MACARTHUR ASTRONOMICAL SOCIETY Inc.

Journal

PRIME FOCUS

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President's Report

I apologise for not attending last months meeting, I was at a conference which involved an overnight stay in Sydney. From members' comments it sounded like a fantastic meeting with a very entertaining guest speaker in Fred Watson. On behalf of all members I thank Dr Watson for making himself available. Also I'd like to thank Daniel Ross for stepping into my shoes and chairing the meeting. Well done!

For tonight's meeting it gives me great pleasure to introduce Dr Don Neely. Don has previously visited our society and gave some clever demonstrations of the Doppler effect. Tonight I believe we will witness displays of spectroscopy.

You may not be aware but this is our last meeting for the year. We shall recommence on Monday the 15th of January 2001. Of course we will meet here at our usual room. Please don't despair as the observing nights continue as per the schedule found elsewhere in this journal.

Our extended raffle will be drawn tonight with some great prizes to be won. I want to thank everyone for your generous support which is very appreciated.

M.A.S. Christmas Party

On Saturday the 9th of December we will be holding our annual Christmas party at the Campbelltown Rotary Observatory at 6pm. Bring your own everything, wives, husbands, kids, food, drinks, games or just yourself. A BBQ will be provided so you can cook a snag. The night is planned as casual and a great chance to socialise, so leave the scopes at home (unless you're really desperate, like me.) Perhaps MacDob might make an appearance and we can sacrifice it to the weather gods (just kidding).

Bob's Feedback

From many comments I've received the articles titled "What's to see this month" form an essential part of Prime Focus and add value to our members' knowledge. Indeed, I've photocopied previous issues with which to plan observing nights. I realise Prime Focus is labour intensive and I fully appreciate time constraints. I personally would miss this easy reference guide with its interesting and sometimes amusing commentaries.

Starters Kit

In last month's Journal I spoke about a help desk. I believe it's a good idea, however, I'm still working on its application and I'm hopeful of getting it up and

running for our 1st meeting in January. I'll keep you posted.

M.A.S. Turkey Award
This award goes to the rather "nice person" who broke into the garage of one of our members and stole his lawn mower. Not content with that our red flashing lanterns and stands were also taken (our first theft of M.A.S. property.) To the "nice person" that stole our lanterns it will soon become apparent that it's a useless acquisition, or maybe not! Some one obviously wants to mow their lawn very late at night whilst setting up red lanterns so they do not affect their night vision. Well done!

John Rombi and myself divided up the stands and lights some time ago so we've still got four left which will keep us going for a while.

Members Recognition Award
This award is voted on by the committee and as such carries official status. It's our plan to issue the award selectively throughout next year, but in order to get the ball rolling, why not start it now.

The M.A.S. members recognition award (M.A.S.M.R.A.) goes to **LLOYD WRIGHT**.
I first met Lloyd some 2 years ago in the car park after one of our meetings. I asked him if he knew any of the constellations. A reply was forthcoming in the positive, unfortunately all knowledge came from computer software. Lloyd admitted that when it came to looking up in the night sky the challenges were much greater. A scope was purchased soon after and many field nights have resulted since. Lloyd has made journeys to the South Pacific Star Party. He also helps the Society at all open nights and enrols himself into astronomy courses at Coonabarabran. He has outfitted his 10 inch Dob scope with the Skyvector computer and a Telrad finder scope. Lloyd is always asking questions and as is the nature of our Society, answers are always forthcoming.

What really impressed me was at a recent field night with the now ever present cloud cover parting just a little, the sights of 47 Tucanae and the Tarantula Nebula were easily located. Lloyds commitment and application acts as encouragement for all members.
WELL DONE AND CONGRATULATIONS.

Our Society has many such achievers. It's not our intention to highlight one person's achievements over another, but what makes this a great Society to belong to is that there are many stories just like Lloyd's, and if I can make a quote from an old TV show, next month "It could be you".

University Open Night
The weather gods have been most unkind lately and the observatory Open Night on Saturday the 4th November was a real big fizzer - or maybe not. The clouds were quite thick and the horizon was flashing with lightning, but it remained dry. A hardy group of about 30 people attended. Amazing! I had a back up plan in mind and gave a talk on astronomy which was lots of fun.

The members of the public were very keen and really wanted to look through the scopes. They waited most patiently for another night to be finalised, obviously hopeful of clear skies. The date has been decided, so it's time again to muster the troops and have M.A.S. represented on mass at the observatory domes **Saturday December 2nd at 7pm.**

Noel Sharpe

President's Special Report

As a society I would like to think that we have had one of our most successful years yet, with great guest speakers, excellent public events (art gallery, schools, scouts etc) and a heap of field nights. Our membership will soon grow past 60, which is just fantastic.

Another highlight is the wonderful cooperation which exists between our Society and the Campbelltown Rotary Observatory and indeed The University of Western Sydney, Macarthur. As a

society our output is great, but our resources are limited and as such I'm proposing a major change in direction for this society that will coordinate our activities so we can operate more effectively. The proposals are:
1. Observatory Friday night program cancelled.
2. Oakdale Farm Society field nights cancelled.
3. Earlier starting time for our monthly meetings. Newer members information, general basic astronomy etc start time 7:15pm; official start still 7:30pm.
4. Monthly Observatory program once a month on a Saturday night for the general public.
5. The Oaks Airfield as our monthly field night (members and guests only).

The plan for the Observatory is to turn that night into a combined event. eg: separate area for telescope workshops for newer, less experienced members, there will be no requirement for public viewing in this section. Public education open policy means no bookings, just every month on a Saturday night having the 16" (40cm) scope working and our own scopes in support. This is a great way to expand our society.

Introductory talk to announce ourselves and a short talk on astronomy with questions allowed from the public. I'm also proposing to project slides onto the dome for education and entertainment. (maybe some space music to set the mood).

With a stronger focus on the observatory program we will have the opportunity to reach into the community. We know how keen the Macarthur public is by our past experiences. This program will not only pool our resources but will give our own members both existing and new a chance to relate to something other than a general meeting or a field night. In other words we are creating an astronomical event for all to enjoy.

I've held preliminary discussions with Ragbir Bhathal, our own committee and other members and we all think it's an exciting plan with a ton of potential to really make our Society something special.

The promotional aspects alone are enormous. We can send flyers to schools libraries and the camera shops that sell telescopes.

In Conclusion:
It's a grand plan that can only work with everyone's support, and I'm sure you as members will see that it has many benefits and is a great opportunity.

Key Dates

Please take note of the following dates, and disregard any previous notices.

Official Events:
25/11 - Observatory field night, no public involvement.
2/12 - Observatory public open night.
9/12 - Christmas party members only at the Observatory.
16/12 - The Oaks Airfield (Members and guests only)
30/12 - The Oaks Airfield
20/1/01 - The Oaks Airfield
27/1/01 - Observatory field night (no public involvement)

I'm also attempting to upgrade my mobile phone, I will keep you informed of my progress.

Noel Sharpe ■

Latest News

Mars Life?

Evidence is getting more and more irrefutable that Mars has water and possibly life. However, NASA is quick to explain no hot springs with Martians bathing in them will be found, or large rivers or lakes with beings swimming and sunbathing in the Martian summer sun. Just to explain to some people Mars can reach up to 27° C near the equator middle of the day, but the thin Martian atmosphere, which is not only 1/100th thinner than Earth's but also 95% carbon dioxide. Plus the fact Mars has next to no ozone layer so you would certainly get red quickly whilst sunbathing.

On a serious note scientists are excited about the recent discoveries and data being streamed back to them via Mars Global Surveyor. Mars Global Surveyor has recently detected features that strongly suggest running water may be very close to the Martian surface. The small object seen is about the size of a car; the area resembles areas of Earth that look just like they have had flash flooding. Gullies on Mars are formed just like on Earth, with deposits of rock and soil transported by these flows.

Twenty eight years ago Mariner 9 photographed channels and valleys that billions of years ago had running water over the surface. The gullies seen are on cliffs, in a crater or valley walls. Mars today has water just below its surface and occasionally breaks through small cracks in the surface only to flow downhill, form an ice dam and then explode and flow down the cliff and eventually evaporate into the thin Martian atmosphere.

The gullies in Earth terms would be similar to those in the latitude of New Orleans, Louisiana, Point Barrow, Alaska in the Northern Hemisphere and from Sydney to much of the Antarctic coast in the southern hemisphere. The most significant aspect of this discovery is that with water present on Mars, human explorers will have water to extract and not have to take it with them.

The water, if easily available over other areas on Mars apart from the poles, would aid explorers with air production and drinking water.

The Mars Global Surveyor shows 20 gullies coming from the south wall of a trough in the Sirenum Fossae and Gorgonum Chaos region in the southern hemisphere. The European Space Agency will be aiming to land in this area in 2003 to further explore it and prove once and for all Mars has water and possibly life (be it bacterial).

Martian Meteorite

Scientists have been studying a Martian rock, which seems to suggest that Mars has 2-3 times the amount of water than originally surmised in the past by scientists.

