MACARTHUR ASTRONOMICAL SOCIETY Inc.

Journal

PRIME FOCUS

Volume 6 Issue 3 March 2001

President's Report

Good evening everyone and welcome to our March meeting. On behalf of the committee and myself, I extend to all our recently signed up and renewed members our congratulations in joining us for the year ahead.

Last month at the Airfield it was quite amusing that whilst securing my polar alignment for photography purposes, a farmer in a nearby field decided to do some ploughing into the late of the night, the tractor's lights dazzling me on each of his turns around the field. I was going to run up the paddock and present some red cellophane to our friend.

I was distracted by photography of a different kind, the one that's attached to a flash unit. We had an excellent attendance and I guess Ian (Cook) wanted to record it for prosperity. I thought it was safe to return to my polar alignment but the fire works display proved another distraction. I overcame all these difficulties to finally perfect the dreaded alignment, only to have the sky obliterated by cloud cover. **Please give me a break!!**

It would be remiss of me not to thank our members who spent time showing and teaching our guests the wonderful world of telescopes, object location and general astronomy. **Thanks guys!**

Our university observatory program is proving to be a spectacular success and we now have several open nights under our belts. Again this would not be possible without your help.

IMPORTANT NOTE:
Due to Easter, the April Meeting and AGM will be on 23rd April, NOT the 16th.

Guest Speakers

Last month we were given insights into Robert Zindler's personal theories on his third dimension of gravity concepts. A lot of work went into this presentation and he was ably assisted by John Muszynski. Please accept my appreciation for your efforts.

Sometimes theories can be controversial. I've just read a very interesting letter in Sky and Space magazine regarding the age of the universe and the reddening of starlight. Suffice to say a prudent approach to these and other theories based on proper knowledge of accepted scientific principals and doctrines will assist you in making your evaluations.

Tonight it gives me great pleasure to introduce our very own **Dick Everett** who will inform us about a great old institution, namely Greenwich.
In **April Dr Ragbir Bhathal** will speak about laser pulses, optical S.E.T.I. and the recent conference he attended in the U.S.A.
Dr Fred Watson will be our guest speaker at the public observing night on the **28th April**. We also hope Your Optical World, Bintel and Sky and Space will have displays set up. This night coincides with the end of Science Week and should be fantastic. Just bring the weather machine and cross your fingers.
For **May** I can confirm that variable star researcher, comet and nova discoverer **Peter Williams** will speak to us. He is a regular contributor to Sky and Space and one of Australia's most respected amateur astronomers, it should be a great night.

Very Important Matters

Membership fees are due **NOW** so please pay up tonight or send your dues to P.O. Box 17 Minto 2566, by the end of this month. At the time of writing I haven't paid yet. Slack isn't it, so I'll have to pay up tonight, and set a good example.

Our A.G.M. (annual general meeting) is on 23rd April. In accordance with our constitution the Society is seeking nominations for the management committee, the forms are available tonight. The committee shall stand down at the A.G.M. and the returning officer shall call for a new management committee to be elected from the nominations received, it would be very appreciated if all nominations could be handed in **TONIGHT**. However for those "sitting on the fence" or our members who receive Prime Focus in the mail our constitution states that the nomination must be received by the Secretary to our post box no later than **Monday 9th April**.

Personal Note

The A.G.M. next month marks the official passing of our Society's year. I wish to state how honoured I feel to have been your President. My job would not be possible without the tremendous support I've received. It's been a great year one of which our society has in my opinion "come of age" and can be proudly confident of what we do

The requirement is for summaries and reports to be provided in next month's Prime Focus from the management committee, so full details of our past year will be in that issue.
Apart from the responsibilities and the time devoted to this position I must admit that its been a lot of fun, it is my intention to put my hand up again and run for the President's position.

Noel Sharpe ■

Other Planets

As you know the list of extra solar planets has climbed to 44. These are mostly large Jupiter sized bodies orbiting very close to their parent sun. These planets are very far away. Now it seems astronomers are detecting multiple planetary systems. eg. Upsilon Andromedae which is the host to three planets.

To clarify, a star is dragged back and forth by its planets. This motion creates a Doppler shift in the stars light that can be detected by astronomers. Who knows what discoveries will be made in the near future in regards to these planets. From my current readings it would seem the N.G.S.T. (Next Generation Space Telescope) might play a significant role. As mentioned these planets are a long way out in space. An exciting recent discovery was that of a brown dwarf star much smaller than our own Sun. This new discovery sits at a relatively close 13 light years away. I'll take a packed lunch for the journey.

