Heavens Above - A Chronicle: 02 All Year - Part 2

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16. NEW FOR OLD

(For 28th May 2002)

One of the exciting things about astronomy is that nothing ever stays the same for long. New discoveries are always being made, and old ones often have to be revisited.Nothing highlights this more than a recent announcement by astronomers and a quick revisit to a set of references on my bookshelf.

In my first Encyclopaedia of Astronomy, dated 1966, it tells me that Jupiter has twelve satellites, or moons. When I flick through a more recent solar system reference book, (1978 edition), I learn that Jupiter has an extra moon, number thirteen. Collins's pocket book "Stars and Planets" (1995 edition) informed me that Jupiter has sixteen satellites. Going up! And when I purchased my first ephemeris by Quasar Publishing, 'Astronomy 2000' (a must for any amateur astronomer), it confirmed that Jupiter had sixteen planets.

But in 'Astronomy 2002', it seems that Jupiter had twenty eight satellites. What happened? Larger, more sensitive telescopes and data analysed from space probes is what happened. Of course, a lot of these satellites are not what you would call 'moons' in the sense of our large Moon.

Then this month astronomers announced that another eleven satellites had been confirmed around Jupiter, bringing the total to thirty nine. These are very small, some only 5km diameter, probably captured asteroids. It's amazing how they see them.The same story goes for Saturn – from nine to thirty and counting. So when getting facts from an astronomy book, first check its publishing date. Things change.

(Update - as of 2008, Jupiter now has 63 moons - RB)

17. SOLAR PIN BALLS

(For 13th August 2002)

We all know that the Earth is an average of 149.6 million km from the Sun and the light from the Sun reaches Earth in 8.3 minutes. So if the Sun is 1.4 million km diameter, how long would take a newly created photon of light to travel from the Sun's centre to its surface? If you pulled out your calculator and got 2.3 seconds, I'd have to tell you that you're wrong – very wrong.

The Sun is mostly made of hydrogen and helium, and its energy, in the form of photons, comes from the nuclear fusion process of converting that hydrogen to more helium. This goes on at a prodigious rate, about 5 million tonnes of hydrogen being converted to helium and energy every second.

Now the core of the Sun is extremely dense and when a photon of light travels less than 1 centimetre, it hits another hydrogen nucleus and is absorbed, then re-emitted. This goes on, centimetre by centimetre, sometimes forwards, sideways, even backwards. It's like a cosmic pinball machine, or like a soccer team passing the ball backwards and forwards, building up an attack on goal.

So with this devious route, with trillions of detours, how long for a photon to reach the Sun's surface? Not 2.3 seconds but anything from hundreds of thousands of years to a million years. Then, a quick non-stop 8.3 minute trip to Earth.

This means the sunlight warming our backs is actually older than human history itself.

18. ASTEROIDS GALORE

(For 27th August 2002)

There's been a lot about asteroids in the news lately. In the scientific circles it has been precise and unemotional, while in the tabloid press it has been… well face it, doom and gloom sells papers.

That's not to say that a large asteroid won't hit Earth one day. But the last really big one was 65 million years ago (the dinosaur killer) and astronomers estimate that such an impact will occur, on average, once every 100 million years. So the next big hit could be anytime in the next 35 million years.

My concern is the manner in which some news media distort facts for sensationalism. They printed banner headlines "Asteroid to hit Earth in 2019" for 1.2 km wide asteroid 2002NT7 'forgetting' to report that astronomers said there was less than 1 in a million chance of that happening. This frightens people unnecessarily. The odds have since been reduced to virtually zero.

A recent non-reported event was that on 18th August, an 800m long asteroid (2002NY40) narrowly skimmed past Earth at 530,000km. That's just 1.3 times the distance to the Moon and only marginally smaller than 2002NT7. Astronomers discovered it in July and predicted this near miss very accurately yet it received no media attention. No doom factor, it seems. Back in July, a 100m asteroid missed Earth by 75,000km, less than a third the distance to the Moon.

The moral of all this? Plan for your retirement with confidence, for a near miss is as good as a mile.

19. IT TAKES TWO TO TANGO

(For 24th September 2002)

We are very fortunate on Earth that our Sun is a single star. By that I mean the Sun is not gravitationally linked to another star. If it was, the evolution and sustaining of life on Earth would be highly unlikely, if not impossible.

Why do I raise this point? Because well over 50% of all stars in our Galaxy (and, we might assume, other galaxies) exist in multiple star systems. That is, two, three or more stars gravitationally bound together, orbiting each other in near-circular or eccentrically elliptical orbits, very close together, or very far apart. Sometimes two stars will orbit each other while a third will orbit around those two.

Alpha Centauri is a nearby example of this. Its two main stars are sometimes only as far apart as the Sun and Saturn and orbit each other in 80 years, while the third, Proxima Centauri, is 1/10th a light-year away and orbits them in a million years.