Phil Ainsworth ■

Observations and Practicalities

Recently a member purchased a 2x Barlow lens, which doubles the magnification of any eyepiece. They come in a variety of lengths and I've heard that care must be taken to ensure a compatibility with the telescope.

Disappointment resulted from this member's recent purchase of the Barlow as the rack and pinion focuser on the telescope could not be "racked in" far enough to achieve focus. Obviously an incorrect purchase, or so it seemed. Upon investigation it became apparent that several eyepiece adaptors were present on the focuser itself. An adaptor will increase or decrease the overall diameter of the focuser in order to accept different widths of eyepieces, namely 2" to 1 ¼" to 0.96". I personally have such a device and recognised it quickly on the telescope. The task now was to remove the adaptor so that the Barlow would 2x multiply whilst maintaining focuser distance travel in both directions; eg inward/outward. We need to do this so when changing back to a single insertion of an eyepiece, it too would come to focus. We were successful in that task.

In other matters that occurred on our recent field nights, a small number of members applied themselves to astrophotography and have purchased Newtonian scopes that have "fast" systems, eg F5. Again as I've indicated above, compatibility must be looked at. In this case the scope will not accommodate prime focus photography, which is a huge setback for our budding photographers.

The prime focus photography aspect can be described as just using the scopes mirror to reflect an image onto a camera's film plane without the placement of an eyepiece. In simple terms using the system as one gigantic telephoto lens. The images that result have a strong light

penetration when compared to the slower systems, ie F9 or F10.

A purchase made with the intention of taking prime focus photography should fulfil requirements and as discovered sometimes it does not, but it can be overcome by moving the primary mirror forward. This lengthens the focus stream allowing extra back travel on the drawtube/ camera attachments.

Again what compensates for one action throws out the other. From experience with the mirror placement forward, a low magnification eyepiece has to be placed fully receded out of the draw tube, and secured just to reach a clear and precise focus. This is a lot of trouble to go to!

Another solution to gain prime focus photography is to insert a Barlow lens into the draw tube/ camera arrangement. Whilst it does serve to focus the image plane effectively it lengthens the system's speed to a slower focal ratio and completely defeats the purpose of buying a fast optical scope. A fast system should record excellent bright and short time delayed focused images. That is the desired result.

In conclusion of this practicality section, please explore all your options and make informed decisions that best suit your needs.

Noel Sharpe ■

Spaced Out

Astronomical Techniques

Most of the members that attend our Uni and observing nights know that I'm a Messier maniac. Newer, novice members might wonder what the attraction is in trying to track down the "faint fuzzies." Well, every astronomer that I've spoken to, regardless of experience always try to improve their observing skills.

The 100 or so Messier objects visible from Sydney pose a worthy challenge in achieving this aim. They are scattered over the majority of the constellations. This can help first timers and experienced observers to become very familiar with the star patterns they face each season.
The Messier catalogue comprises of 14 types of objects:
38 Galaxies
1 Double Galaxy (M51)
1 Galaxy nucleus (M54)
28 Globular clusters
25 Open clusters
6 Nebulous open clusters
1 Milky Way bright patch (M24)
1 Asterism (group of stars M73)
1 Double star (M40)
4 Planetary nebulae
1 Emission nebula (M43)
1 Reflection nebula (M78)
1 Super-Nova remnant (M1)

Each of these groups have different appearances, and so need a varying approach when trying to identify them. The first item we need, apart from a telescope or a pair of binoculars is a star wheel. This will help you identify the constellations year round. Next a star atlas (you don't need to spend a fortune here) will show where the object you are seeking is located. All you need now is a moonless night and a dark backyard or observing site. eg The Oaks Airfield that our Society uses.

...the 100 or so Messier objects visible from Sydney pose a worthy challenge...

If you are using binoculars a good size is either 7x50 or 10x50. This size will allow you to see about 50% of the above objects and the low magnification will give you a good wide field of view. If you are using a telescope the choice you have is varied. To find any of the above objects the best advice is to use an eyepiece that will give you **low power (20x-50x).** The reason for this is, if you use a medium or high power the field of view will be greatly reduced and this will increase the time that it takes to find it, if you can find it at all.

Orientation is very important when starting your observing night. Become familiar with all the directions N.S.E.W. Even our most experienced observers have had trouble with this when confronted by an unfamiliar site. This will be helpful when using your star wheel or maps.

Plan your night. There's nothing worse than arriving at the site and thinking what do I do now. There are many ways to gather information about **"what's on show tonight"**. The yearly Astronomy Ephemeris which sells for approx $20, or closer to home the excellent **"What's to see this Month"** in Prime Focus presented by Bob Bee. There are also specific books about Deep Sky objects available from the usual astronomical suppliers. The one I use is Messier Marathon by Harvard Pennington. It's very easy to understand and use.

Perception. Usually novice observers are attracted to astronomy by the brilliant colour photographs taken by David Malin and other astrophotographers. The reality is though, that with the majority of amateur scopes it's highly unlikely that you will ever see any colour at all, just B&W images, but still spectacular nonetheless. Even though the images you're seeing are nothing like the photographs, it's still amazing to think that the light that is hitting your eyes left its origin 100s, 1000s or million of years ago.

Telescope tuning. This isn't as difficult as it first sounds. Usually the first part that needs attention is the finder scope. It needs to be aligned with the main tube. It's best to try this during daytime with a stationary object at least a kilometre away.

Care of optics. This is an often neglected area. If your eyepieces have dirt or finger smudges on them, two things will happen.
1: You won't be able to see the object you're looking at clearly.
2: The acidity from your skin will eventually eat away at the delicate coatings used to enhance image quality.

A blower brush and a calotherm cloth should also be an important addition to your kit. You never know when they'll be needed. Keep your eyepieces, Barlow lenses etc, correctly stored in a case and if possible keep the caps on each end when they are not being used.

Bits and Pieces. Make sure that all tripod nuts and bolts are secure, and always anchor the tripod when setting up your scope. The last thing you want to see is your pride and joy taking a dirt bath.

Well I could go on for a while, but I'm afraid it would take up the rest of Prime Focus. I hope that this information has been helpful, especially to our novice astronomers. If you need further information, any of the Committee members will be happy to help you. We can be identified at our monthly meetings by our yellow name badges.

Happy Hunting,

John Rombi ■

Socially yours

It's been really great to see some new faces and indeed some familiar ones at our field nights. The weather has not been kind to us but if I, say, look at the last 6 months I can recall names such as Randall, Keith, Michael, John K, Bob, Peter N, etc who are not regular attendees. Our field nights are conducted twice monthly which gives those who may have other commitments the chance to attend either night, eg Lou or Michael might be working or Bob's down the coast. A rough calculation is that some 30% of our total membership will attend field nights at some stage, which is an excellent result when compared to other societies.

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It's true to say when clouds restrict our observations that many subjects are discussed, but mostly astronomy in any form it wishes to take. Anything from new discoveries, telescope techniques, latest books and of course movies and TV series, Stargate and Voyager being the flavour of the month. Sometimes we even talk about our family and children and life in general, always with good humour and best intentions.

Now the point of this article is to advise our more recent members who have not yet made the commitment to attend, to pull out "all stops" and come on down to "The Oaks Airfield" whenever you can. The Airfield is more suited to just dropping in, say, at sunset or after than the farm at Oakdale which is our second site, but of course you're welcome there too. Just by being a M.A.S. member entitles you to attend. Owning a scope is not essential as everyone is more than happy to show you the wonders of the night sky. For those with scopes the knowledge you will gain from other members is invaluable and cannot be underestimated. You will never learn more than at a field night.

...the four largest moons can be seen doing a merry dance...

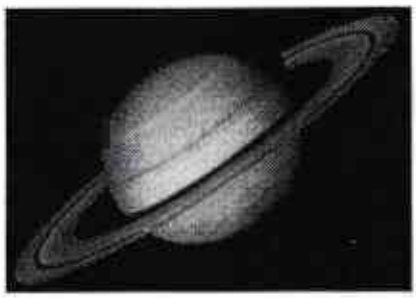
The field nights provide us with a safe hassle free environment. The regulars are just itching to expand their ranks and will make you most welcome. John Rombi and I are the coordinators and you can approach us anytime. Indeed I make it a point to catch up with everyone on the night. I have maps available tonight and my new mobile phone number. You will find The Airfield dates listed elsewhere in this journal, see you soon.

Noel Sharpe ■

The Gas Giants

In between the crook weather we've had lately I've been privileged to see the return of two of the most spectacular objects in our night sky, Jupiter and Saturn.

Jupiter's northern and southern temperate belts have been very prominent. They would be visible in any telescope and even in a steadily held pair of binoculars. The other usually spectacular feature, The Great Red Spot has been very pale in colour over the past year and has been very difficult to see. Unfortunately the situation has not changed. The four largest moons Io, Ganymede, Europa and Callisto can be seen doing a merry dance around Jupiter during the night. The other **12 moons** are all dimmer than **14th magnitude** and can be seen in only the largest of scopes. Jupiter will be at its closest to Earth at the end of this month.