Dr Paul Butler is at the forefront of this type of research and it was a honour to have him speak to us some time back.

A more concentrated effort to locate extra-solar planets is taking place with the Anglo-Australian Telescope (A.A.T.). The Very Large Telescope Interferometer (V.L.T.I.) currently under

construction in South America and the N.G.S.T. Maybe in my lifetime a planet similar to our own "pale blue dot" will be located. To quote some teenagers when recently looking through our telescopes, "How cool is that!". N.S.

New Space Telescope

Early preliminary work is under way on the N.G.S.T. (Next Generation Space Telescope) which will have a primary mirror of 8 metres in width, which is a lot larger than the Hubble scope at 2.4 metres. The N.G.S.T. will be parked some 1.6 million kilometres behind the Earth in a region of space that offers gravitational stability. At the moment the Hubble scopes' observations can be affected by the Earths heat radiation and of course our planet takes up a fair proportion of the sky around Hubble.
The N.G.S.T. will host many new technologies. One concern, howeve,r is the large sun shield which is designed to keep the N.G.S.T. cool and dark. It's large, the size of a tennis court and when it is deployed it could be affected by the solar wind and blow away. "How embarrassing". A prototype will be tested by the Space Shuttle this year and taking no chances N.A.S.A. will launch a one third scale model in October 2004 called Nexus. The final contract should be signed in July this year. The planned launch date for the N.G.S.T. will be 2009. This project is very exciting and will lead to many new discoveries. The N.G.S.T. is a major project for N.A.S.A. so I'm sure you will be hearing a lot about it. N.S.

Official M.A.S. Program Key:
Oaks = Airfield (members only)
GM = Monday General Meeting
OPN = Observ. Public Night

24th March	Oaks
23rd April	GM plus **A.G.M**
21st April	Oaks
28th April	OPN
- Plus guest **Dr Fred Watson**	
19th May	Oaks
21st May	GM
26th May	OPN
18th June	GM
23rd June	Oaks
30th June	OPN

Coming Guest Speakers:

April.. Dr Ragbir Bhathal
- Optical S.E.T.I.

May...Peter Williams
- Variable Stars.

Heliopause

Sometimes when you read a certain article or a book related to astronomy, you might find technical expressions that confuse the relationship between your understanding and meaning of an entire sentence. This can be frustrating (and I know) especially if you have never encountered a particular word before.
So I've decided to write a range of articles expressing the meaning of certain words. Together we can learn and contribute to our knowledge and understanding. For the pros, it may be a boring read. For those who are eager to boldly go where no man has gone before (my article that is), join me on this voyage to a better comprehension.

Termination Shock and Heliopause.

There is a certain relationship between the two. *Termination shock* is where a pressure wave backs up from an even farther-out boundary, possibly caused by the collective energy released by active interstellar matter. It is believed to have particle density and magnetic field characteristics.
The termination shock zone is not quite where the Sun's influence ends.

The *Heliopause* is where the region of space dominated by particles streaming from the Sun ends and interstellar space begins.

The relationship starts when the termination shock is gradually influenced by recent solar activity. It increases the solar wind of outbound particles and will begin to push back on the heliopause in the not so distant future. Thus the shock region or zone could move outward.

Voyager 1, the farthest human-made object from Earth, could reach this boundary between our solar system and interstellar space

within three years. Voyager 1 is now about twice as far from the Sun as Pluto's orbit.
The outward-bound shock region could move faster than Voyager 1. NASA believes that if the spacecraft doesn't encounter the region in the next three years, it may not catch up with it for several more years.

Attila Kaldy ■

Has Apathy Taken Away Our Heroes?