In some delightful cases, one pair of orbiting stars will orbit another pair of stars, making a double-double, or a quadruple. And so it goes on, 'dancing with the stars'.

When two stars orbit each other, they are called a "binary star." This is to distinguish them from the other type of double commonly seen, called an 'optical double.' An optical double occurs when two stars, totally unrelated gravitationally and probably vast distances from each other, just happen to be aligned from Earth's viewpoint and seem to be very close. There are plenty of those, too.

20. THE SOUTHERN AURORA

(For 8th October 2002)

I was with some other members of Macarthur Astronomical Society at a dark site south of Berrima on 7th September this year (2002) when we were fortunate to witness a display of the Aurora Australis, or Southern Aurora. Though we were dragged from our warm beds at the ungodly hour of 4am, we didn't mind a bit after we saw the spectacular curtains of red and purple soaring above the southern horizon and through the trees. Piercing the curtains, like search lights were towering white beams reaching from horizon to the black sky.

This was a truly inspiring sight and the first aurora I had ever seen 'in the flesh.'

Southern Auroras and Northern Auroras are exactly the same phenomena and usually occur at the same time as a result of a sudden and large flare on the Sun. Northern Lights are only more heard of because there are larger populations living in those latitudes of 60º north and higher. Not many (except penguins and bearded scientists) live in the same southern latitudes.

Basically, when the Sun throws out huge amounts of charged particles from a flare, they reach Earth about a day later and react with Earth's natural magnetic fields, forming the weird shapes we see. They are visible because the particles electrically react with various elements in the atmosphere, producing the different colours of red, purple, yellows and greens.What was amazing that night was that we saw it at such a high latitude. I can only guess how magical it would have been from Tasmania.

21. KUIPER BY THE DOZEN

(For 22nd October 2002)

Astronomers are abuzz over the first visual confirmation by Hubble Space Telescope of a Kuiper Belt Object (known as KBO.) (More have been observed since this first discovery – RB.) The Kuiper Belt is a large collection of frozen celestial bodies strewn around the solar system at distances beyond the orbit of Neptune. It is thought there may be billions of them, in sizes ranging from a house to as big as Pluto. They are the remnant of the material that formed our Sun and the planets.

The object in question is Quaoar (pronounced kwa-whar), the name of a native American god given to it by its discoverers. Quaoar is thought to be 1,300 km diameter and 6 billion km from the Sun. This puts it about 1 billion km beyond the orbit of Pluto and the biggest object discovered in our solar system since Clyde Tombaugh found Pluto in 1930.

While not as big as Pluto (2,300 km diameter), it is larger than Pluto's moon Charon (1,200 km). It is also larger than some other KBOs discovered in recent years. Varuna is about 900 km diameter, while Ixion is estimated to be 1,200 km. So the Kuiper Belt is being found to contain a lot of large objects. They expect to find many more, some even larger than Pluto.

In fact, these KBOs are denting Pluto's case for retaining the title of planet. Most astronomers agree that if Pluto were discovered today (and not in 1930), no-one would even consider calling it a planet, as it is clearly 'just' a Kuiper Belt Object.

22. FOREVER NEW

(For 14th – 21st January 2003)

I'm sometimes asked: "Isn't astronomy boring after a while? Once you've seen everything, that's it. Everything stays the same." Nothing could be further from the truth.

It's like all hobbies – the deeper you go into it, the more you discover there is to do, until you realise you don't have enough lifetimes to make a dint in it. With a modest reflecting telescope of 200mm (8") or larger, the solar system, Milky Way galaxy and the closer universe up to 50 million light years away are attainable and much of that can be seen even with a 100mm or 150mm scope.

This raises the agonising question on club field nights (often going from sunset to sunrise): What will I observe tonight? Will I track down Moon craters or mountains, planets, multiple stars in their glorious colours, open star clusters (with thousands to choose from), globular clusters (hundreds, all different), wispy nebulae (hundreds, all unique) and the prize of prizes – galaxies of all shapes and sizes?

That's putting aside the occasional distraction of passing comets, variable stars, searching for supernovae in other galaxies, lunar and solar eclipses, and even the Sun itself. And then there is astrophotography.

The exciting thing is that there is something new for the amateur astronomer to discover every night, no matter how many years they have been at it. As Hamlet said: "There are more things in heaven and earth than are dreamt of in your philosophy."

No, I never get bored.

23. ASTEROID POTTERS ALONG

(For 4th February 2003)

Astronomy often has its quaint surprises and coincidences. I stumbled across one this week after having seen the latest Harry Potter movie.

There is a growing list of discoveries of asteroids and Kuiper Belt Objects (KBOs) which are actually binaries. That is, despite their relatively small sizes, they manage to have enough gravitational pull to hold a smaller companion object in orbit about them. An extreme example of this is Pluto and Charon, which purists maintain is not really a planet and moon but a large binary KBO.

