only a few people managed a glimpse of totality. Rain also disrupted viewing on the Atlantic coast of Argentina. But the weather, bar a few clouds, was clear across central Patagonia. Such a pity that so few people were able to enjoy it. There was a group of 150 Argentinian astronomers in a camp elsewhere on the estancia, but we never saw them, though I was chatting to two of them on the plane back to Buenos Aires. Of the 94 foreigners, 40 were in our group, 7 more with Sirius Travel from Colorado and 3 we met from Aberystwyth University doing serious solar research – I don't know about the rest.

The weather continued to favour us in the succeeding days of the tour. In addition to a sightseeing tour on Bariloche Lake, the Bariloche group were able to enjoy an evening of southern stargazing from a dark-sky site. My Neuquén-based astronomers didn't have an opportunity for dark-sky observing, but were able to view several southern clusters, as well as a barn owl hunting, from a site close to the hotel.

Back in the capital, my tour group had an end-of-tour meal; the Eurotur people made sure we had a separate room in a steakhouse close to our hotel. I had forgotten how good Argentinian steak and Malbec wine is. My group wouldn't let me pay and sang "For he's a jolly good fellow" for me! I must have done something right...

Our flights back, Iberia via Madrid, were a lot less crowded, however service was terrible - no alcohol, rubbish food. There were at least three dogs traveling in economy class – how is that allowed? But I really didn't care. We got home! Safely. Judging by what has happened in the UK since with tier 4 and new-variant COVID-19, we were lucky. We could easily have been stranded in Argentina.

This was an eclipse that few of us expected to be able to attend – getting a tour group into Argentina and then safely to the eclipse site demanded a mastery of bureaucracy and painstaking negotiation skills. Much kudos is due to Julie and Brian at Astro-Tours, and to the staff of the local agents, Eurotur. Well done, guys!

Entanglement

By Ivor Clarke

The phone beeped.

The picture on the screen was Colin, an old friend of mine who had gone on to great things, now being in charge of a large university research lab nearby. He was one of those folk who you have known for ages and then don't see for a year and carry on the last conversation you had without a pause.

"Hi, any chance you can do a little video job for us next week?" he asked.

"Let me look. . . . yeah, I can juggle things around. What is it you want?"

"Well next week we are having an opening of our new lab, it's all a bit hush-hush, but we would like a 5 minute behind the scenes video we can use for the web to promote the new facilities. I can do a VO for it after you've shot it and edited it."

"I thought you had an agency to do all your videos at the uni?"

"We have," he replied. "And they will be here for the official opening. But if they come up to do a 5 minute video, it'll take them a week with a camera-man, sound man, lighting guy, director and not forgetting the continuity / script girl. And interrupt the lab so we can't get on with any work."

I laughed, "I know how they like to get it just right even if it takes all day. I'll pop in on my way home for a recce if you like and you can fill me in with what you want."

"Great," he replied. "I'll Message you a pass code for the new security gates."

Things had changed a lot since I had last visited the uni, but the pass code Colin had sent to the phone worked and I got to park in a bay with a charging point right next to the impressive new glass and wood ply building at the rear of the old labs. Colin was waiting at the door with a plastic photo pass for me on a lanyard. "Nice to see you again, how do you like the new lab?"

"It's very modern looking building, eco-friendly, looks like a posh hotel with this entrance and atrium," I replied.

"Wait until you see inside. The main labs are now underground to stabilise the temperature and minimise vibration. Ho, by the way, you need to sign your life away with a none disclosure form." I signed the form at the desk in the foyer and he led me past more security to one of the lifts.

"This is all very James Bond type of secret hideout place," I said as the lift doors closed.

"Look, I've known you for decades and I trust you to keep what you see here to yourself," Colin said. "We are in a global race to produce the worlds first quantum computer which actually works properly. And not just for a few seconds, but to solve real world problems. Like modelling the Sun's magnetic fields to predict Coronal Mass Ejections, how virus change their RNA, how enzymes really work in the body, bioengineering, geology, solve problems in chemistry, medicine, engineering, discover new drugs, catalysts for chemistry, quantum medicine." Colin was really excited by what could be achieved. He continued, "How to modal new DNA changes in cells and how to block changes in mRNA. All these take days on the best super computers and a few minutes on a quantum machine. We can map the stars in the galaxy and their orbits around the centre, the long term orbits of all of the solar systems bodies to millions of years. We can use it to predict the weather better. You name it, we can do it

faster and better."

The lift doors had opened onto a short passage way with doors off for toilets and store rooms as well as the main lab. Near by were a set of lockers with coveralls and overshoes. We dressed in the paper covers and even the overshoes.

"We can't afford any contamination in the labs so that's why the coverups." Colin pressed the pad on the door with his pass and it opened into the Programming Room.