Saturn is twice the distance from the Sun than Jupiter, but it still gives you breath taking views through any optical instrument. The most prominent and well known feature of Saturn is, of course, the huge ring system around the planet. When the rings were observed with the first telescopes, astronomers believed that the rings were a solid mass. As the resolving power of telescopes improved (improving resolving power allows your scope to see finer detail) an astronomer by the name of Cassini observed a separation or gap at the outer edge of the rings. This is now known as The Cassini Division. This can only be seen through a telescope, and only when the atmosphere is clear and steady. The next time you're observing Saturn see if your scope can resolve that detail. Saturn will also be at its closest to Earth at the end of the month, so if the weather holds off we should be in for a feast, Bon Apetito!

John Rombi ■

Observational Aspects

A clearing in the dense cloud cover revealed a section of sky that was just wide of the circumpolar. This showed our satellite galaxies, the Large and Small Magellanic Clouds (LMC and SMC). One of the finest globular clusters is 47 Tucanae. It is easily discernible. I also give that status to Omega Centauri, but with such a bright central concentration 47 Tucanae is instantly impressive no matter what scope images it.

I'm using the Vixen VC200L which has an 8" (200mm) mirror and works at F9.

I employed a 25mm wide angle Kellner eyepiece which gave 72x magnification.

47 Tucanae gives a splendid sight of a huge sphere containing thousands of stars. Nearby is the LMC. What is not quite so discernible is the Tarantula Nebula. I found using the 15mm Lanthanum eyepiece which came with the scope gave a nicely blackened field and a contrasty view of the nebula. Maybe 120x mag was a bit too much, but the lower powers gave too much background sky glow which washed out the viewing.

Recently I was introduced to Messier hunting. This has helped me to gain a developing skill in recognising objects through the 7x50 finder scope. That which gave the appearance of a star actually turned out to be something else.

Here's one for you M'niacs. What is it?

While locating the Tarantula Nebula, a small cluster appears in the wide field of the finder scope. This cluster is quite close to the nebula. If I haven't said so before it is a splendid object with spider like tendrils giving good definition. In attempting to enlarge this cluster I came across the method using higher powers which can highlight certain faint nebulae. It's interesting to note that supernova 1987A appeared in February of that year in the same region.

The clouds regathered and any hope of further viewing was dashed. I hope this information is useful and shows that attending field nights can be a way of gaining invaluable experience.

Noel Sharpe ■

Infinity and Beyond

The stars that shine so brightly above us blaze away in a glory that is immensely beautiful yet distant. Each speck of light burns with an outward intensity of such magnitude that it defies our comprehension. A trillion suns in a trillion galaxies with countless planets in a myriad of stellar wonders.

An entire universe of possibilities awaits us as we desperately cling to this mortal coil we call Earth. For one brief moment ponder our existence in the grand scheme of things and turn the Heavenly reflections inward and consider something that may burn brightly within us all.
Life changing events can alter the way we used to see things. Our planet Earth embraces us with such beauty rich and rare with wonders we all can see, touch and feel, but there is more.
Am I speaking about spirituality? Perhaps. I know I feel different when I look at all that shines above and I put to you the following: **"Do we as human beings possess all knowledge?"**

Noel Sharpe ■

Accelerating Universe - Why Is(?) it So?

Since late 1998, there has been a lot of discussion and papers about observations made implying that the expanding universe is actually accelerating, not slowing down as expected.

Remember, there used to be three possible models for the 'ultimate fate of the universe.' These were: i) Keep expanding, gradually slowing but never stopping;
ii) Slow down and come to a permanent stop;
iii) slow down, stop, then accelerate inwards for the 'big crunch.' Now, it appears, there is a 4th possible model.
iv) Don't slow down, but speed up.

This has led to a resurrection of Einstein's famous Cosmological Constant (Lambda Λ) in his equations of General Relativity. He had put it in as a Force of Repulsion, to balance gravity and keep the Universe static.

But when Hubble demonstrated that the universe was expanding, Einstein declared that Lamda was the biggest mistake of his life, and took it out of his equations. Maybe premature?

The jury is still out, but things are definitely looking good for Lambda.

I want to touch very briefly on some of the observations that have led to this situation. It has arisen from unrelated studies of both Gamma Ray Bursts and Type 1A Supernovae.

Gamma Ray Bursts – what are they? They are powerful, non-repeating flashes of gamma rays that come from all over the sky. Believe it or not, no-one (yet) knows what causes them.

...this leads inevitably to an accelerating universe...

The key to this link to an accelerating universe is that astronomers expect Gamma Ray bursts, being a natural astronomical phenomena, whatever they are, to have a similar range of intensities as do all other astronomical phenomena such as star luminosities, supernovae luminosities etc. ie a range of 1 million to one.

But observed gamma ray energy intensities, when based on population densities, give a range of only 6 to 1. This flies in the face of empirical astronomy. But, this inconceivably small range would have to hold true if Lambda was to have a Zero value. (ie if universe was not accelerating). Astronomers are faced with the dilemma that a dearly held belief (the wide range of natural intensities) would have to be badly wrong (there goes their other calculations and models) if they want to believe the universe is not accelerating. Snookered! If the normal and expected range of intensities of 1 million to 1 was to hold true, then the universe would have to be accelerating (Lambda > 0).

Obviously there is a lot of statistical analysis employed here, but a simple model to explain it is:

The astronomers measure population densities of gamma ray bursts as they observe further and further out into the far distant (and younger) galaxies. They relate these densities and distances to relative intensities. By simple spherical geometry, the volume of a segment of a cone increases with the cube of the distance to that segment. Also, the intensity of any standard candle would diminish by the square of that same distance.

So, for any range of intensities, one would expect to observe the bursts that are diminished by the square of the distance to increase in density by the cube of the distance. Observations, however, indicated that the population was thinning out, not increasing. This leads inevitably to an accelerating universe.

Type 1a Supernovae. The other data source suggesting an accelerating universe are Type 1A supernovae.

Astronomers are comparing the rate of expansion of the universe (ie the Hubble Constant) in km/sec/megaparsec, which has been currently accepted as 65km/sec/mps which we measure locally (for distances in order of tens or hundreds of millions of light years) with the Hubble Constant for supernovae in galaxies billions of light years away. i.e they are comparing the Local (newer) Hubble Constant with the remote (older) Constant.

The Hubble Constant is simply the speed an object is receding from us, divided by the distance that object is from us.

When they measure the Hubble Constant of something, say, 5 billion light years away, they are obtaining a snap shot of what the universe was like 5 billion years ago.

The speed of the object is measured by its Red Shift. This is relatively absolute and an independently measured value, not dependent on the measure of distance.

The distance of the supernova is measured using the Standard Candle property of the Type 1A supernovae. The perceived brightness, compared to the known absolute brightness, gives a direct measure of its distance from us.

The problem is that the supernovae are turning out to be about 15% dimmer (ie 15% further away) than they should be if the Hubble Constant for that earlier era was the same then as it is now for the local universe.

At first intuitive glance, this might suggest that the universe was expanding faster **then** than now, like we would expect. (After all, it is further away than expected). But, the arithmetic of calculating the Hubble Constant shows the opposite.

Suppose a local galaxy has an observed receding velocity of 650 km/sec and a distance of 10 megaparsec (32.6 million light years)

This gives a Hubble Constant of 650/10 = 65 km/sec/mps
This is the **Local Hubble Constant**

Suppose a vastly remote Type 1a Supernova has a measured velocity of 65,000 km/sec. Now if the remote (earlier) Hubble Constant was the same as our Local (older) value, its distance would be 65,000/65 = 1,000 mps (3.26 billion light years)

But the observed distance is ~ 15% greater than this, ie about 1,150 megaparsec.
i.e. the old remote Hubble Constant = 65,000km/sec / 1,150mps
= 56.5 km/sec/megaparsec.

This is less than the current value.
This means the universe was expanding slower then than it is now!

Ergo, the universe's expansion is accelerating.

There are a few other interpretations of this which are very interesting, if not a bit 'left field.'
a) Universe is NOT accelerating but the Speed of Light is slowing down. (Don't laugh, it fits the data).
b) There is in fact some Great Attractor of mass 'outside' our universe which, as we are now approaching it, is exerting a greater gravitational influence causing the outward movement to speed up.

But the current favoured theory (which theoretical physicists and cosmologists are trampling each other to be the first to produce a viable theory to explain) is that the universe **actually is** accelerating due to some unknown feature of space-time itself. That is, as space gets big enough (as it has over 15 odd billion years), a very weak repulsive force (Lambda) built into the nature of space-time itself is starting to assert itself over gravity and the repulsive force is beginning to win.

Local gravitational systems (such as planetary and galactic motions) are not affected as the distances are too small. But in a mechanism as big as the universe, Lambda rears its head and , against all previous wisdom, overpowers gravity. And it's out, out and away!

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SMC & 47 Tuc

There is a very interesting part of the sky tucked mid-way between Achenar and the South Celestial Pole. It contains two significant objects in one binocular field of view.