All in all, presently astronomers know or suspect the existence of 31 binary asteroids and KBOs, spread between Earth crossing orbits to far out in the Kuiper Belt beyond Neptune. I'm sure that as time goes by there will be many more discovered. The strange becomes the commonplace. Recent observations of a 210 km diameter asteroid (No. 121) through the giant 10 meter Keck telescope shows it has a 13 km wide orbiting companion, about 650 km away. But how's this for coincidence and timing? The asteroid is called Hermione, a name very familiar to Harry Potter fans.

However, searching the net, I can't find where the asteroid's name came from. Is it from ancient mythology, or named after the discovering astronomer's grandmother? Maybe the astronomer was a Harry Potter fan and was able to slip it in? The question is: what should they call the small companion? How about Hermione's cat? Can anyone remember its name?Astronomy – it's magic!

24. BLAME IT ON THE HYPERNOVA

(For 15th April 2003)

I've often said that the universe is a big place, covering unimaginable distances and occupied by a mind boggling number of galaxies and stars. Our finite minds have great difficulty comprehending the numbers involved. Astronomers have had to invent new names for numbers which just had too many zeroes attached to keep writing down.

Hence, the 'googol' for a 1 with 100 zeroes after it (10_{100}). And the googolplex? Don't ask. OK, you asked. It's a 1 with a googol number of zeros after it (10_{googol}).

But professional astronomers, used to these huge numbers, were still like the proverbial stunned mullets when they observed a stupendous explosion in a galaxy two billion light years away. It was a hypernova, the violent demise of a star from 50 to 100 times more massive than our Sun, giving birth to a massive black hole. Light from that event had been traveling across the universe unimpeded for 2 billion years, to reach Earth at 10.37pm on 29th March 2003 as an average brightness star, fading quickly within the first minute.

What staggered the astronomers, and still gives me a headache to think about it, was the unbelievable amount of energy released by that single star's explosion. Imagine this: One million times the energy being given out by all 400 billion stars in our Milky Way. That's 400 thousand million million stars worth of energy – in one minute. During that minute, the exploded star would have been one million times brighter than its home galaxy. Wow!

So why are the astronomers recharging the batteries on their pocket calculators? Blame it on the hypernova.

(As an unrelated aside, the googolplex is such a large number that the late and famous astronomer, Carl Sagan, it reputed to have said that you could not possibly write down the number googolplex as a 1 with googol zeros behind it because the observable universe is

not large enough to contain that many zeros on a piece of paper.)

25. THE AGE OLD STORY

(For 29th April 2003)

The secrets of the universe are starting to be unraveled, mostly with the help of giant telescopes looking back in time in a wide range of wavelengths – visible light, infrared, ultraviolet, X-ray and microwave. It's a high tech smorgasbord up there!

One of the 'holy grails' of astronomy has always been to measure accurately the age of the universe. Nearly everything in the science of cosmology leads to and from the answer to this puzzle. In the past, there were estimates ranging from 10 to 20 billion years. Some favoured the middle range of 15 billion years. The problem was that uncertainty in certain measurements gave a wide range of possible answers.

But that was then. This is now. Recently released results from a 12 month long survey of the entire sky by the NASA probe called MAPS measured the all pervading cosmic microwave background (affectionately dubbed CMB) to an unprecedented level of accuracy. The CMB is actually the afterglow of the Big Bang when it became 'visible' for the first time.

And with extremely high confidence (within 1% error) astronomers now know that the cosmic microwave background was frozen in place only 380,000 years after the Big Bang and the Big Bang happened 13.7 billion years ago. That's pretty precise. So when someone tells you something is as old as the universe, now you'll know how old that is.

But astronomers aren't getting cocky. History tells them that for every mystery solved, two new mysteries appear. What's awaiting us around the corner?

26. STELLAR TOOLBOX

(For 8th July 2003)

Ask people to name some constellations and they will probably come up with the usual suspects… you know, Centaurus, Orion, Southern Cross, the zodiac dozen. After that, it may be a strain. But there are plenty more to choose from. In all, there are 88 official constellations. How many can you name?

Of course, the ones we know have exciting mythologies attached… Greek gods, super heroes, monsters, exotic creatures… that sort of thing. Unfortunately, that's not always the case.

For example, could you find the following constellations? Air pump, Chisel, Compasses, Furnace, Pendulum clock, Table mountain, Microscope, Set square, Octant, Painter's easel, Magnetic compass, Reticule, Sculptor, Telescope?

You haven't heard of them? I'm not surprised, they are not exactly exciting subjects unless you are craftsman or a scientist and even then...

