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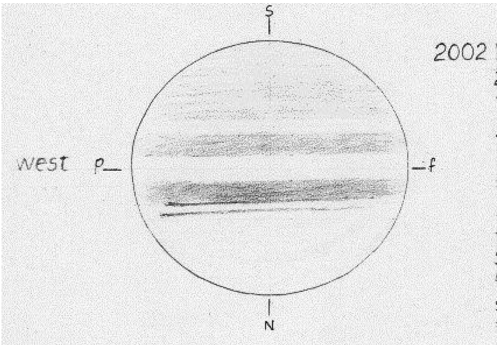
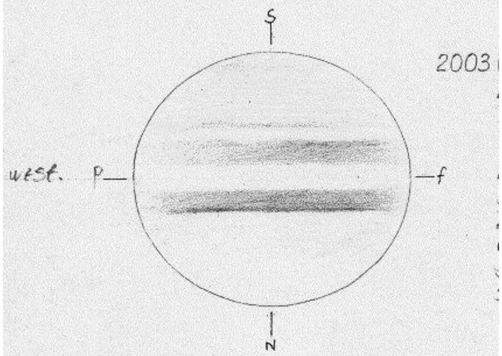
Drawings of Jupiter by Vaughan Cooper



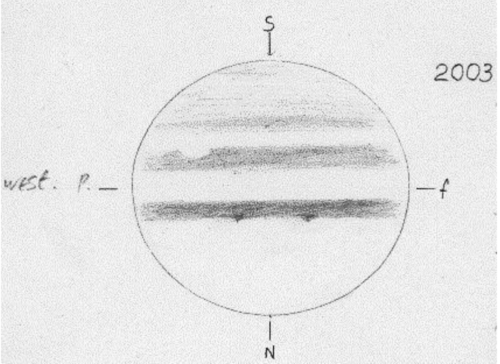
2002 February 26
21.00 UT
100mm Refractor x180 9mm Nag + x3 Bar
Ant III

The N. Edge of the NEB seemed a little darker than the rest of the NEB as recorded. NTB well seen - although the preceding side seemed a little darker than the following. SEB equally as broad but fainter than the NEB.
SEZ well seen separating the remainder of the southern hemisphere.



2003 February 22
22.00 UT
100mm Refractor x180 9mm Nag + x3 Bar
Ant III

NEB a little narrower and darker than the SEB with a suggestion of its northern edge slightly sharper than its southern edge.
SEB wider and fainter than NEB and diminishing in intensity preceding.

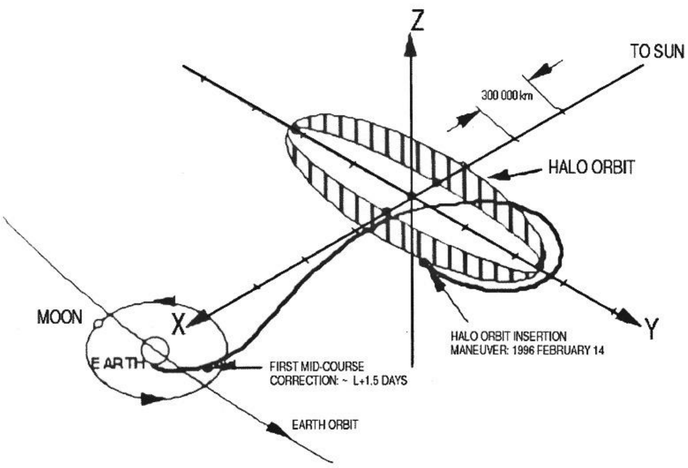


2003 March 6
21.00 UT
100mm Refractor x180 9mm Nag + x3 Bar
Ant II

NEB still the prominent feature with two slightly darker spots on its northern edge.
SEB - again fainter and wider than the NEB.
Of interest though, was I suspect, the Red Spot Hollow within the southern of the SEB.
Four hours later after the above observation was made a further examination of Jupiter and I noted the two belts were of the same intensity.

CONTENTS

One of the interests I have in astronomy and space exploration is in the way objects in space behave. What I mean is how the orbits of planets and their moons move, and how satellites, both natural and artificial, dance to the pull of other bodies in the solar system. Nothing moves quite like you would think it would at first glance, but all follow the laws of Kepler and Newton. If you look back to the very first article I ever wrote for MIRA (No 29), it was on gravity assists to send spacecraft to other planets. This was inspired by a talk by John Mason at a BAA meeting. Did you know that the orbit of our Moon is convex if looked at from the suns position? From our point of view the Moon goes around the Earth every month, but from the suns point of view it wobbles in and out slightly in its orbit around the sun as it moves along with the Earth during its yearly circuit!