The lab was smaller than I had expected, but was brightly lit with soft daylight lighting. Rows of top spec Apple computers lined the desks with many laptops down the right hand side. In the centre were three islands also filled with computers with the tech guys bending over them, in all there were about 30 in the room. One corner had a small glass enclosed rest kitchen area with seats, a microwave and coffee machine. Down the left hand wall were cabinets with, I guess, different equipment inside. At the end of the room was a large glass window. We walked over, Colin nodded to some of the tech people working at the computers.

"In here is the heart of the operation, the quantum machines," Colin said proudly. I peered in through the thick glass window. Inside were three similar looking objects like three silver crosses at 90 degrees to each other coming out of silver ball, a bit larger than a tennis ball all spaced about 2 metres apart, with lots of wires and tubes coming out of each. Behind was another room which I assumed was the area were they adjusted the lasers and assembly.

"Is that what I think they are?" I asked Colin.

"Yes, those are the quantum computers," he laughed.

"But they are so small," I said in amazement.

"What did you expect, row after row of cabinets like in an old SciFi movie?"

"Well something bigger than a grapefruit," I answered. "Why three?"

"Well, each one is programmed by a team of different programmers, each with the same goal in mind and the three machines average out the result so in the end it is much nearer to the correct answer. Or even the right answer! At the size of these machines are, the speed of light around the components gives them the extra speed, in large setups transmission times can slow down the processing speed. In each of the centre balls is the quantum computer, each contain a twisted doped graphene membrane, folded several times onto itself, a bit like a strand of DNA, but many hundreds of times larger. This technique is called twistrionics, and it's all cooled down just below -200° so it's a superconductor. It is cold, but no where near 0° zero like a lot of superconductors need to be, so is easier to maintain. The bars poking out of the ball are lasers to format the doped graphene into the order to do the operation. They are also needed to read the quantum computer after the operation to extract the result. To say these quantum machines are tricky to code and read is an under estimate of how difficult it really is. The programmer has to think in 3D, that's what all the Mac's in this room do. Try to program the quantum machines. In ordinary computers we use what's called a logic circuit, but in one of these," he gestured to the machines, "quantum computers operate on quantum bits or qubits. Qubits can exist in quantum superposition as both zero and one simultaneously so they can be in four states simultaneously giving them tremendous power. We can go into the assembly room through the air lock, as we have the

coveralls on."

Colin opened a heavy door at the side and we went in. "The air lock has negative pressure to suck out any dust from this area."

With a hiss the inner door opened. Six or seven technicians in full coveralls were in the room spread around several benches all loaded with lots of measuring and scanning systems and tools. Along the wall racks were filled with backup parts and equipment and the super refrigerant cooling system.

"We have to make sure we are in a super clean environment because of having to adjust the lasers in the quantum processor cells. The slightest speck of dust could deflect the light off the mirror assembly, resulting in the wrong outcome."

"Very impressive, I suppose most of the rest of this stuff is just to keep the temperature correct?"

"Yes, that's right, but that's not all. . . ." Colin paused. "The rest of this installation is under us," he added mysteriously. "Come."

I followed him to a door at the side end, he flashed his pass, it clicked open. I followed him down a couple of storeys until we arrived at an armoured door with 'Do Not Enter' written in red below a window. "Have a look, but there is no point in going in here."

Colin stepped aside and I looked through the window into a room filled with cabinets, all but a few had a single green light on them, but the ones near the door were winking orange and green. "They're computer storage files, backups aren't they?" I offered.

"When we start to use the quantum computers in earnest the amount of data they'll produce is astronomical so we've had to come up with a better method of storing the data. I'll show you a sample in my office."

"Coffee?"

It felt good to be rid of the coveralls and in Colin's office was a good coffee machine.

"Please, you've got a nice office, better than the one in the old block."

"Anywhere would be better than there. Anyway, what do you think of this little beauty?" He tossed me a small grey cube about one and a half centimetres, it was quite light, one side had multiple gold connections in a grid.

"Is this a memory chip?" I asked.

"You wouldn't believe how much data that cube can hold. Once it's loaded it is like an ordinary memory card and requires no power. We think its life would be better than 1,000 years."

"You're kidding," I laughed. "Most memory cards have a life 5 to 10 top. And the more they hold the shorter they seem to last."

"Well it holds more than a petabit, a million gigabits, just one of these can store about 10,000 human DNA sequences." I stared at the little cube. "It could hold every image and video for several lifetimes for every member of your family. And last for future generations. And we've got thousands of 'em in dozens of cabinets."

"Where can I buy one?" I asked.