The Small Magellanic Cloud is a misty 'cloud' some 3.5° across. It is in fact an irregular galaxy, part of our Local Group, and is 190,000 l.y. away. Your binoculars and low powered scope will reveal knots of stars and glowing gas clouds.

About 3° to the west of SMC is another famous smudge of light – 47 Tucanae, 2nd only to Omega Centauri in the beaut globular stakes. It has a marked central core and its outer stars can be resolved in even small scopes. 47 Tuc is a mere 15,000 l.y. away, over 10 times closer than SMC. Keep this in mind when comparing the two.

■

Measuring the Distances to the Stars

We read in books and journals, even our own Prime Focus, that the nearest star, Alpha Centauri, is 4.2 light years away, that Betelgeuse is 510 light years away and M31 (Andromeda Galaxy) is a staggering 2.2 million light years away. But how do we know that?

What we will be looking at in this series of articles is a very simplified account of the various techniques used to arrive at these distances. I have no intention of covering the full range of methods used, but will look at a few of the main methods.

We will discover that like the construction of a pyramid, one layer of knowledge is built on top of another. We learn what we can from one method. Then, when that method can be taken no further, we build on top of that knowledge with information from another method. And so on, and so on...

It becomes immediately obvious from the pyramid, that if there is an error in a lower layer method, this will multiply through the results of all later methods built on top of it.

The Andromeda Galaxy is a good example of this. Back in 1929, Edmond Hubble used a method to calculate the distance to the Andromeda Galaxy (at that time thought to be contained within our galaxy). He calculated it to be 900,000 l.y. thus proving it to be outside our galaxy. On this yardstick, the size of the then known universe was calculated. Later, the distance of Andromeda was recalculated to 2.2 million l.y.

The size of the known universe was doubled overnight.

The Astronomical Unit

The most basic yardstick of astronomy to be measured is the Astronomical Unit, the mean distance of the Earth from the Sun. Without this, we can go no further than to measure other distances in A.U.s We would not know the distances in km or light years etc.

Ptolemy (the Greek) made a fair stab at it when he estimated 5 million miles. But the first reliable measurement came from Cassini in 1672. He used parallax to measure the planet Mars' distance from Earth at various times in Mars' orbit.

From Kepler's 3rd Law,
$P^2 \alpha D^3$ where P = planet's period of orbit,
D = mean distance from Sun.

He already knew that Mars must be 1.52 times further from the Sun than the Earth. Using measured distances to Mars, he was able to calculate Earth's distance to the Sun as 86 million miles. That was pretty good for 1672.

The epic measurement took place in 1769 when Captain Cook travelled to Tahiti to observe the transit of Venus. This measurement involved using a large baseline on Earth (ie London to Tahiti) and Kepler's 3rd Law. They got it pretty right at 92 million miles.

Current methods involve bouncing radar off Venus and other measurements by planetary satellites. The end result is an accurate A.U. of 92,976,000 miles or 149.6 million km.

With this yardstick, the A.U., the first step to measuring the distances to the stars can be taken.

Trigonometric Parallax

Note: This is called 'trigonometric' parallax because there is another kind...more of that later.

Let's start by recognising a basic problem. The nearest star to the Sun is a VERY LONG WAY AWAY. i.e. 265,000 Astronomical Units.

So, what is the parallax method?

The parallax angle of a star is defined as **'the angle subtended at the star by the radius of the Earth's orbit.'** That is, the angle at the star subtended by one A.U.
This is usually done by using photographs to measure the angular displacement of the subject star (earlier

astronomers didn't use photographs, of course, they did it the hard way) against the 'fixed' background stars from the opposite ends of Earth's orbit at right angles to the direction of the star to the Sun. The actual angle measured is halved (averaged) to give the parallax, 'p'.

The measurement of this parallax angle is agonisingly painstaking.
FIRSTLY, because it is so small. The closest star has a parallax of less than one second of arc, and one second of arc equals 1/3600th of a degree.
SECONDLY, because the star is actually moving. This is called proper motion and needs to be measured and taken into account.
THIRDLY, the background stars can have their own parallax. This needs correction.
FOURTHLY, atmospheric aberrations and other astronomical phenomena need to be allowed for.
FIFTHLY, limits to accuracy of even the best telescopes.

Eventually, the astronomer has a parallax angle ,p, he has confidence in. After that, it's simple. With apologies for the maths:

Distance r = D/p
where D = Earth's Radius,
p = the parallax in radians (a unit of angle = 57.29 deg.)

Now, there are 206,265 seconds of arc in one Radian.

Therefore, r = 206,265 x D/p
where p is in seconds (")
If D = 1 A.U., then
r = 206,265 x 1/p A.U.s

It's done this way because p is always small (less than 1").
However, it's a cumbersome formula, so let's simplify it.
If we DEFINE the distance to a star with a parallax of 1" as a PARSEC, we get:
1 parsec = 206,265x 1 A.U. /1 = 206,265 A.U.
But 1 A.U. = 149.6 x 10^6 km

Therefore 1 parsec (pc) = 3.086 x 10^{13} km= 3.26 l.y.

We now have a smorgasbord of formulae to calculate the distance to the star:
R = 206,265 x 1/p" A.U.s
= 3.26 x 1/p" light-years (l.y.)
= 1/p" parsec (pc)

The first star to have its parallax measured was 61 Cygni. In 1838, the German astronomer F.W. Bessel calculated a parallax of 0.35" (giving a distance of 2.86 pc or 9.3 l.y.). The currently accepted value is 0.30" (equal to 10.9 l.y.)

The irony is that a Scottish astronomer, Thomas Henderson, working from South Africa's Cape University had earlier (about 1835) calculated the parallax of Alpha Centauri. It was easier because it was much closer than 61 Cygni. But he wasn't in a hurry to publish his results and Bessel went to press first, getting all the kudos.

The moral: Publish or be damned!

Oh, yes. Alpha Centauri's parallax is:
0.76" = 1.3 pc = 4.2 l.y.

What are the limits of the parallax method? After considering the previously mentioned corrections, by using a large number of photographic plates and the most modern techniques, the error can be reduced to about 0.004". Using CCD technology fitted to large telescopes, this can theoretically be reduced to 0.002" for stars as faint as 20th magnitude.

Presently, there is a satellite called HIPPARCOS (launched in 1988) which is progressively measuring the parallaxes of 100,000 stars to an error of +/- 0.002"
But all that means is they can measure distances up to 100 pc (=326 l.y.) with a confidence of +/- 20%. And that's about the theoretical (not practical) limit. About 80 times the distance to the nearest star.

So, how do we measure distances beyond 100 parsec? This is where we start building our pyramid of knowledge. A number of different techniques exist and, to some degree, overlap. I will attempt to describe some of the better known techniques in future articles.

■

Destination Moon - Pt 1

J Casey

For those who observed the recent eclipse, where the Earth's shadow tracked across the Moon's surface, it may be interesting to find out that the Greek astronomer Aristarchus, in the third century B.C. likewise observed such a lunar eclipse and estimated that the Moon was about 60 Earth radii from Earth. (This is in good agreement with the 55-63 Earth radii, or 354,000 to 404,000 km by current measurements.) The elliptical orbit of the Moon around the Earth causes its apparent size to change, being largest at perigee, when the Moon is closest (356,410 km away) to smallest at apogee, when it is farthest away (406,697 km.)

In 1610 Galileo Galilei turned his spyglass at the Moon and began the first systematic description of its surface features. He published his observations in 1610, in his book "Sidereus Nuncius" – (Celestial Messenger.)

He described the rough and mountainous surfaces and noted that the light and dark regions of the Moon were the rough, hilly topography, and smoother plains respectively. The Greeks also believed that the dark areas were flat areas of seas, and called them "maria" –(seas), and for the bright, rugged highlands, "terrae"- (lands).

In 1651, the astronomers Giambattista Riccioli and Francesco Grimaldi published a map of the Moon that established the scheme of nomenclature that we used today, where craters are named after famous scientists such as Copernicus and Archimedes, and the dark regions or maria were given classical Latin names denoting the weather, such as Mare Imbrium, "Sea of Rains", or states of mind, such as Mare Tranquillitatis, "Sea of Tranquillity".

In 1610 Galileo Galilei turned his spyglass at the Moon...

When I was in my teens, I saw the movie "Destination Moon". Unlike all the other science fiction movies of the era, this attempted to show what it would really be like, from the perspective of the 1950s. They even suspended the actors in spacesuits from thin cables and walked them along a set mounted on the side of a tall building to show the bouncy effects of walking in a low gravity environment for the Moon surface shots. The movie was a bit out in the extremely ballistic shape of the craft, and showed the astronauts wearing magnetic boots so that they would not float about in the (steel?) spacecraft on the way there, but even now would show up OK with the space walk to free a thruster, where the high vacuum of space had welded the parts together by friction.

Micro meteorites zapped one of the space walkers and he drifted off to eternity. There were no little green men, just big question marks for all the unknowns - would the space ship sink into the surface of the Moon like quicksand? The fact that I can still remember this now shows that it made a big impression and gave a lasting interest in the Moon.