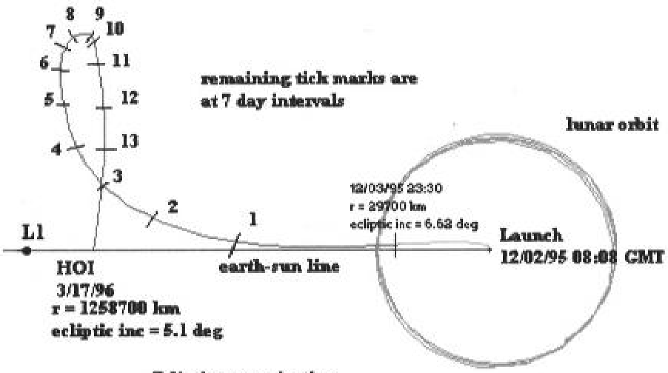


An interesting orbit is followed by the SOHO spacecraft (see drawings), it follows a long oval orbit about the L1 point, 1.5 million km sunward from Earth, about 1/100 the Earth/sun distance, taking 178 days to complete a loop. This position is an excellent one for long term observation of the sun and measuring the solar wind, as it is upwind from Earth by about one hour and just outside the bowshock wave of the Earth's magnetic field interacting with the solar wind.

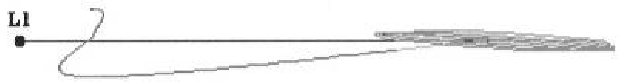
The existence of Lagrangian points was predicted by a French mathematician Joseph Lagrange in his 1788 book *'Mecanique Analytique'*. Every planet has five Lagrange points, 3 on a line defined by the sun/planet and 2 on the planets orbit at 60° in each direction along its orbit. In the orbit of the planet Jupiter are several hundred Trojan asteroids at the L4 and L5 positions. All orbiting the sun in the same period as Jupiter.

So how does the SOHO observatory stay in space and not fall into the sun? For if the space craft is closer to the sun than Earth is, it will need to orbit faster just as the inner planets orbit at faster speeds so to not fall into the sun. But there is a spot where the gravitation pull of the Earth and sun cancel out; and that place is at the L1 point 1.5m km sunward. This distance will vary slightly during the year as the Earth's orbit moves from aphelion to perihelion. The drawings show how the spacecraft moves, influenced by the pulls of the sun and the Earth/ Moon system. This position is not however stable, the craft must from time to time correct its position with small rocket burns, this is one of the limiting factors in the life of the mission as at some time it will have used up the fuel supply and will drift away.

Another Lagrangian point is at L2, this is on the night side of Earth, about 1.5m km distant from Earth again and so should be travelling slower in its orbit, but in this case the Earth pulls it along. In June 2001, NASA launched its Microwave Anisotropy Probe (MAP) towards the L2 point. This point has also been chosen by NASA as the future site of a large infra-red observatory, the Next Generation Space Telescope.



Ecliptic x-y projection



Ecliptic x-z projection

Other points are L4 (counterclockwise as viewed from above the north pole) and L5 (clockwise) and are at the 60° positions in the orbit. This can be a stable point in the orbit for all the planets and indeed this position could be used for a space base located in the Moon's orbit and make transfer out to other planets easier. And the L3 point? That is on the far side of the sun and would not be stable.

Ivor Clarke

Going Grey

by Mark Edwards

"Och, You'll noo see anything!" With these words still ringing in my ears I turned back to stare again at the gathering gloom. As I shivered in the cold breeze I kept asking myself why I bothered to come here at all. It seemed such a good idea all those months ago . . .

That was when I had poured over the map of the north of Scotland trying to decide where to go to observe the May 2003 annular eclipse of the Sun. The eclipse was to take place shortly after sunrise so in my mind the chances of having a clear north-eastern horizon free of cloud in Scotland were near zero. So if I were not to see the eclipse, what could I see instead?

As I live in the land-locked midlands I always enjoy going to islands on holiday, so looking at the possible islands under the track of the eclipse, there were several such as Skye, The Hebrides, The Shetlands, The Orkneys, etc. Most of these though I could discount as they were either difficult for a non-driver like myself to get to, or I had already been there before. However, I did spot a place that seemed to be ideal. I could easily fly there, it was flat and treeless so getting a view of the Sun at sunrise would be easy and it had some interesting archeological and other sites to visit when the inevitable cloud would cover everything. That place was the Orkney Islands.

It was in the days of black and white television that I first came across these islands when the BBC had their first live climbing outside broadcast from the Old Man of Hoy. Later brilliantly parodied on Monty Python, I'll always remember Chris Bonnington and Joe Brown amongst others making their slow progress up this magnificent sea stack. Now this was my chance to see it in person and in colour!