"Maybe in a few years time, if, when, it gets taken off the secret list," Colin answered mysteriously. "Now you can see why I don't want the agency swanning about shooting video down there." Colin had a dim view of the London agency folk who knew nothing of science and even less about keeping quiet about what they could have seen.

"I'll tell you bit about these machines," Colin knew I was interested in the science of computing even when it went completely over my head. "Have you heard of

Entanglement?" he asked.

"It's what Christmas lights do when you carefully pack them away one year and try to put them up next year." I offered.

He laughed. "Well yes, that's true, but the Entanglement I mean is in quantum mechanics. Even Einstein didn't like it and called it 'spooky action at a distance'. In the quantum world two or more particles can be linked across space instantaneously in a way so it defies logic. But it can be shown to be a fact. It's called nonlocality, subatomic particles that seem to violate special relativity, for instance they can be light years apart yet still react the same. There are lots of augments on both sides with this, but we have shown it does work. As can be seen in our three separate quantum machines, they have no direct connection with each other except Entanglement."

"Well they are a lot closer together than light years, so how do you know they 'talk' to each other?" I asked.

"In the results we see. I'll give you a copy of one of our less technical papers to read and you can get a sense of what's it all for. I must say an awful lot of government money has gone into this world class department. And don't forget countries all around the world are racing to develop quantum and AI machines like the USA, Russia and China with its National University of Defence Technology funded by the People's Liberation Army in Changsha and they are pushing forward. Sending students to all the western universities with computer courses." He paused, turned to the bookshelves behind him and took a folder off a pile, "We want to beat them. Here's the press pack for the science magazines, it's more detailed than the one for the dailies. See you next Wednesday for the opening at 2.00pm."

By the Wednesday I had got through most of the press pack Colin had given me, more detailed he had called it, good job he hadn't handed me a technical one! I had arrived early to see what was happening, the agency were there making everyone run around for them. Lots of greenery, shrubs and small trees in large pots added a nice eco-look to the place. I wandered in, a large meeting room off the reception had been turned into a make believe lab with some of the computers from downstairs running simulations with a mocked up quantum computer in a glass box in a corner.

"Hi, the boss said to look out for you. My name's Tom." A tall chap in a lab coat offered his hand. "I saw you with Sir last week in the lab and he asked me to look after you today as he'll be tied up with all the Big Wigs and hangers-on for most of the afternoon."

I introduced myself to him and gave him a brief idea how I knew Colin from our old student days at the local astronomical society and what he had asked me to do.

"Sounds good," Tom said. "This London lot know next to nothing about what we are trying to achieve here. Let's grab a coffee and we can decide how we proceed."

We went up stairs onto a small balcony with tables and chairs and a drinks machine in the wall. "I can shoot most of the opening ceremony from up here with one camera and have a hand-held one on the floor." I said. "It should be safe to leave it up here running the whole time."

"Sounds like a plan," agreed Tom. "No-ones going down into the main lab today, it's all up here as a dem. That lot will never know," he laughed. Tom obversely had a high regard for the agency crowd too.

"What's your job here?" I asked. He took a sip of his coffee.

"I'm one of the programmers who look after the Macs, the really brainy guys use them to program the quantum machines, they have to program in 3D. Can you imagine? I

work mostly on the middle one Meeni, we call them Enni, Meeni, Mynee between our selves. Don't tell the boss who just calls them A,B,C. There are about 5 or 6 of us in each team trying to write the code for one them, each team has a machine to themselves and we all have to work on the same problem simultaneously, So far, we have run the machines one at a time and we've had one twin run. We hope to run all three together soon. It does mean lots of late nights, but we are getting there."

"It sounds like you have years of work ahead." I said.

"True, but we are still trying to figure out what the hell is happening a lot of the time. The lasers have to be set up very carefully with the tiny mirrors angled right by millionths of a degree to hit the correct bit of the doped graphene. It's a really rare earth metal that's very hard to get hold of and even harder to coat and dope the graphene. That's what the Macs do, what I do, program the lasers to fire into the graphene ball at the right spot. Then we collect the data from the run, and then, use the Macs to analyse it all. For instance, all the data we get off the quantum machines goes into the store below, in the first few runs it filled a few of memory cubes, but some of the recent runs and one, one evening last week, two cabinets got filled with data. It's going to take ages to go through all that to find out what the heck it is. And where did it all come from in a simple test run?" Tom shook his head. "We could all do with a good nights sleep around here."

"So is all that storage backup for the Uni too?" I asked.

"Yes, we've got all the Uni files and library and backup from the very first computers in the 60's to date loaded into the cabinets. We don't access any of that as it contains student files and such with passwords."

"I'd better get ready," I said finishing off my drink.

"Thanks for the info. I'm sure it will come in useful in the finished video."

I got up and went to fetch my camera equipment for the opening.