The Real Moon from Earth

The plane of the Moon's orbit lies neither in the equatorial plane of the Earth, nor in the

ecliptic plane, in which nearly all the planets orbit the Sun. The spin axis of the Moon is nearly perpendicular to the ecliptic plane, with an inclination of only 1.5° to the vertical. As a result, the Moon experiences no seasons. The Moon is gradually receding from Earth, at about 4 cm/year. Early in planetary history, Earth was spinning much faster than it is now. Over time, energy has been transferred from the Earth to the Moon, and this is causing the spin rate of the Earth to decline, and the Moon to speed up in its orbit, and move further away. In a few million years the Moon will be too far away to create a total solar eclipse.

There is a 7° inclination of the plane of the Moon's orbit to the Earth's equator, and this libration causes it to move slightly above or below the equatorial plane over time, and allows us to see about 59% of the lunar surface over a prolonged period.

Craters on the Moon

The word "crater" is of Greek origin, and means "cup" or "bowl". The Moon's surface is covered by craters of all sizes, down to the limits of visibility of telescopes on Earth, and with the largest the size of whole countries on Earth. Various theories tried to explain the mechanisms for such crater formation. The English scientist Robert Hooke, in the 17th century, proposed that the craters were frozen, partially burst bubbles created by slow release of gas from a boiling surface, after experimenting with boiling alabaster. This model implied that the Moon is, or was at one time, molten. For the next 200 years volcanism was the favourite mechanism for crater formation amongst the astronomical community, because of the similarity of lunar landscape and that of craters on calderas at the summits of many terrestrial volcanoes.

A notable exception to this view was the British astronomer, Richard Proctor, who, in 1876, proposed that the craters resulted from collision of solid bodies with the Moon. Few supported this proposal, partly because no one had yet seen and described an impact crater on Earth. In 1892 the American geologist Grove Karl Gilbert became interested in the Moon. He knew that meteorite fragments had been found in the vicinity of Coon Mountain (later to become known as Meteor Crater), so he studied the area as a possible example of how an impact could create a hole in the ground.

However, he reached the conclusion that Meteor Crater was produced by a steam explosion rather than an impact (because no one then understood the mechanics of high velocity impact.) Gilber had expected that if an impac had occurred, a huge buried meteorite should exist beneat the floor of the crater, but his magnetic survey failed to show any iron meteorite bod was buried there.

...in a few million years the Moon will be too fa away to create a total solar eclipse...

However, Gilbert still though that Moon craters were impact sites. He made small experimental craters by dropping balls of clay, and shooting a pistol into clay an sand targets. However he wa puzzled by the high degree o circularity of Moon craters, given his calculations showing that the average angle of impact should be 4 degrees for cosmic impacts. However, Gilbert recognise patterns he called sculpture where material hurled out o the impact basins spread across the surface. He also suggested a scheme to classify surface features by relative age, by the overlay of such ejecta onto surrounding craters. His recognition that the Moon' surface was complex, and built up by innumerable events over long periods o time was the key to

unravelling the history of the Moon.
Some years after Gilbert's work, Daniel Barringer, a mining engineer, set about to prove that Gilbert was wrong about Meteor Crater. He was convinced that the crater was formed by an impact, and that he could make his fortune by mining the nickel- iron in the body he was sure was underneath the crater. After spending 10 years of drilling the crater floor, he went broke. In 1921, the German geologist Alfred Wegener, (best known as the father of the concept of continental drift) defended the impact origin of the Moon's craters. In 1935, two American geologists suggested that several large circular structures that they observed on Earth were eroded impact craters, which they called "astroblemes" (meaning "star wounds".) Many of their examples were in Canada.

Then in 1949 Ralph Baldwin wrote his book "The Face of the Moon", and explained the details of high energy impacts. On the basis of telescopic observations and meteor entry data, he plotted the number of meteoric objects in space as a function of size, and showed that the size frequency distribution perfectly matched the size-frequency distribution of craters on the Moon.

Eugene Shoemaker was the next to make a substantial contribution. After carefully following the US army's experiments with captured V2 rockets, he foresaw the likelihood in the near future of sending rockets to the Moon. He decided in 1961 to found the Branch of Astrogeology of the US Geological Survey. His careful analysis showed that a geological perspective could be obtained from recognition of relative ages of rock units near the Moon's crater Copernicus.

(Eugene Shoemaker)

His belief in crater impact theory was vindicated to the world in 1994 when he and his wife, Carolyn Shoemaker discovered the Shoemaker-Levy comet that subsequently hit the planet Jupiter. This was the first time a giant impact had actually been observed. In 1971, Don Wilhelm and Jack McCauley of the Geological Survey published the first geological map of the near side of the Moon from all this work done under Eugene Shoemaker's guidance.

The Space Race

Exploration of the Moon was not in the name of science, but political one-up-manship between the USSR and USA. The launch of the Soviet satellite Sputnik in October 1957 sent shock waves in politics and within the military in the USA. The USA set up NASA, the National Aeronautics and Space Administration in 1958, but played catch up to the USSR when the first man in space was Russian - Yuri Gagarin, in April 1961. After the failure of the invasion of Cuba by CIA trained rebels, the newly elected president, John F Kennedy needed a diversion, and decided on a ten year plan of landing a man on the Moon. This goal was set for a million km trip, lasting over a week, when the USA space experience was 15 minutes (for Alan Sheppard in Freedom 7), covering 500 km in space, and would require a rocket with several millions pounds of thrust and a pay load in orbit of 100-300 tonnes, at a time when the best US booster rocket, Redstone, had 80,000 pounds of thrust and could only just push a capsule weighing 1 tonne into low Earth orbit.

...exploration of the Moon was... political one-up-manship...

The Soviets continued to keep ahead in this political race for the Moon, when they successfully photographed the far side of the Moon from their Lunar 3 spacecraft in 1959.

The US Ranger program started in late 1959. The first

success of this series was Ranger 7, which obtained close up images of the Moon as it collided with the surface at near escape velocity of 3.5 km/sec. Several of the previous missions blew up on launch, missed the Moon completely, or crashed without sending back any pictures or data. Ranger 7 gave close up images of a portion of Oceanus Procellarum, the largest maria on the Moon, and showed that the surface was cratered down to the limits of resolution in the images.

...again the USSR beat the USA to the punch...

This lead to the concept of crater equilibrium, where the rate of crater production by impact equals the rate of crater destruction by erosion by micro meteorites. As is turns out, all lunar surfaces are in crater equilibrium at some diameter. The larger this equilibrium crater diameter, the older is the surface. The oldest surfaces of the highlands have equilibrium crater diameters of tens of kms, indicating that they are saturated with very large impact craters and that the crust here is crushed and broken by impacts for depths of many kms.

Ranger 8 was sent in early 1965 to the western edge of Mare Tranquillitatis, and showed the same crater upon crater texture, but also showed two unusual craters - Ritter and Sabine, that were thought at the time to be large volcanic craters. The last of the Ranger series, Ranger 9, in March 1965 was sent to the spectacular ancient crater Alphonsus, on the edge of Mare Nubium This is a floor fractured crater, with cracks present, and dark rimmed craters that might be cinder cones from volcanic activity can be seen there. This region is famous for the lunar transient phenomena - where, from Earth, reddish, glowing clouds have been observed issuing from the crater. However, Ranger 9 saw no evidence of such gas venting. This last mission was the first to return pictures in real time with live TV images being watched by millions as the probe struck the Moon at high velocity.

The next phase of NASA's exploration was to be a soft landing, but again the USSR beat the USA to the punch (after a number of their own failures), by soft landing Lunar 9 in February 1966. It showed a surface similar to hard packed sand, with a thin layering of dust. Surveyor 1 was the first USA landing, in June 1966. Surveyor 1 returned hundreds of images that showed evidence of the mixing and crushing of bedrock into the rock laden dirt and dust at the surface. The surface was shown to be strong enough to support the weight of astronauts and equipment. Five Surveyors successfully landed, but 2 a 4 lost contact and presumab crash landed. Surveyor 3 carried a trenching tool to study the surface properties and strength. Three years la Apollo 12 astronauts recovered the trenching tool and TV camera and returne them to Earth to study the effects of long exposure to t lunar environment.

Surveyor 5 was the first to carry instrumentation to measure the Moon's surface composition, and showed th the maria were rich in magnesium and poor in aluminium - consistent with Earth's very common lava rock, basalt. Surveyor 6 landed at another maria site called Sinus Medii. The last the series, Surveyor 7 spectacularly beat the odds and successfully landed on rough, hazardous rim of the crater Tycho, in the souther highlands. The rocks here showed a surface rich in aluminium and depleted in magnesium (the reverse of maria rock data.)

(Rendezvous of Apoll Landing Module wi Command Modul

The last series of unmanned probes before the Apollo manned missions were the Lunar Orbiters. They were to map the surface in detail, and give details to certify appropriate safe landing sites. Five such craft flew between August 1966 and August 1967, and all were overwhelmingly successful. This was because they were based on the design of classified espionage spacecraft that the USA used from Earth orbit to photograph features in the USSR at very high resolution. The first three spacecraft were placed in near equatorial orbits, and mapped features as small as 0.5m. The last two missions were near polar orbits, so the whole Moon could be mapped.