So it was that the day before the eclipse I was sitting a few feet from this magnificent edifice watching the sky becoming bluer and bluer, the strong wind which had been in the west ever since I had arrived in the islands had moved around to the north east and things were looking more and more promising for the next morning's events. The weather had other ideas though, as that evening the clouds rolled back across the sky as they had on all the previous evenings and there they stayed until the following morning . . .

It was three o'clock and time to go to my observing site. Instead of joining the multitude at the far east of the island I had decided to walk along the sea front from my hotel in Kirkwall, to a spot where I could see the annular part of the eclipse well clear of any hills on the off-lying islands. Walking along the main street I was completely alone, the only sounds being from the ever present gulls and bizarrely a one-man Karaoke party left over from the night before.

Reaching the site the omens seemed good as the only non-working street light was directly over it, unfortunately so was a solid covering of cloud. This cloud was of the "it will never clear" type that will be familiar to any astronomer.

Undaunted, I set up the two cameras - a stills camera for general scenery shots and a camcorder to take close up views. To protect this camera from the sun I had brought with me the same 'Womble' eclipse glasses I had used four years previously to such good effect during the total eclipse on Alderney. These glasses had a light orange filter so I hoped they would give the sun a more natural colour.

Dark grey cloud, light grey cloud, high grey cloud, low grey cloud, it all looks the same at 4:30 in the morning shivering as I was in the cold Orkney wind. Even the oyster catchers and gulls feeding on the mud in front of me had decided they would see nothing and had flown elsewhere. Sunrise had been and gone a quarter of an hour ago with no noticeable effect, no golden glow, no blazing burst of light, nothing except that imperceptibly the murk was gradually becoming lighter, or was it? Anyway, to show willing it was time to start the camcorder recording in case there were any noticeable effects from the eclipse.

Annularity was due to start at around 4:45, so judging by what had happened during the total eclipse in '99 I thought that 5 minutes before I might see the sky start to go darker. So there I was staring at the murk, trying to see if the murk was becoming murkier, when "Och, You'll noo see anything!" broke my revery. With that the car and its perceptive owner drove off leaving me staring back at the clouds. "You know, I'm sure it is darker" I kept trying to convince myself. No other effects were obvious - no let up in the cold wind, the birds had not come back — everything as it had been a few minutes before.

The time of annularity was now past and quite obviously something had happened up above that grey blanket, as quite rapidly it became brighter and brighter and brighter. Still no Sun to be seen, but at least I had seen something! With that the birds came back, the wind still blew and I declared at 5:15 enough was enough, time to pack up and go back to bed.

The rest of the day? I got sunburnt cycling across the Churchill Barriers of Scapa Flow - obvious really!

You can judge for yourself if I did see something by looking at my speeded up video covering 9 minutes before annularity and 6 after on my website at:-

http://members.aol.com/vidnoorederlicht/eclipse.mpg

Transit Street, Rhode Island

By Mike Frost

Ahead of next year's transit of Venus across the face of the Sun, I have been compiling an occasional series of tales from the previous transits. You might remember my articles on Jeremiah Horrocks in MIRA 64 and on Charles Mason and Jeremiah Dixon in MIRA 58. The latter paired up, not to survey the Pennsylvania-Maryland border that bears their name, but rather to observe the transit of 1761, from southern Africa.

Now, transits occur in pairs, eight years apart, and the 1769 transit was well placed for observation from North America. In Eli Maor's recent book "June 8, 2004 — Venus in Transit", there are descriptions of the sterling efforts made by the American colonists to observe the transit. One description in particular caught my attention. *"In Providence, Rhode Island,"* writes Mr Maor, *"a street near the hill from where the transit was observed is still named Transit Street: from atop this hill, at local noon on the day before the transit, a cannon was fired, so that people could mark on their windows the exact direction of the meridian — the north-south line."*

The reason why this passage intrigued me is that I know the city of Providence quite well. In 1903 my maternal great-grandmother was the only one of six children not to emigrate to Rhode Island — she was the eldest child and stayed in England because she was already married to my great-grandfather. Anyway, as you can imagine, the state of Rhode Island is full of my relatives, and on my many visits to the USA I have often taken the chance to visit them. I think I may even have unwittingly made a transit of Transit Street; it is close to the centre of Providence, and near to Brown University, Rhode Island's member of the Ivy League.

So, I sent an email request to Jim Collinson, one of my American cousins, and he obliged with a few pictures of Transit Street. The building you can see in the background is the Barker Playhouse, where Jim's wife Lynne, well known in the Rhode Island theatre community, has directed several plays. Jim has also passed on my correspondence to the local newspaper, to see if anybody knows more about the 1769 transit.