I didn't hear from Colin or Tom for a couple of days, then I called and made arrangements to go in one morning to get some footage in the lab and workroom along with some 'talking heads'; tech and lab folk saying how great the new labs were and what they do. This all went off smoothly and as I was finishing up for the day Tom arrived with a message.

"The Boss just grabbed me and asked if you can come back about 7.00pm tonight to shoot a real run? Not a test like up to now. We're going to run all three machines simultaneously."

"OK, wow, that'll be fine. This will be exciting to watch." I replied. "Can I leave my stuff in the little office till then?"

"Yes, that'll be OK, everybody knows you now and what you'er doing. See you at 7.00. It might be a long night." Tom warned.

Four hours later I was back down in the lab with all the tech guys and programmers. The atmosphere had changed to one of anticipation at the prospect of a successful run. Colin and Tom were by the window looking at the quantum computers which were now covered in a frosting of white. Colin turned as I approached, "Hello, you're just in time, we've got them down to operating temperature, in a while we'll start the run."

"Great, I'll grab my cameras and keep out of the way," I replied. "How long will the run be?"

Colin and Tom looked at each other, "That's a great question," Tom said. "And I wish I could answer it."

"Several minutes at least," added Colin. "You can see the progress on the big screen on the wall. It shows how far the program has run and the amount of data produced."

I started with a few establishing shots, then a few close-

ups of the frosted computers, fingers on keyboards, shots of screens, eyes peering at data, shots of the new big wall screen. After an hour or so the room went quiet and one of the quantum programmers did a count down to execute the start. Nothing seem to happen for a couple of seconds then the lines on the big screen started to move. A little ripple of excitement ran round the room as the bar started its progress across.

"What the hell's happening?" Suddenly cried one of the tech folk looking at one of the Macs showing the data storage.

We all rushed to the side to look at the large 32" screen showing the storage capacity of the vault filling up at a frightening speed. One after another of the storage cabinets were being filled at an alarming rate.

"We'll be out of memory in less than 15 minutes at this rate. This was supposed to have 10 years storage capacity." Colin said, his voice shaking with disbelief.

"50 seconds until end of program," someone announced. That 50 seconds was a long time in quantum computing, trillions upon trillions of calculations were done and the data store continued to fill. Near the end it slowed and the program ended.

"What have we just seen?" Colin asked everyone in the room after a long silent pause.

"The store looks like it's nearly a third full." The tech lady sat in front of the store screen said in disbelief. "What could have filled so much memory so quick?"

"Is it real data, not just noise or random junk?" Asked one of the team.

"No, it seems like real data, but it's in a funny form, is it Chinese?" She asked. "How, if it is, did we get hold of it?"

"Quantum Entanglement," said Colin after a pause. "I bet the Chinese use the same rare minerals as we do in their graphene and with entanglement it grabbed their data."

I suddenly had a disturbing thought, "Maybe it's not just the Chinese or Russians."

Colin looked at me with a look I hadn't seen for many years, when I was pulling his leg about some strange fact I'd read. "Go on."

By now the whole lab was looking at me. "Well, where did all the rare-earths and minerals come from? They all formed in super nova explosions, possible 8 to 10 billion years ago, then cooled into gas clouds. Our Sun and planets started to form along with God knows how many other star systems around 5 billion years ago. We could have formed in a gas cloud bigger than M42, the Orion nebula and that has hundreds of stars forming in it right now. As the stars light up they push away the other gases and eventually the stars go off on their own orbits around the galaxy. But we could have lots of brothers and sisters and cousins, all born from the same materials as other star systems roughly the same age as our Sun. And as over half of all stars have planets. Mr Frank Drake might be right with his numbers of intelligent civilisations in the galaxy!"

"You mean what I think you mean," said Colin in a low voice. "We have grabbed all the data stored by alien civilisations who are using quantum computers at this moment, and I suspect if it's true, they have our data too."

"Well look on the bright side," I replied, "it's not often a world shattering event gets a full video recording of it happening."

Further reading I would recommend

The World According to Physics By Jim Al-Khalil, Princeton University Press, 2020

Jim Al-Khalil is professor of physics at the University of Surrey and has presented many science programs on the BBC.

Tides

By Geoffrey Johnstone

In the December meeting Irene presented a talk on the Moon, which was most interesting and enjoyable. As she talked my passed life flashed before me and my mind was filled with thoughts and anecdotes so here are the ones I can remember, and they are mostly about tides.