Stand outs? I can barely find them using a star map. These constellations are the brain children of one Nicolas Louis de Lacaille (1713 – 1762). Despite being a brilliant astronomer who travelled to the Cape of Good Hope to survey the little known southern sky, he suffered from an appalling lack of imagination, naming these fourteen faint groups of stars after practical but dull tools and instruments.

Their astronomical names are: Antlia, Caelum, Circinus, Fornax, Horologium, Mensa, Microscopium, Norma, Octans, Pictor, Pyxis, Reticulum, Sculptor and Telescopium.

It's a pity he didn't ask some of the indigenous locals to tell him their star stories. Oh well, it takes all kinds to make a sky.

27. DUTCH TREATS

(For 22nd July 2003)

In my previous column, I mentioned the fourteen obscure and unimaginative constellations named by Lacaille. There is another group of twelve constellations arranged closely around the south celestial pole, this time named in the late 1500s by Dutch navigators Pieter Dirkszoon Keyser and Frederick de Houtman.

This dynamic Dutch duo didn't have a lot to work with. In the twelve sections of sky they gave names to (constellations), there were only five stars as bright as 2nd magnitude. The rest were all fainter. However, at least their imaginations weren't clogged, and the constellations were all quaintly named after exotic animals, except for two. Their constellations are:

Apus (Bird of Paradise), Chamaeleon (Chameleon), Dorado (Goldfish), Grus (Crane), Hydrus (Lesser Water Snake), Indus (Indian), Musca (Fly), Pavo (Peacock), Phoenix (Phoenix), Triangulum Australe (Southern Triangle), Tucana (Toucan) and Volans (Flying Fish.)

These are certainly more interesting than Lacaille's toolbox. Some are rather easy to see, such as Grus which looks like a flying crane and appears high overhead in September through to December, and Musca which is visible all year perched directly beneath the Southern Cross.

Although their stars are faint, some of the twelve contain exciting astronomical objects for binoculars and telescopes. Dorado has the Large Magellanic Cloud with its famous Tarantula Nebula while Tucana contains the Small Magellanic Cloud and the glorious globular cluster 47 Tucanae.

And flying just east of the crane and toucan is a fiery phoenix, well known by young (and not so young) Harry Potter fans.

Magic!

28. SIZZLING METEORITES, BATMAN

(For 29th June 2004)

"Last night I saw a shooting star, it travelled fast and bright.

Do you think it really was a star, or just a meteorite?"

Someone told me recently that they had never seen a meteor. That's sad. Then a local man gets to see a rip snorter, looking "as big as a house" blazing across the sky and into the ground. Lucky man.

I've seen my fair share of meteors, most like little fireflies zipping briefly across the dark sky, some like fireballs leaving a smoking trail behind them. The latter are always spectacular, reminding you that we live in a very active solar system. On any night, with patience, you will see at least one.

But what is a meteor, or meteorite? How big are they?

Briefly, they can come from the dusty debris left behind by a comet or from chips off asteroids that are floating in orbit around the Sun. The vast majority are no bigger than grains of sand. Some millions of these enter Earth's atmosphere every day but quickly burn up. Others are bigger and they too burn up, but more brightly, like last week's near Bulli. Then some start quite large and a remnant actually reaches the ground, or the water. About 10,000 each year. When they reach ground, they are then called meteorites. Most are small and go un-noticed. The bigger, and much rarer ones leave a crater.

However, you've a better chance of winning Lotto than being hit by a meteorite. So fear not, and keep looking.

29. A TALE OF FOUR DWARVES

(For 13th July 2004)

Stars come in all colours and sizes. Surprisingly, the type of star that is most common in our universe cannot be seen with the naked eye or binoculars. About 85% of all stars are of a class called red dwarves. These are stars with a mass much less than that of our Sun, which gives them a low temperature so that they look red. As a result, they are small, not very bright and thus hard to see. Proxima Centauri, the companion Alpha Centauri is a red dwarf and only visible with large amateur telescopes.

There are three other types of dwarf stars.

White dwarves are fantastic – literally. When the first was discovered in 1844, it was too weird to believe. It had the Sun's mass but small – about Earth's size – and white hot. This meant it was very dense. A sugar cube sized lump of its stuff would weigh as much as a family sedan. The star Sirius has a white dwarf binary companion.

When a white dwarf finally cools down in trillions of years, it will be a dense dead star, a black dwarf, totally invisible. There are no black dwarfs now – the universe isn't old enough.

The other kind is a brown dwarf – a star less than 8% the Sun's mass. Its core never got hot enough to light up its nuclear furnace, so it's really a failed star, a warm ball of gas. Everything that a star is made of, just not large enough.So there's more up there in the sky than meets the eye.

* * *FOR MORE ARTICLES OF A GENERAL SUBJECT, CONTINUE TO NEXT SECTION: GENERAL PART 3.