Thanks Jim!

There's a Hole in My Pocket

By Mike Frost

(As always, I try to base these stories in known physics — see the notes at the end of the story)

Clive, my oddball friend from the Interplanetary Dangerous Sports Club, leaned over his pint and said confidentially to me, "You'll never guess what I've got in my pocket. . ."

He'd rung me earlier in the evening in an excited state (which, for Clive, was fairly common behaviour) and suggested we meet for a drink. When Clive suggested a night out, it was usually because he had some wildly improbable story to spin to me. So far, this one didn't sound especially promising, but it was worth winding him up to find out some more.

"How should I know?!" I retorted, "Give us a clue. . . who did you buy it off?"

Clive looked shifty, "Dunno. . . it fell off the back of a lorry. . ."

". . .A fork-lift truck?. . ."

"No, not literally! I bought it off a man in the pub last night. Said he'd got it off his uncle who worked in the spaceport. . ."

"Aha, *contraband*. . ."

"No, no, it's legit. . . He swore it was legal. . ."

I hazarded a few guesses but I wasn't on Clive's wavelength. Eventually I gave up and demanded that Clive played show and tell. Clive fished a small box out of his pocket, metallic, with a small window in one side. I took it from his hand; it felt surprisingly heavy.

I held it up to the light. Clive grabbed it back off me, nearly dropping it on the floor in the process. "Don't show it around!!" he hissed.

So it was contraband!

I took the box again and peered at it more circumspectly. There were no markings, not even a radiation symbol. I looked through the window, inside the box.

"Can't see anything!" I complained. Clive looked triumphant.

"Of course you can't!" he said, smugly, "it's a black hole."

* * * * * * *

Now, you'd think that Clive would have had quite enough of black holes. When he first joined the Dangerous Sports Club, you'll remember, he went bungee jumping onto a black hole, a jaunt in which, allegedly, he conveniently managed to deposit his recently-married wife onto the event horizon; a set of circumstances which meant that he later managed to wangle out of marriage to his ex-girlfriend Clarissa, another young lady whom he had almost managed to dump into a singularity during the course of one of his madcap adventures.

What was it about Clive and black holes?

And why was he trying to drag me into this one?

Come to think of it — why wasn't I being dragged into this one? I regarded the alleged black hole with some scepticism.

"Well," I said with all the sarcasm I could muster, "thank God I managed to engage warp drive in time, or we'd have been dragged in to that sucker before you could say naked singularity."

Clive did his best to ignore my sarcasm. "As you can see, it's not a very big black hole. And more important, it isn't a very massive one."

He picked up an ashtray, and made me take it in one hand, weighing it against the box in the other. They weighed about the same.

"So," said Clive, "the black hole is going to attract you with the same gravitational force as that ashtray, isn't it? And I don't see you being dragged towards the ashtray."

Clive had a point. In fact, the black hole was going to weigh rather less than the ashtray, because you had to subtract the weight of the box that contained it. But I was still worried — it doesn't matter how big a black hole is, you're in trouble if you get too close. I put the box very carefully down on the table.

"You go and buy another round," I said, "while I figure out how large the Schwarzschild radius is."

* * * * * * *

Clive looked happy as he supped his pint. He had succeeded in engaging my attention for another of his crazy stories.

"The Schwarzschild Radius," I said," is the point of no return for a black hole. If you get closer to the singularity than the Schwarzschild radius, there is no way to escape the gravitational pull. The thing is, it's very easy to compute the radius — all it really depends on is the mass of the black hole. Two Gee Em over C-squared, if my memory serves me right. . . So if your black hole has a mass of, I dunno, five hundred grams. . . c is three hundred million metres a second, G is six point six seven times ten to the minus eleven. . ." Fortunately I had my science data book with me (what do you mean, you don't carry one round with you?!).

I finished my calculations off. "The radius would be just over ten to the minus. . . twenty eight metres."

"What's that in real money?"

"Not a lot! Well under a million million million millionth of an inch in diameter. In fact, that's really small, isn't it! Much smaller than the size of an atom — even smaller than an electron."

"So," said Clive, "the chances of anything falling in by accident are pretty small, aren't they?. . ."

Clive, annoyingly, was right. I remembered the details from my lectures. Big black holes, the sort that Clive bungee jumped onto for fun, were easily big enough to grow in size as matter fell onto them. But small black holes, once formed, were unlikely to get much bigger, simply because they were so small in diameter. Anything in the neighbourhood would easily miss the event horizon and avoid falling into the black hole.

"OK, OK." I said. "You're right; there's next to no chance that anything will ever fall into the black hole, so we don't have to worry too much about the radiation given off as matter crosses the event horizon. But that makes me think that you might have been conned, Clive. *How do we know that that the black hole hasn't escaped?"*

I knew immediately Clive had been waiting for that one. "Because the guy who sold it to me told me that it was held in place electrostatically. . ."