(Apollo 11 Astronaut on the Moon)

The Lunar Orbiter missions revealed an unexpected hazard for the manned missions. Their orbits changed with time because of high density material in some surface locations tugged at the spacecraft and change it's orbit. These "mascons", short for "mass concentrations" caused a small communications satellite released from Apollo 16 to crash into the surface after only two weeks, when it had been expected to last for years, and caused the first landing by Apollo 11 to be several kms down range and completely outside the intended landing site. So the Lunar Orbiters also were used to generate the first gravity map of the Moon. Uplift of mantle rock, rather than lava flooding is the dominant cause of the mascons. By the time of the second landing by Apollo 12, the fruits of the gravity maps plotted from data from the Lunar Orbiters was put to good use, and Apollo 12 landed with pin point accuracy within tens of metres of the Surveyor 3 spacecraft.

(This is the end of Part 1. Parts 2 and 3 will follow in future issues of Prime Focus.)

Borrowing MacDob

The Society's own telescope, a 6" Dobsonian, is available for loan to members. It is easy to transport, set up and use. If you would like to borrow MacDob for a month, speak to Phil Ainsworth who is its custodian. Though there is no hiring fee, members are invited to make a donation of their choice which will go towards the upkeep and upgrade of MacDob

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M45 – The Pleaides

Where the author of a Prime Focus article is not indicated, the author is the Editor.

What's to See This Month? 20th Nov. to 14th Jan

(This column will actually cover two months as there will be no Prime Focus in December.)

Planets:

Mercury is a no-show for most of November and December, becoming visible in the evening twilight only from early January through to about 3rd February, after which it is lost in the Sun's glare again.

Venus is much better value. Our 'month' starts tonight with Venus nestled 1.6° from M22 in Sagittarius. Venus is setting very late, from about 10.45pm (tonight) to 11.00pm in mid-December and back to 10.30pm on 14th January. It is fun to go out just before sunset when the western sky is still blue and try to spot Venus. I have done it a number of times, looking fairly high (about 60°) and staring for a while. (I have received all sorts of odd looks from people in the station car park.) All of a sudden Venus pops into view as a bright white star. (Make a wish.)

Venus will form some very attractive arrangements with the Moon. I saw one of these on 30th September when the 3 day old Moon was only 4.8° from Venus, just above the horizon. It was jaw-dropping beautiful, like a still from some science fiction movie. Such arrangements are worth watching for. This will happen again on 29th Nov. (5° from 3 day old Moon) and on 30th Nov. (6.3° from 4 day old Moon). Then there is an encore in December. On 29th, it will be 6.7° from the 3 day old Moon and closer at 4.5° on 30th Dec.

Also of interest on 7th Dec. is a 0.8° approach to M75, an 8th magnitude globular in Sagittarius.

Mars, though respectable at mag. 1.7, is very much an early morning object through to end of January. Though there are a number of near (not close) encounters with the Moon (4.6° on 22nd Nov., 9° on 20th Dec., 6.2° on 21st Dec. and 5° on 18th January), they are not as striking as the ones with the mag. –4 Venus.

There is one dramatic alignment on 21st December when Mars sits midway in line between Spica (mag. 1.0) and the 25 day old crescent Moon.

There is not much detail available to telescopes as Mars' disk is only about 5" diameter.

Jupiter: To paraphrase Crocodile Dundee, "...now that's a planet."

Starting at mag. –2.9 and ending in January at –2.6, it is bright by any standard. It is also at opposition on 28th November, giving a disk size of 48.7". From the trusty table in the February 2000 Prime Focus (back page), you will easily see that Jupiter is about 606 million km away. It doesn't get much closer, so here's your opportunity to observe the cloud bands and Red Spot in high mag.

...Jupiter, Saturn and Aldebaran form a flattish triangle...

Jupiter is spending its Christmas holidays in Taurus, to the west of Hyades and Aldebaran. At the start of December, it is only about 6° from Aldebaran (mag. 0.9). The Full Moon splits the pair on 10th Dec, with the 'blazing Moon only 2.8° from Jupiter.

Though most of December, Jupiter, Saturn and Aldebaran form a flattish triangle, with Saturn and Aldebaran making the long side. As a Christmas treat, on Christmas Eve, they makes a perfect triangle with both Saturn and Aldebaran lying exactly 8° from Jupiter.

In early January, the Moon steps back in. On 5th January The Moon, Saturn and Jupite form a straight line, Saturn i the centre, with a spacing of 8° between them. Then, the next night (6th) the Moon sli in between the two gas gian (and a bit off line) to form a flat triangle with the Moon and 3° from Saturn and Jup respectively.

Saturn, also in Taurus for few months, is rising about minutes ahead of Jupiter a

like Jupiter, is visible all evening. Towards end of January, it is setting about 1am. so there's plenty of time to study it in binoculars or your telescope (@%*$# clouds permitting).

Its magnitude is moving from –0.4 to 0.0, and it reached its opposition on 19th November. Although the planet's disk is only 20.43" dia, (giving a distance of 1,220 million km,) its rings are a massive 46" across, rivalling the apparent size of Jupiter. (You will notice that Saturn is almost exactly twice the distance from us as Jupiter.) Also, at this time of year, the angle of the rings to our view is extremely large, though not the largest possible. So make the most of the opportunity.

Saturn forms some nice arrangements with the Moon and Jupiter, some being mentioned above. On 9th December, the new Full Moon will be 4.1° from Saturn, with Jupiter another 8° away.

Uranus and **Neptune** are setting earlier now and by the end of January will be setting during evening twilight. Though they are still in Capricornus, you really need a chart or Dick Everett to know where to find them.

Constellations:

There's a cacophany of constellations to feast on over the festive break:
Aquarius is heading west, taking M22, The Saturn Nebula and the Helix Nebula with it.
Pegasus, to the north west, is also disappearing fast – check out M15 (6th mag. glob) and NGC7331 (10th mag. spiral) while you can.
Pisces, to the north, is the home of M74, a beautiful face on 9th mag. spiral galaxy.
Cetus (the Whale) starts in the north, moving to the north west. Its main interests are M77, another face-on 9th mag. spiral, one of the most remote of the Messiers at 50 million l.y., In contrast, Tau Ceti is one of the closest stars at 11.7 l.y. and also one of the nearest single Sun-type stars, a prime candidate for SETI (No messages yet!)
Orion: Welcome back! Now high in the east and climbing higher. It is full of interesting stars and NGC objects, the best being M42, the Great Orion Nebula, only 1400 l.y. away.

That should keep you busy till January.

Good Seeing! ■

The Uninvited Guest

A Short Story by Robert Bee

*

The Christmas turkey was but a flayed cage of bones on the serving dish. Its former flesh lay heavily in the four stomachs surrounding the Hoggit dinner table, announced by the occasional belch.

The potato, corn, pumpkin and peas had gone the same way, adding to the symphony of digestion.

"I'm full, Ma," complained Alma.

"Me too." Ikky threw a stray pea across the table at his twin sister, aiming at the zit blossoming on her button nose.

"Ezekial, behave," Essie Hoggit snapped. "I told you kids to leave room for the puddin'. Now we'll have to wait a'whiles."

"Suits me," Horace Hoggit belched from the end of the table. "I'm stuffed." He gazed out the cracked dining room window at the flat dry fields reaching towards the equally flat horizon. His old tractor stood in the afternoon sun beside the even older barn. The barn's corrugated roof shimmered in the mid-day heat, daring any wayward crows to even try a landing. "Jeez, it's hot Essie."

"Bite your tongue, Horrie. Remember whose birthday we're celebrating." Essie piously pushed her chair back and headed for the kitchen.

"Sorry, Essie." Horace winked at his two children. "I wouldn't want God to strike me down. At least, not until I've had my pudding." Alma and Ikky giggled at their Dad's rare display of humour, and Horace joined in, between burps.

As if on cue, there was a sound like the curtain of the firmament being ripped, then a thunderous explosion. The following shock wave lifted the old farmhouse off its foundations. The turkey carcass leapt off the table and

landed in a fatty mess on Horace's lap.

Profanities log jammed behind Horace's clenched jaw, afraid to escape lest another heavenly blast strike him down. He felt a particularly blasphemous phrase squeezing past his teeth and braced himself for a second dose of heavenly wrath.

"Schweppes, what was that?" Alma screamed.

"Buggered if I know," Ikkie yelled, and ran to the window. "Uh oh!"

Horace upended his chair, scraped the turkey off his lap and on wobbly legs went to the window. "My barn," he cried.

Horace could be forgiven the exaggeration, for up to that moment, a barn had in fact stood at the spot now occupied by a great smoking crater. Bits of barn and tractor continued to rain down, though most of it lay in a twisted ruin encircling the crater.

"My barn," Horace groaned.

"My, what a bang." Essie stood at the kitchen door, cross-eyed, covered in custard powder, and a saucepan over her head like Johnny Appleseed. "You lot see what it was while I get the pudding ready." She returned to the kitchen, humming 'White Christmas'.