Irene talked about the tides and why there are usually two tides per day. I have never really understood why there is a second tide which occurs on the opposite side of the Earth to the Moon. I have even tried to understand the actual mathematics used to explain the phenomenon. My maths is not that good so I abandoned that line of enquiry. Then I sat and used 'deep thought' and came up with the following, probably incorrect, but at least it makes sense to me. It goes like this. The Earth Moon system is actually a double planet with the centre of mass just inside the Earth. In fact about 1700 miles below the surface. I have been thinking that instead of the Earth following a smooth curve as it goes around the Sun the pull of the Moon causes the Earth, as it rotates about its centre of mass, it move towards or away from the Sun by a very small amount. Because the seas are a fluid and not solid they get left behind when the Earth moves slightly closer to the Sun, hence this causes the tidal bulge on the opposite side to the Moon. That is my explanation right or wrong.

This paragraph is copied from the internet. *The tide at any place can be thought of as the sum of a large number of components, called constituents, each of which is associated with a distinct physical (usually astronomical) cause. As long as the periodicity of the constituent is known, its amplitude (size) and timing with respect to other constituents (its phase) can be found by a process called harmonic analysis. The first practical method was put forward by Sir William Thomson (Lord Kelvin) in 1867. So now you know.*

Due to topological differences there are places where more or less than 2 tides a day are possible. There are 4 high tides a day in the Solent. There is a narrow channel between the mainland and Seil island in Scotland where, what ever the tide, it is said that water always flows in the same direction. In some parts of the world there is only one tide per day, which is apparently due mainly to the fact that the Moon's orbit is tilted with respect of the Earth's. The rest of the explanation is beyond me, so look it up yourselves.

High spring tides always occur about two days following new or full Moon. Two places where I have had more holidays in the UK than anywhere else are Barmouth, in Wales, and Weston Super Mare. High spring tides always occur close to 9 or 10am or pm in those places, but I can't say that this is the same everywhere in the UK. The highest of a spring tide series always seems to be slightly higher in the evening than the morning. This is known as diurnal inequality and is explained by the tilt of the Earth in relation to the tilt of the Moon's orbital plane. When holidaying in Barmouth there was a notice board which displayed the tide times and heights, and every time we went in the town I studied the tide times. This was partly from necessity as holidaying with the children 40 years ago, decent showers were absent from most caravan sites. So sea bathing apart from a pleasure was essential!

Here are some tidal anecdotes. When my Son was doing his PhD on the energy use of certain species of birds at

Sterling University, another student was studying estuarine bird foraging. He needed to do all his field work at low tide. Because the tide was roughly high on one side the Kintyre peninsular and low on the other he could just drive backwards and forwards across the peninsular.

I once went to a talk on tidal bores, and it was far from boring, in fact it was fascinating. Until that talk I wasn't aware that tidal bores were common on rivers other than the Severn. During the presentation videos were shown of bores on several UK rivers. The internet says bores are possible on the rivers Dee, Eden, Great Ouse, Kent, Lune, Mersey, Trent, Nith, Parret, and Ribble.

An eclipse in China, probably 2009, was attended by the usual eclipse chasing crowd. Another highlight of the trip also included was to view one of the most spectacular tidal bores in the world. Hmm yes, good plan. So all the eclipse chasers stood on the banks of the Qiantang River located in east (China's) Zhejiang Province at the appropriate time and waited, and waited and nothing happened. You can imagine the banter going on until they all went back to their coaches and hotels in disgust.

Equinoxial spring tides occur near the equinoxes, which occur near March and September. This is when both the Sun and Moon are over the equator so their combined effect raises unusually high tides. If they occur when the air pressure is low and there is an on shore wind blowing, the tides can be spectacular. There was a ferryman at Dartmouth who decided to do some work on the hull of his boat, so he beached it at high tide in March. It was September before he could refloat it so he missed the whole of the summer season!

A friend of my father in law was pottering down the River Severn in his cabin cruiser, when a man on a boat coming the other way shouted to him to pull into the side and tie up. Thinking a larger boat might be coming he did as he was told. To his amazement the height of the river rose 6 feet in the space of a few minutes and the water turned into a raging maelstrom.

It has been shown that minor earthquakes in earthquake regions are more common near new and full moon as the tides raised in the Earth also causes slight stresses in already unstable ground.

I showed this piece to Irene before sending it to Ivor for MIRA as it refers to her talk and she has kindly added another anecdote which is below.

I was brought up in a village on the edge of the flood plain of the River Usk which flows into the Bristol Channel at Newport, right on the edge of the mouth of the River Severn. As you know, my home country is prone to wet weather, being on the wrong side of rain-bearing winds from the west, so, after periods of heavy rain, water from the hills would come raging (literally, in some cases) down the Usk valley, bump into high tides' water and back-up into the valley. Even, right now, especially at full moon, and after the recent rain, the flood plain is living up to its name. Low-lying fields are covered and, at its worst, the water comes up to the edge of the churchyard. Everyone in Wales has a selection of wellies and I used to have the odd day off school as, before embankments were built along its edge, the road was flooded and the school bus wasn't amphibious!