"Oh! That's clever!. . . A black hole can have an electric charge, can't it. . . and so if you line the inside of your box with particles of the same charge, they will hold the black hole in place by electrostatic repulsion."

Clive nodded. "The charge needs to be quite strong to overcome the gravitational pull of the Earth, but I'm sure it can be done. . ."

I nodded in agreement; then I noticed something out of the corner of my eye.

"Clive," I said, "are you absolutely sure that you acquired this new toy of yours legitimately?"

Clive looked hurt. "Course I did, Frosty. Have I ever lied to you?"

Underneath the table, I crossed my fingers. "Clive, I've never for a moment doubted a single one of your stories. It's just that the police have walked into the bar. . ."

I've never seen Clive move so fast.

* * * * * * *

I had time to get another round in before Clive emerged from the toilet. He didn't want to show me the box at all at first, but after some prompting he did, clandestinely, under the table.

The observation window had been smashed. The box felt much lighter.

"Clive," I said very sternly, *"what did you do with the black hole?"*

Clive grinned at me. "I swallowed it."

"You did what!!" Then I thought a bit more. "Shouldn't that be the other way round?"

Clive tutted. "Sometimes you don't follow your arguments through, do you Frosty! You've told me that the black hole is so small that it's unlikely that anything will ever fall into it. So why shouldn't I swallow the black hole"

"I might have *told* you that, but I didn't expect you to believe it!. . . Anyway, I guess we'll soon find out."

Then something struck me. "Of course, Clive," I said, "that's still a black hole with an electric charge on it. And now you've opened the box, there is no longer a containing charge in place. . ."

"So. . .?" Clive looked a little worried.

"So your black hole is now free to attract particles with the opposite charge."

"But will they get sucked in?"

"I guess not immediately. . . I suppose what will happen is that the black hole will end up surrounded by a little cloud of oppositely charged particles. And every once in a while, maybe a long while, one of them will get a bit too close, and get sucked in."

"Never mind that," said Clive, "What about me? When will the black hole you know. . . clear the system." At that point he burped loudly.

"Maybe you just belched it out!" I thought a little more. "I guess the charge will neutralize pretty quickly, in fact I'd be surprised if your black hole isn't already surrounded by a cloud of particles. So the whole thing is now neutral, and the only force acting on it is gravity. My guess, Clive, is that the black hole doesn't even know you're there. If it wants to drift away, that's just what it'll do."

"Speaking of drifting away," said Clive, emptying his glass, "I have to go see a man about a dog star. See ya!. . ." He stood up to leave. "By the way," he added, absent-mindedly, "I hope my black hole won't evaporate. . ."

Oh yes! Black hole evaporation. . . I'd forgotten about that. Black holes don't stay stable forever. Like everything else, they are surrounded by a sea of virtual particles; particle/antiparticle pairs which appear from nothing, last for a few nanoseconds, and then recombine, annihilating each other. These are called quantum fluctuations, and they happen all the time. Quantum fluctuations are much more frequent than interactions between ordinary, long-lasting particles.

However, if a particle/anti-particle pair created by a quantum fluctuation is close enough to the black hole event horizon, one particle in the pair will cross the event horizon, and the pair cannot recombine. The net effect is that the black hole appears to emit a particle. The result of this process, first suggested by Stephen Hawking, is that a black hole evaporates in a shower of radiation. The original contents of the black hole are lost, but, essentially, the matter inside has been converted to energy.

The question was, how long would this take for Clive's black hole? Would it evaporate in a huge shower of lethal gamma rays any time soon?

"Hang on a second. . ." I said, calculating frantically once again, "Evaporation is the third power of the mass inside the black hole, so if we do the arithmetic. . . we get an evaporation time of. . . two million million million millionths of a second. Why you. . . CLIVE!! You've been having me on!!!!. . ."

But Clive, like his so-called black hole, had already vanished.

The Schwarzschild Radius of a Jaffa Cake

By Mike Frost

Please read the story above before reading these notes!

We've all heard about the properties of big black holes, with masses the size of a galaxy or two. They're dangerous places, best avoided unless you are a reckless maniac like Clive. But there's nothing (much) in physics to prevent the formation of rather smaller black holes. I wanted to explore the properties of black holes that have human dimensions. How big are they? How much do they weigh? How dangerous are they? What do they taste of? Who better to find out than Clive, who is daft enough to get closer to an event horizon than most of us would consider sensible.