"Essie, the barn's been blown to bloody billyo," Horace yelled.

"That's nice, Horrie. You go repair it while I fix the pudding." 'Jingle Bells' warbled from the kitchen.

Horace and the two teenagers tumbled out of the front door – the front steps hadn't landed back in the right place – and approached the still smoking crater, stepping around pretzelled sheets of roof iron and melted tractor tyres.

The hole was as big as the barn had been.

"My barn," Horace sobbed as they climbed the crater rim.

"Remember 'The War of the Worlds'?" Ikky whispered in awe. "Do you think..."

"No, this is more like what happened in 'The Blob'," Alma said. "So don't touch anything, no matter how pretty it looks." She turned to her father. "What do you think it is Dad?"

"My barn," Horace whimpered.

They reached the crest of the rim and looked down. Amid the smoke and shadows, they could make out a large hemispherical mass, glowing in pulsating purples.

"Wow," said Alma.

Ikky tested the side of the crater and almost fell in. "Great Zorel, this is how Superman came to Earth. Holy Christmas Day, do you think..."

"My barn," Horace croaked.

Alma and Ikky peered into the crater, trying to penetrate the smoke. "It's not moving," said Alma.

"No doors opening," agreed Ikky. They stared at the glowing object, ignoring their father's lamentations.

"Of course, it could be just a meteorite," Alma said.

Ikky stared at his sister, torn between fantasy and reality. He chose reality. "No, it has to be..."

"Pudding's on," Essie called across the debris strewn yard. "Get it while it's hot."

Alma and Ikky exchanged glances, then shrugged. "May as well," said Ikky. "This thing's not going anywhere."

They each grabbed one of Horace's arms and started leading him back to the house to finish their Christmas dinner. His final "My barn" was cut off by the slamming screen door.

At the bottom of the crater, the purple mass lay still, cooling, crackling. Then with glacial slowness, it rose from the smoky shadows and began to seep up the side of the crater. As it slurped over the rim's crest it accelerated and, as if driven by a primal need, continued to gain speed. It approached the listing house like a snail in full flight.

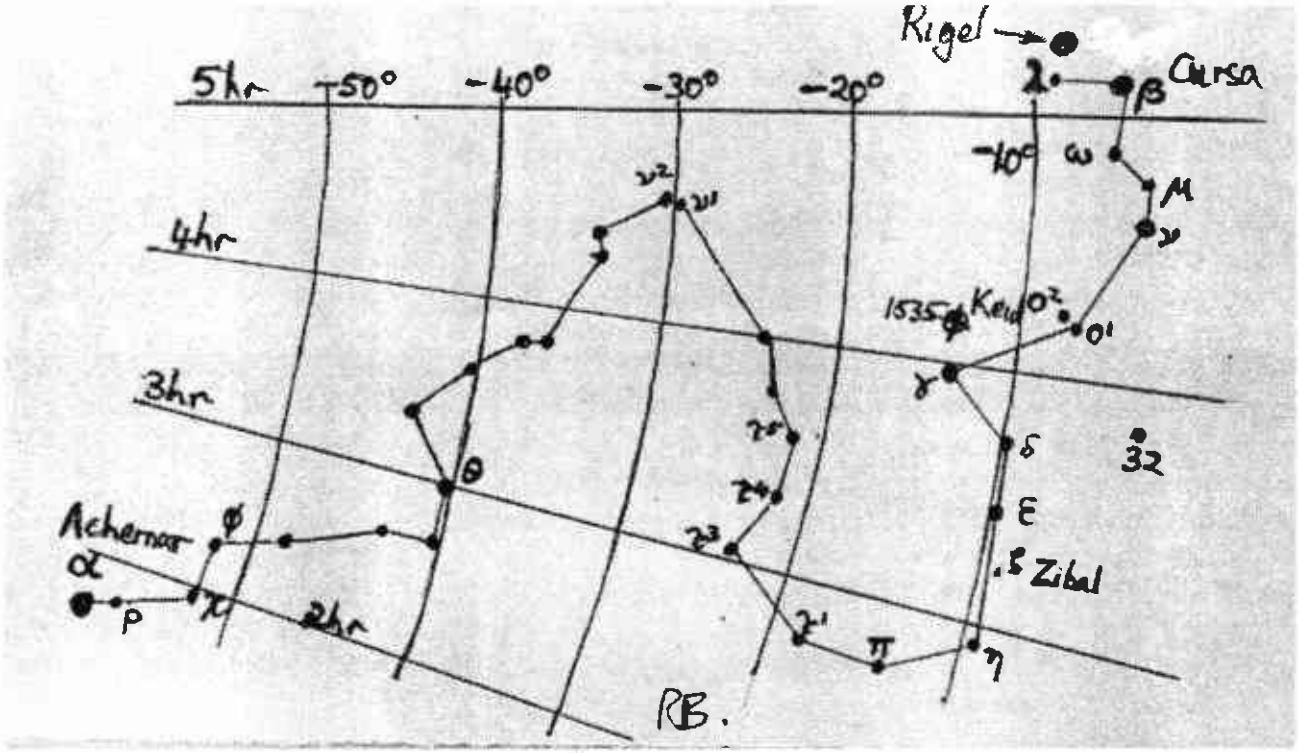
The aroma of plum puddin and brandy custard wafting from the shattered windows enveloped the nebulous mas shaping it from primordial codes deep within its alien genes until it resumed its tri form.

As it crashed though the front door, deep inside its impossible mind, an ancien adage was repeated... and repeated...

"Bones are all right, but careful of the threepences the pudding."

*

Eridanus – The River



This constellation meanders like a river (surprise!) across 60° x 30° of sky. Unfortunately it's as faint and indistinct as it is large. It stretches from Orion to Phoenix .

However, it contains some interesting multiple stars and a nice planetary nebula, so it's worth the study. The reason I've picked it is because at this time of the year (Nov/Dec) it is nicely placed for viewing from our latitude – almost directly overhead at 9pm, and more so even later at night.

So, what can we catch in the River?

α Eridani ('Achernar' – the river's end) is the brightest star at mag 0.5. It's also the *9th brightest* star in the sky. Though not spectacular, it is a blue-white star 91 l.y. away. (1hr 38m, -57°) and can be one of the landmark stars to help you find your way about the sky.

β Eridani ('Cursa', the foot stool. Now that's quaint. You will notice that Cursa is immediately beneath Rigel, which is Orion's ankle or foot – hence the foot stool. At least it can be found this way.) It's a blue-white giant, mag 2.8, 78 l.y. away. (5h 8m, -5°). You will note the obvious:– α and β are at the extreme opposite ends of Eridanus.

ε Eridani is the *10th nearest* star to us, at 10.7 l.y. away. At mag. 3.7, it is a similar class star to our Sun, a yellow dwarf. It is suspected to have a large planet or small star as a companion and has also been a candidate for SETI study. Unfortunately, ET's phone appears to be off the hook.

θ Eridani is Acamar, a nice pair of blue-whites of mag 3.2 and 4.3, about 55 l.y. away. A small telescope should divide these easily. (2h 58m, -40°).

o^2 Eridani is a stunner. Also called Keid or 40 Eridani, it is 16 l.y. away. It's in fact a triple! Here's a chance to easily gaze upon a white dwarf, the 9.6 mag companion to the main yellow 4.4 mag primary star. Both are easily seen in a small telescope. But there's more. A small

telescope will also show a 11th mag red dwarf companion to the white dwarf – triplets! (4h 15m, -8°).

32 Eridani is a colourful double, suitable for small telescopes. It has a 4.8 mag orange giant and a 6.1 mag blue-green. 290 l.y. away. (3h 54m, -3°).

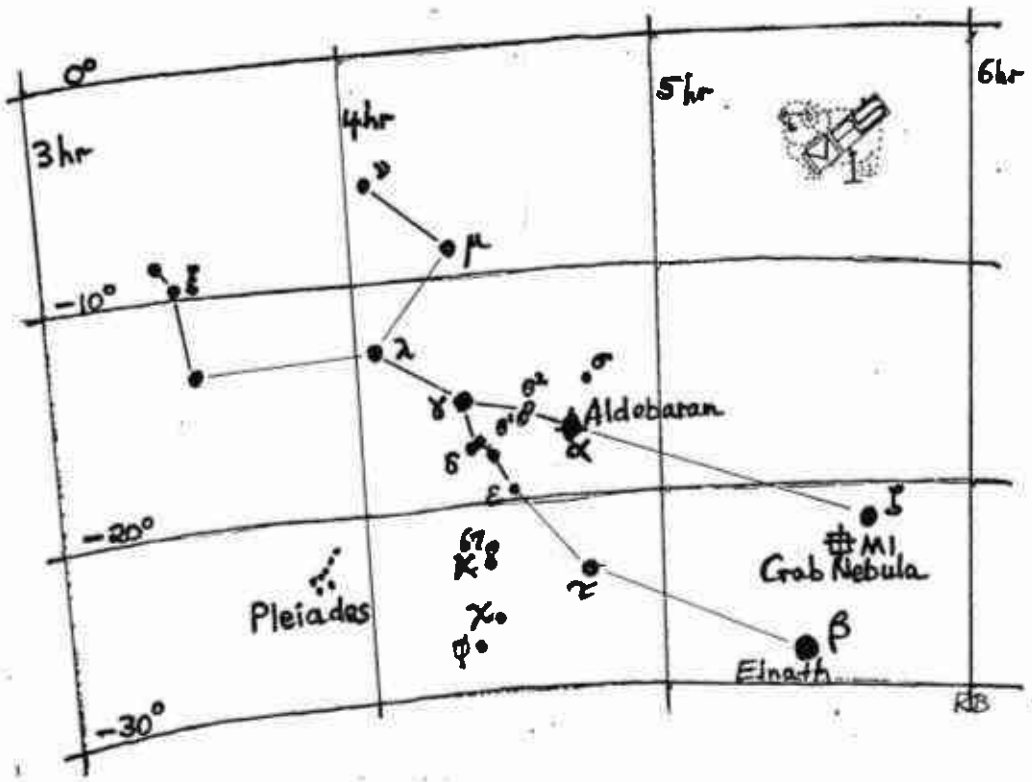
p Eridani is a wide pair of beautiful mag 5.8 and 6.0 orange stars, 22 l.y. away. These stars take 500 years to orbit each other. (1h 40m, -56°).

and last, but not least...