Dear Human, A warning recived by Irene RogersSkaro
2021

Dear Human,

I read a review written by an American critic for his American readership of the latest "Dr Who v The Daleks" BBC TV production. He said that, given how many times the Daleks have appeared on Earth, he was always amazed that the humans they encounter don't know who and how dangerous they are.

Exactamente, my dear friend, and that is precisely what we've been working towards. Our researchers say that, by now, Dr Who had been televised in 94 countries and dubbed or subtitled into 15 languages, so most of the world's Sci-Fi watching human population believe they know exactly what a Dalek is - an extra in a metal costume - a figment of imagination. A concept raised by Terry Nation in the 1960s and realised in physical form by designer, Raymond Cusick - although we must say a half-tennis ball studded dustbin with a sink plunger and a corkscrew brush was not exactly the image we'd channelled to them, however. . .

When I say, "channelled" I mean it. I know Terry Nation has said he had Nazi culture in mind when he wrote his stories but that was what we had planted in his thoughts after studying their methods. The Nation notion of a master race bent on world domination and determined to exterminate everyone else who stood in their way was our notion.

The Doctor characters in their various guises always defeated their assorted enemies but we, like the Cybermen - who, after all, are just a variation of us - always seem to survive to try again. But, unlike the fictional Doctors and the Cybermen, we are real; we exist.

Why would you want to bother with our pitiful little polluted planet? I hear you ask. A good question, and the answer is, because we can. Have you ever heard of Dalek mummies and daddies, and little Dalek children? Of course you haven't. Everything - personal - like that we keep secret, as well as how we manage to build our ships and shells and learn your various languages. After all, a secret is only a secret if it is kept. . . a secret.

All you need to know is that we can and will take your planet and eradicate you in the process. And it will be so easy; you are all so familiar with us now and you are all being confined in your various little communities too! It is the perfect time for us to act; we have been waiting in our ships for just this moment!

So, the next time you see a Dalek appear in your streets, human, it will not be that extra in his metal costume, it will be one of us and when we exterminate you, you will stay exterminated!

Be afraid, be very afraid.

Yours (well, not really),
Davros the Third.

NB.

We have read HG Wells' "War of the Worlds". Don't expect one of your plague particles to get us.

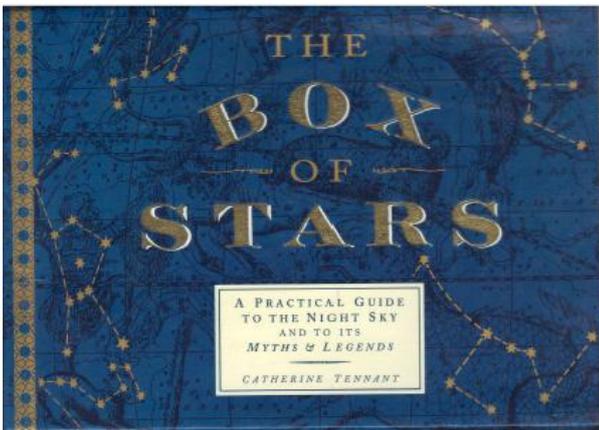
Our shells protect us from everything!

The Reverend Richard Rouse Bloxam (1765-1840) and a Box of Stars

By Mike Frost

A few years ago, I purchased a lovely and unusual astronomical object.

It's called *The Box of Stars: A Practical Guide to the Night Sky and to its Myths & Legends*, produced by Catherine Tennant. The Box of Stars is a collection of 32 coloured cardboard pictures of the constellations of the night sky, with the stars embedded into pictures of the mythological constellations. The source of the pictures is Alexander Jamieson's *A Celestial Atlas* (1822) engraved by Sidney Hall. Best of all, the stars are pinholes of varying size, larger for the brighter stars, smaller for the fainter. Hold a card up to the light, and the pinpricks show an approximation of how the constellation looks in the sky.



There's a very useful booklet accompanying the cards. This makes it clear that *The Box of Stars* is a reprint of a much older publication, *Urania's Mirror*, which was published in 1824 and was very popular almost 200 years ago. The pictures are all taken from *Urania's Mirror*, but I can understand the change of title – who nowadays would know that *Urania* was the Muse of Astronomy in Greek mythology? Probably not even astronomers! But we forget just how widespread classical education was 200 years ago. I suspect it's also true that the best way to use the cards is with candlelight, prior to going outside into pitch dark skies to see the real thing.