The difference in behaviour between big black holes and small ones is a result of the extreme limits imposed by two important quantities. One is the Schwarzschild radius, the fundamental distance associated with a black hole of a given mass. The other is the evaporation time for a black hole of given mass.

The calculation for the Schwarzschild radius, R_S, runs as follows: -

$$R_S = \frac{2 * G * M}{c^2}$$

Where G is the constant in Newton's law of gravity, M is the mass contained within the black hole, and c is the speed of light (actually, the calculation doesn't properly hold when the black hole is rotating, but let's not worry about that here). Anything that comes within a distance R_S of the singularity at the heart of the black hole MUST be swallowed up by that singularity, adding its mass to the black hole and therefore increasing the Schwarzschild radius.

Conversely, if you succeed in cramming mass M within its Schwarzschild radius, a black hole must form — although, as we'll see, this can be a tall order.

It's not a particularly complicated equation, perhaps indicating the underlying simplicity of a black hole. The equation is well known to those studying astrophysics — indeed, I was once asked in an astroquiz "what is the Schwarzschild radius of a Jaffa Cake?" Clearly this was a question formulated over coffee and biscuits.

The other important quantity to consider is the evaporation time for a black hole. This is also a relatively straightforward equation. The evaporation time in seconds is:

$$T_E = \frac{c^2 \;.\; M^3}{1.069x1033}$$

The square of the speed of light is a pretty big number, but it is dwarfed by the large number on the bottom of the equation. So the mass of the black hole has to be pretty big to give a reasonable evaporation time.

The table below lists the Schwarzschild radius and evaporation times for a number of entities, ranging from the estimated masses of the giant black holes thought to lurk at the heart of a quasar, through the rather smaller black hole at the centre of our Milky Way, through to objects the mass of the Sun, the Earth; and then mini black holes the size of Clive's. And a Jaffa Cake.

You can see that black holes of galactic masses have a very substantial Schwarzschild radius and a huge evaporation time, much greater than the age of the universe to date. These black holes are pretty big and will be around for a long time to come.

In the medium range, both the Sun and Earth have a Schwarzschild radius that would be appreciable on a human scale — kilometres in the case of the Sun, millimetres in the case of the Earth. Just fix on that for a moment — a black hole with the mass of the Earth would be 18mm across! Suppose that Clive had unwittingly brought such a black hole into the pub. We would have been in trouble, I think!

The gravitational pull of such a black hole would be as strong as that of the Earth, in fact, stronger, as we would be closer to the singularity than we are to the centre of the Earth. It would be very difficult to avoid being pulled towards the event horizon; certainly matter would be falling into the black hole all the time, giving off huge amounts of radiative energy as it did so. But, by the same criterion, Clive would have insurmountable difficulty moving the black hole around — it has the same mass as the Earth. The evaporation times are also respectable for the Sun and Earth.

If the Earth itself has a Schwarzschild radius of only a few millimetres, then even objects we would regard as overwhelmingly massive become sub microscopically tiny if squeezed tightly enough to form a black hole.

Ayers Rock (Uluru), for example, in central Australia, is listed in the Guinness Book of Records as the biggest single rock on the Earth's surface. This would still be clearly too heavy for Clive to be able to carry around. Yet the Schwarzschild radius for Ayers Rock is only 7×10^{-15} m. This is about the same size as an electron. The evaporation time, however, is still much greater than the age of the universe to date.

It isn't until we get down to masses of millions of kilograms, thousands of tons, that the evaporation time becomes a worry. A mass of five thousand tons — I estimate about the mass of Nelson's Column - will evaporate in just under three hours. Stand well back!

By the time we get down to the size of Clive's so-called black hole, the evaporation time is a tiny fraction of a second. What does that mean? If one suddenly materialised in Clive's pocket, then, before Clive could have chance even to register its arrival (let alone scrounge a pint off me) the black hole would evaporate in a blast of gamma rays rather more powerful than our largest atom bombs, killing every-thing for several hundred kilometres in all directions.

So, if you meet a man in a pub who wants to sell you a black hole, refuse his offer politely. And leave the country - just in case he really does have a source of supply!