NGC1535 is a nice challenge for small and medium telescopes. 2000 l.y. away, it is a small 9th mag planetary nebula. It can be seen with small telescopes, but you need a MacDob size scope (150mm) to really see the blue gray planetary disc. (4h 14m, -13°).

Hopefully, this is one river that won't drive you around the bend.

Taurus – The Bull



Taurus, the Bull, is getting ready to visit that big corral over the horizon, so this would be a good time for us to take a last look for '97 until it reappears again about November (for evening viewing, anyhow).

I'm sure the majority of us have studied Taurus many times, even if we were not aware of it. That's because those much loved clusters Hyades (the "Big V"with the evil red eye, Aldebaran) and Pleiades (the Microdipper) form part of Taurus.

As you can imagine from the diagram of the constellation, Hyades forms the face of the Bull, with Aldebaran α (Alpha) Tauri as one of its eyes. Taurus is graced by two exceedingly long horns tipped by β (Beta) and ζ (Zeta) Tauri. Below the face, there is only the shoulders and front legs. Part of our legacy of living in the Southern Hemisphere is that we look at most constellations 'upside down' and so don't immediately recognise the shapes the ancient

astronomers saw and named. So for Taurus, we see the legs up and horns down.
Taurus is a rich field of interest but not all of it accessible to binoculars and smaller telescopes.

a (Alpha) Tauri is Aldebaran, a red giant of Class K5. It's actually an irregular variable that fluctuates from mag. 0.75 to 0.95. Its name means 'The Follower'. Although it's the most prominent star in the Hyades cluster (the Big V), in fact it is not actually part of the cluster. At 68 l.y. it is only a line of sight member of Hyades, which is 150 l.y. away.

No doubt because of its prominence, Aldebaran has figured in most ancient societies' legends and literature. On of the more modern poems that I like, by Sigourney (no, NOT 'Ripley' Weaver from Alien), goes:
"...go forth at night,
and talk with Aldebaran,
where he flames in the cold
forehead of the wintry sky..."
(though for us it is summer.)

β (Beta) Tauri is also called Elnath which means 'The Butting One', being one of the horn tips. 145 l.y. away, Elnath is a blue white giant, mag 1.7. As a piece of useless trivia, try this: β Tauri is the closest bright star to the position of the Galactic Anti-centre, i.e. it marks the exact opposite direction to the nucleus of our Milky Way (which, of course, is found in Sagittarius.)

ζ (Zeta) Tauri is the other horn tip. At mag 3.0, it's not as bright as Elnath and is a blue giant, 520 l.y. away.

θ (Theta) Tauri is an obvious double, consisting of white (mag 3.8) and yellow (mag 3.4) giants. They are resolvable with binoculars, or on a good dark night, naked eye. At 150 l.y. away. Theta ^{2} is actually the brightest star in the genuine Hyades cluster.

There are a number of other doubles, visible to either naked eye (ne), binoculars (b) or small telescopes (st). Can you spot & resolve them? They are:

κ (Kappa) Tauri (ne/b) a white star of mag 4.2 doubles with 67 Tauri (mag 5.3). Part of the Hyades, though outlying.

λ (Lambda) Tauri, an Algol type eclipsing binary. Fluctuates from mag 3.4 to 3.9 every 4 days. 330 l.y. away.

σ (Sigma) Tauri (b) is a wide double of white stars mags 4.7 and 5.1. 150 l.y.

φ (Phi) Tauri (st) consists of a mag 5.0 orange giant and a mag 8.4 white star. 280 l.y. away.

χ (chi) Tauri (st) is 360 l.y. away. It has beautiful blue and gold components of mag 5.4 and 7.6.

The Hyades: This cluster extends outside the distinct V shape. It contains about 200 stars all travelling through space together. Because the cluster is so close (150 l.y.) and its distance measurable by parallax and other indirect techniques, it is a valuable first step in determining the scale of galactic distances.

Being such a large cluster (about 4.5° in length), Hyades is best viewed in a pair of binoculars. There are stacks of doubles stars to see (referred to earlier), some of which would bear closer viewing in a telescope.

Hyades was also popular with the legend writers and poets. Homer, in his 'Ulysses' wrote:
"Thro' scuddling drifts
the rainy Hyades vext the dim sea..."

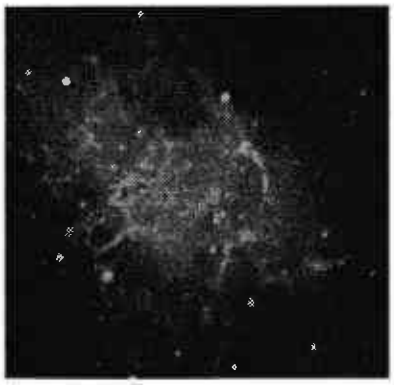
The Pleiades (M45), also known as The Seven Sisters or, to some, the Microdipper. This open cluster is worthy of its own separate article. (Another time perhaps.) It is arguably the brightest and most famous star cluster in the sky and is about 410 l.y. away. Used as an ancient eye chart (can you see seven with the naked eye?) binoculars explode this number towards its actual total of about 100.

The brightest Pleiades star is η (Eta) Tauri at mag 2.9 with other prominent members ranging from mag 3.6 to 5.5. Pleaides is relatively young (about 50

million years) and so contains many young blue giant stars. Sources differ on the nature of the faint reflection nebulosity that immerses the cluster. Some say it's the remnant of the cloud from which the stars formed, others that it simply occupies the same region of space. Watch this space!

The Crab Nebula (M1, NGC1952). The remnant of a supernova explosion that was seen in 1054 A.D. It's snuggled up against ζ Tauri and can be spotted in binoculars on good dark and clear nights. However, for binoculars and small scopes, it looks nothing like David Malin's gorgeous pictures, appearing only as a wisp of faint nebulosity about mag 8. It takes long exposure photography to reveal the name-giving crab shaped nebula.

Though not visible in amateur size telescopes, at the centre of the nebular is a pulsar, the remains of the exploded star. M1 and pulsar are about 6500 l.y. away.



M1 – The Crab Nebula

From the Editor

This is the final issue of prime Focus for 2000. The next issue will be the first of the New Millennium so it will be a challenge to make it something special.

As I have said in previous 'end of year' issues , it continues to amaze me how far we have come since the society first began in January 1996. I confess that when I first offered to edit the Society's Newsletter, I had no idea how the journal would grow. Compare this issue, both in size and quality, to one of the earliest issues and you'll see what I mean.

It couldn't be done without the band of regular contributors who have changed my task from mostly writing to mostly editing. Thank you 'guys'. You know who you are (and so do the reader-members) but I won't name names for fear of offending by accidental omission.

As Noel has said (somewhere) Prime Focus is a labour of love. Though I gain great satisfaction from seeing it published and (hopefully) read, the time required each month does keep me from my other writing projects... I have three (yes, three) books currently in production but going nowhere fast. So any time I can save by other people writing articles (which require little editing by me) so I don't have to write so many myself, is greatly appreciated.

Noel and I have discussed possible new innovations for Prime Focus for 2001. I won't mention them here in case they don't come off, but they sound exciting. Watch this space.

So here we are, at the end of another year (almost.) My folder is thick with 50 issues covering the active life, so far, of our growing Society. We have seen many changes in our Society's membership, observing activities, community involvement, guest speakers etc. We've also seen exciting changes in the world of astronomy; extra-terrestrial planets discovered, an explosion of 8 metre telescopes, the accelerating universe hypothesis. Then there's the wonderful world of Internet access to Hubble and other telescope images. What will the next 5 years bring?

As I once quipped, if there isn't a major comet around the corner, there Oort to be. And who knows, it cold be Comet Bee-Sharpe.

Happy Christmas to you all!

Bob Bee ■