Urania's Mirror was attributed, anonymously, to "A Lady", and ever since its publication, there has been speculation as to who that lady might have been – perhaps Caroline Herschel or Mary Somerville. That speculation was ended by Peter Hingley, librarian of the Royal Astronomical Society, in a paper in the *BAA Journal* in 1994 *Urania's Mirror: a 170-year-old mystery solved*. Many of you will remember Peter, who lectured to C&WAS many years ago. He was a popular and likeable man whose sudden death, just before planned retirement, robbed the astronomical historical community of one of its most knowledgeable members.

Peter was cataloguing the fellowship applications for the RAS, when he came across the application, in 1829, of Revd Richard Rouse Bloxam, rector of Brinklow, to the east of Coventry. On the nomination form, signed by his four proposers, it stated, matter-of-factly, that Bloxam was the author of *Urania's Mirror*. Bloxam may not have known that this was disclosed on the form.

So, what do we know about Bloxam? As often in my research, I turned to my friend Chris Hicks from the Rugby Local History Group. He was able to fill in a lot of gaps in my knowledge. It turns out that Bloxam was a schoolteacher, at Rugby School, as well as a clergyman. The registers of Rugby School record 12 members of the Bloxam family – Richard,

his five sons, and other cousins and connections. According to his son Rev John Rouse Bloxam, the family migrated from Bloxam, Oxfordshire to Gloucestershire in the 17th century.

Richard Rouse Bloxam was born in 1765, the eldest son of Richard Bloxam, a medical practitioner in Alcester. He was sent to Rugby School in 1777. He paid 14 guineas a year for board, but had to provide his own towels, knife, fork and drinking horn. However, he was always hungry. He decided to run away to Market Harborough. To do this, he had to cross the Clifton Brook, but could not face wading through it, so turned back (the Market Harborough road crosses Clifton Brook at a location called Butler's Leap, which suggests a difficult fording!). At the age of 12 he was already keeping a diary and his detailed record of Speech Day in 1777 provides the first complete surviving programme for the event. The diary also records the start of building a westward extension of the 1750 Big School on 3rd September 1777. (The school had moved from Church Street to the present site in 1750.)

Richard matriculated as a student of Christ Church College Oxford in 1782. He was awarded his B.A. in July 1787 and was ordained a Deacon on the same day. He received his MA in September 1793 and was ordained priest at the same time. In November 1793 he was appointed rector of Brinklow. In 1790 he had been appointed an assistant master at Rugby School by the headmaster Dr James. In 1794, Bloxam was teaching the Second Form, when Henry Ingles became headmaster. Around 1800 he was listed as running a boarding house, when an assistant master taking in boarders was unusual.

In December 1802 he was appointed domestic chaplain to Charles Stanhope, 3rd Earl of Harrington. In January 1803 he was also appointed vicar of Bulkington. He was officially licensed as a schoolmaster with Rugby Free Grammar School in March 1804. In 1807 he bought Elborowes's House on the junction of Sheep Street and School Street – the house faced School Street with the property running down Sheep Street. After his death in 1840 it was bought by surgeon Bucknill. The main house was pulled down in 1926 and the Merry Minstrel pub built on the site – it now houses now a (very good!) Thai Restaurant.

On 10th March 1796 he married Ann Lawrence, sister of Sir Thomas Lawrence, who was president of the Royal Academy. They were married at St. Anne's Soho, Westminster, London. They had five sons and four daughters.

Their five sons were admitted to Rugby School as foundationers (attended for free as Rugby residents): Rowland Jan 1802 aged 5, Thomas Lawrence aged 6 on 17th Feb 1805,



Bootes, Canes Venatici, Coma Berenices & Quadrans Muralis

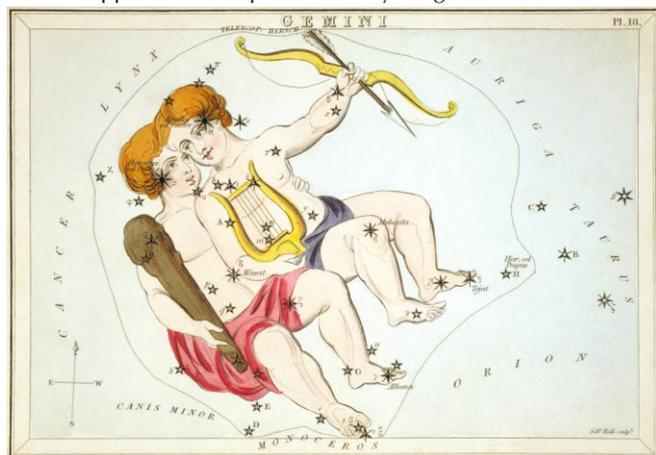
Henry aged 7 on April 29th, 1806, Andrew on Sept 22nd, 1808, Matthew Holbeche aged 8 on May 12th, 1813 and John Rouse aged 7 in April 1814. Three became praeposters (class monitors doing some teaching) and Andrew and John Rouse were Exhibitioners. Thomas gained a scholarship to Lincoln College Oxford, Andrew a scholarship to Worcester College Oxford. Henry and Matthew both became lawyers. Additionally, Matthew Holbeche Bloxam is well-known in Rugby as a local historian and antiquary. Lucy Bloxam (baptised 1804) married Revd Roger Bird, but Anne (baptised 1801) and Mary (baptised 1809) were still spinsters at the time of Bloxam's will; Susan (baptised 1803) isn't mentioned in the will and so may have died young.