Object	**Mass**	**Schwarzschild Radius in m**	**Evaporation Time in seconds**
Quasar black hole	10 Million Solar Masses	2.95×10^{10} (29,500,000 km)	6.63×10^{95}
Milky Way black hole	100,000 Solar Masses	2.95×10^{8} (295,000 km)	6.63×10^{89}
Sun	1 Solar Mass	2950 (2.95 km)	6.63×10^{74}
Earth	0.00002 Solar Masses	0.0089 (8.9 mm)	1.79×10^{58}
Ayers Rock (Uluru)	5.0x1012 kg	7.43×10^{-15} (3 electrons wide)	1.05×10^{22}
Nelson's Column	5,000,000 kg	7.43×10^{-21}	10,500
Clive's black hole	0.5 kg	7.43×10^{-28}	1.05×10^{-17}
Jaffa Cake	0.0125 kg	1.86×10^{-29}	1.64×10^{-22}

Electrons have a "classical radius" of 2.82×10^{-15} m, i.e. 0.000 000 000 000 002 82 metres

The age of the universe is approximately 4.2×10^{17} seconds, i.e. 420,000,000,000,000,000 seconds

STAR PARTY AT BIRDINGBURY By Reg Nobbs

Its always a gamble with the weather, so I choose Saturday night the 4th October instead of Sunday to support Geoffrey Johnstone's first Star party. After a few spots of rain had cleared, time was spent assembling the telescopes that had arrived. Geoff our host already had his telescope set up and working, so the night started with looking at nebula's and galaxies with different magnifications. We had a look at Mars, which had just poked from behind a tree, it was very bright, so Geoff put his home made filter on the eye piece which worked very well, but I still could not see any canals on the planet. I asked to see Uranus, and with a touch of the key pad the telescope swung around to its new position, and there it was, dead centre in the eyepiece. I wish my own telescope was computer controlled. Clive had taken a photo of the Dumbbell Nebula (M27) or was it Graham?, the detail and colour was amazing. Geoff was in his element dashing back and forth from telescope to computer adjusting this and explaining that, time went by very quickly only to be interrupted by a cloud seen creeping down from the north. So we all took a break and went indoors for a hot drink, after which we were back outside to look at new constellations that had now appeared from over the horizon. With more cloud about it was time I took my leave and head home. A great night and I hope we can do it again, thank you Geoff.

The Sunday Times - Britain Oct 5, 2003

Put that light out - MPs want ban on 'trespass' in the night sky by Jonathan Leake, Science Editor

A NEW offence is to be proposed this week by MPs to curb light pollution - when bright lighting stops you from seeing stars in the night sky. Members of the Commons science and technology committee want people whose outdoor lighting blots out the stars to face penalties for "light trespass".

Local authorities, supermarkets and even homeowners who install security lights would risk legal action for "statutory nuisance" if they intruded on their neighbours' enjoyment of the night sky. The committee's report, to be published tomorrow, will point out that few children have ever seen the nightsky properly because of the surge in light pollution. Senior astronomers say the number and power of modern illuminations is destroying the night view across Britain. Even people who live in the country are affected by distant towns and cities.

A parliamentary source said: "Its not just street lights that are to blame. Supermarkets, sports pitches and even the cheap security lights people put on their houses are big contributors." The committee wants ministers to enforce rigorous technical standards on outdoor lighting so that light is spread downwards and reflection and glare are cut out. The rules would be easy to implement since ministers could impose them under existing legislation. One Whitehall source said ministers were "sympathetic". The light pollution of Britain's night skies has become a serious problem for astronomers, especially amateurs who lack access to scientific telescopes. Many school astronomy clubs have closed. When Liverpool John Moores University was asked to find a way of bringing astronomy back into schools it decided it would have to build a new telescope in the Canary Islands - and give schools access via the internet. The two-metre Liverpool Telescope has just started operation on La Palma.

One MP said: *"It's ridiculous that our children cannot even see the night sky properly without using the internet. This problem could easily be solved by making local authorities, supermarkets and others installing outdoor lights adhere to strict planning rules."* Other countries are already imposing such legislation. The Czech Republic became the first last year with an act that outlaws light pollution. Two months ago Scottish ministers announced similar moves. The spread of Scotland's cities and a rising number at street lights stops the night sky becoming dark in many areas. The problem is particularly acute in Scotland's central belt, where the night sky is dominated by an orange glow. Southeast England and the Midlands suffer similar light pollution.

The Stars of December by Ted Nicholls

Constellation of Aries the Ram, two of its stars are noticeable, α Alpha or Hamal and β Beta or Sheratan. In mythology it was the Ram of the Golden Fleece, "The Princely Ram glittering in golden wool" as the poet Manilius called it (the golden fleece has a basis in fact, shepherds would peg a fleece in the bed of a mountain stream that was carrying specks of alluvial gold in it and the grease in the wool would trap the gold until it looked golden). It is not surprising that the nomadic shepherd tribes of Chaldean where many of the constellation signs originated chose it as the first constellation of the Zodiac where the sun held court at the opening of the northern spring. Babylonian priests thought that the world was created when the sun shone from the stars of Aries and when the sun moved into that sign the Egyptians held the sacred feast of the ram. The star Gamma in Aries has the distinction of being the first double star to be discovered by the telescope of Robert Hooke in 1664 as he followed the course of a comet. Between Aries and the line of stars making Andromeda is the small group Triangulum. The Greeks called it Deltoton from the triangular shape of the letter Δ Delta. At the eastern end of Andromeda's stars is the hero Perseus of the Greek legend containing some interesting stars, the brightest star is a Alpha or Mirfak, a supergiant, a little above second magnitude, whose name originated in an earlier period than the Greeks.

Another interesting star is β Beta Persei, the famous variable star Argol, whose name is supposed to mean the *"Eye of the Demon"*. Maybe because of the variable light coming from it and authenticated in the late 19th century. The variations of Algol's light is due to the present of a dark companion star which periodically eclipses it. As the two stars rotate about their common centre of gravity Algol varies from magnitude 2.2 at its brightest to a minimum of 3.2, a loss of about five-sixths of its light, during a period of decline lasting for 4½ hours. This ends after 20 minutes, the light then gradually reaching its former brightness. The two members of the Algol pair are estimated to be two million miles apart, the rotation period is about 3 days, distance 60 light years. Also interesting is χ Chi Persei, the brilliant double star cluster known as the Sword Handle of Perseus. In a telescope of moderate size or a good pair of binoculars the sight of it is one of grandeur and beauty, a worthy companion to the wonders of the M31 Great Galaxy in the neighbouring form of the chained maiden, for some reason this double cluster was not included in Messier's catalogue, I wonder why?

A Letter from Dennis W. Spratley

Dear Editor

Those members of your society with an interest in cosmology. . . and nowadays in most astronomical societies this is a significant number. . . may be interested to learn of a very bad error that appeared in the May 2003 issue of *Astronomy Now*. My reason for pointing this out to your society is because I have had no satisfaction in writing to the magazine and the erring consultant.

I refer to the regular column entitled *Ask Alan*. It is written by Dr Alan Longstaff, a consultant who describes himself as a professional tutor in astronomy and a science writer. His contribution in AN is headed *"Ask Alan. No question is to difficult and no problem too taxing for Astronomy Now's resident astronomy educator and populariser Dr Alan Longstaff. Send him your questions!"*

In the May 2003 issue the following question was asked. . . *"Why is the relative velocity of two galaxies at the edge of the observable universe, each travelling away from the Earth in opposite directions at close to the speed of light, not almost twice light speed?"*

Obversely I cannot quote Dr Longstaff's complete reply. Readers who are sufficiently interested must refer to the magazine. I feel that a good proportion of society members must buy AN. However, it is only necessary to give the first part of his opening sentence; he writes: *"It is because of the special theory of relativity (SR), which Einstein published in 1905. . ."*

This is quite wrong. The SR does not apply over cosmological distances. In fact the SR may be described as physics in the absence of gravity. Since the universe is dominated by gravity the solution to the problem requires the general theory of relativity (GR). This was published in 1916 by Einstein and is the definitive theory of gravity of our time. On the other hand the SR is a restricted theory applying only to 'local' regions of space-time.

As I have indicated I have had no satisfaction on this matter. This despite two communications by post with Dr Longstaff. In his last letter of June 2nd 2003, in which he promises to write when his work load eases, the nearest admission to error is when he writes: *"A first reading of your work does, I confess, suggest I have made a mistake but I would like to go through it again in detail and have a colleague look at it, to confirm (or refute) this and ensure that I thoroughly understand the arguments."*

I am still waiting.

It is, of course, incumbent on me to give the correct answer. This is where the trouble begins! For years I have struggled to get across to some. . . but not all. . . astronomy society members the nature of the expansion of the universe. Firstly, objects in recession are not moving through space as would be the case resulting from an explosion; they are moving with the expansion of space itself. . . in simple, interpretive terms the 'stretching' of space. Secondly, as stated, the SR theory does not apply. If we take the simplest case that space is 'flat', or Euclidian, or if you like, is as in school geometry. . . which is the current view of the cosmologists. . . then cosmological velocities add together in the simple way that we learned at school. So if we consider the two galaxies, say A & B, in opposite directions in the sky, both with a recessional speed relative to us of just under the speed of light, we may ask the question — what is the speed of A relative to B?

In answer, contrary to the assertion in the 'AN Readers Questions' answer is, in fact, just under twice the speed of light! This is why, in principle, we on Earth can detect A and B but it is not possible for A and B to 'see' each other.

I do not expect to be believe by all readers of my letter, consequently before any possible overreaction let me recommend that those who would instantly reject what I have written first consult the brief list of recommended reading.

Best Wishes

Dennis Spratley

Further Reading

Understanding Relativity Les Sartori, University of California Press

Essential Relativity Wolfgang Rindlar, Springer-Verlag

Basic Relative Richard A Mould, Springer