In 1827 Richard resigned from the School, the year before Thomas Arnold was appointed headmaster. However, he was appointed to a School Fellowship (a form of pension for assistant masters) until he died in March 1840. The School Fellowship was created in 1826 and abolished in 1868 by two Rugby School Acts.

Because of Matthew Holbeche Bloxam's stature as a local historian, the name Bloxam is well-known in Rugby today. There are roads called Bloxam Gardens and Bloxam Place, a Bloxam Room in the Town Hall, and a Bloxam Primary School close to the town centre.

There is an interesting connection between the Bloxam family and the family of another Rugby-based astronomer, Joseph Norman Lockyer, discoverer and namer of helium. Joseph Hooley Lockyer, Norman Lockyer's father, was a member of Rugby's literary and philosophical society. On 11th March 1839 he made an application to register a printing press (registration of such dangerous devices was mandated by an anti-sedition act of 1799). The application was witnessed by Matthew Holbeche Bloxam, presumably in his capacity as a lawyer. The document was held in the archives of the late Ernest Timmins, another local historian. Amusingly, the indexing notes on the document state that "Bloxam was a well-known local antiquarian but nothing is known about Lockyer".

It seems that Richard Rouse Bloxam had a reasonable career as a clergyman and teacher – but there really doesn't seem to be much astronomy! Apart from *Urania's Mirror*, he doesn't appear to have produced anything else. His will



Gemini



Orion

mentions "philosophical instruments", so perhaps these included a telescope.

However, he does appear to have been part of a network of astronomically interested clergy in the Midlands. It's instructive to carry on reading Bloxam's application form for RAS fellowship. At this time, four nominators were required. Bloxam's nominators were Revd William Pearson of South Kilworth, Revd Thomas Belgrave of North Kilworth, the leading instrument-maker Edward Troughton, and Dr John Lee, who had an observatory at Hartwell, near Aylesbury. The villages of South and North Kilworth are to the west of Market Harborough, 8-10 miles north-east of Rugby and both Revd Pearson and Revd Belgrave stated they knew Bloxam personally.

As you probably know by now, I have written a lot about Revd William Pearson, the co-founder of the Royal Astronomical Society. He was born in

Whitbeck in the south-west Lake District; Troughton was born not far away in Corney, so it is likely the two had known each other for some time. William Pearson's assistants included Thomas Pooley, who also went on to work at Rugby School; perhaps Bloxam helped him land a job. Dr John Lee was part of a circle of Buckinghamshire astronomers called the Hartwell Synod; he drew Moon maps on which he named several craters after astronomers he knew; for example, Smyth, honouring his friend Admiral William Smyth.

One last question remains. Why did Bloxam publish *Urania's Mirror* anonymously? Peter Hingley offered several solutions. The marketing of *Urania's Mirror* as by "a Lady" precluded the identification of a man as the real author. Perhaps Bloxam felt that the cards were unbecoming for someone with his status (although I doubt this, as they are surely a useful educational resource). Or perhaps he was just modest. Whatever the reason, Bloxam's anonymity set up an amusing mystery which Peter Hingley solved 170 years later.

Well done, Peter. We miss you!

Sources and Notes:

I acknowledge, as often, the assistance of Chris Hicks in providing local historical information. "A Box of Stars" by Catherine Tennant can be purchased from Amazon (and other retailers!) <https://www.amazon.co.uk/Box-Stars-Practical-Guide-Legends> "Urania's Mirror – a 170-year old mystery solved", P.D.Hingley (J. Br. Astron. Assoc 104, 5, 1994, pp. 238-240) Bloxam's nomination for RAS Fellowship reads (as far as I can decipher!) as follows:

The Revd Richard Rouse Bloxam D.D. Author of Urania's Mirror and Rector of Brinklow in Warwickshire now resident at Rugby being desirous of admission into the astronomical society of London [the name the RAS took before receiving its Royal charter], We the undersigned propose and recommend him as a proper person to become a member thereof.

Witness our hands this 9th day of November 1829.

W.Pearson } From Personal
T.Belgrave } Knowledge
Edw. Troughton
John Lee