As I sit in front of the computer screen listening to the mesmerising soundtrack of "The Dish" I wonder, Has Apathy taken away our Heroes?.
I am, like many of our members, a child of the Space Race, a romantic, breath taking, dangerous and exciting time in the history of our planet, set during the late fifties and into the "groovy" and "funky" sixties.
These were also pioneering times for space exploration, 1957 brought the launching by the U.S.S.R of Sputnik the first artificial satellite into orbit.
There would not be many people above the age of forty that could not tell you who the first person in space was, for those whose mind has faded it is (Yuri Gagarin U.S.S.R.).
The Americans had been beaten to the punch, but they quickly retaliated by sending up two missions back to back. Allan Shepard and John Glenn carried out sub-orbital and orbital flights, these were of only a few orbits but enough for the U.S.A. to save face.
The subsequent missions (called Mercury) were crewed by just one astronaut, the capsule had no internal atmosphere so the occupant had to wear his space suit for the entire mission, until splash down.
After Mercury came the Gemini Capsules. These had an internal atmosphere and carried two people.
This era brought to the forefront the names that would sit on the tips of the tongues of people world wide: Allan Shepard, John Glenn, Walter Schirra, Frank Borman, Charles Conrad, Eugene Cernan, Ken Mattingly, Harrison Schmitt (the first professional scientist in space).
The tragic loss of three astronauts (Virgil Grissom, Edward White, Roger B. Chafee) who died in a cockpit fire during a pre-launch ground test of Apollo 1.
Of course no one can forget Apollo 11, Edwin Aldrin, Michael Collins and of course Neil Armstrong the first human to step on the Moon. I had the privilege to see these three men in a ticker tape parade through Sydney in 1970, as their car drove past I felt that pioneering spirit pass through me, it was almost spiritual.
Apollo 13 could have been a tragedy like Apollo1, the mission had to be aborted whilst on the way to the Moon, when an oxygen tank exploded in the service module. With the combined talents of the ground engineers and the tenacity and skill of the three astronauts, they were returned to Earth safely. This mission was classified as a "successful failure".
These times were fraught with dangers, most of the launch vehicles used at the time had failed on many trial occasions, the astronauts were not sure whether they would make it into space in one piece or many.
Since the introduction of the Shuttle in the late 70's, early 80's the gloss has worn off the space program, (how many current astronauts can you name regardless of their country of origin) the lack of vision and political guts by the American Government and the failure of vital equipment on the shuttle Challenger that killed 6 astronauts has left further exploration of the Moon deep into the future. This is not to say that the current batch of Astronauts are unworthy, the work that they have carried out has taught us better ways of doing things on Earth, unfortunately this has been considered by us mere earthlings as only trivial work and not worthy of hero status.
Maybe with the up coming Mars Missions and the inherent dangers of distance, time and a hostile environment we will once again look up in awe to these pioneers of the human spirit.

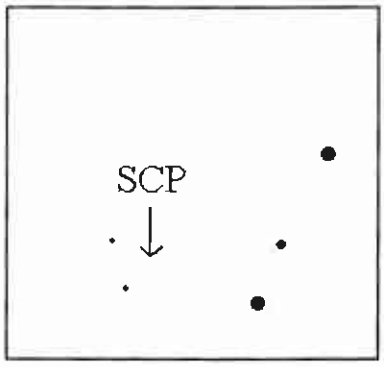
John Rombi ■

Polar Alignment Made Easy

Polar aligning is not as hard as some would think. There are many aspects of our complex lives that present problems with uncertain outcomes where our proper path is a complex blend of experience and guesswork with the circumstances changing under our feet like shifting sand. Not so with polar alignment! The spot you're aiming for doesn't move and there are only two directions for you to adjust in; left/right and up/down. At any given time it is a simple matter to determine which direction needs correcting and a simple matter to make that correction. All you need is a telescope with an equatorial mount and an illuminated cross-hair eyepiece. A pair of binoculars on a tripod can also be a great help, not to mention clear skies and a bucket load of patience.

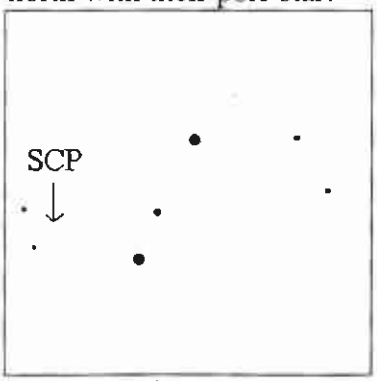
First off, it is helpful to know just exactly what polar alignment is. It is simply this - your telescope's axis is parallel to the earth's axis. This may seem counter-intuitive at first because you achieve this goal by pointing at an extension of the earth's axis...and how can they be parallel when they intersect? It is merely because of perspective that these lines appear to intersect. They are, however, parallel.
When polar aligned, and with the motor turned on, we have the following circumstance; our telescope is spinning on its axis which is parallel to the Earth's axis. Given these parameters, you can clearly see that your tripod does *not* need to be level. As long as that axis is in the right place (parallel to the earth's axis), the motor and tripod legs could be hanging from the ceiling for all that it mattered (although this might make for some difficult star gazing!).

Having said that, you do want to have your tripod *approximately* level for a couple of reasons. One, you don't want the thing falling over on you, and two, you have already set the latitude setting on your mount to 34 degrees and need to take advantage of that. This setting, however, is only very rough and you therefore only require a correspondingly rough level of the tripod. For now, all we need is the South Pole to show up somewhere in the finderscope when looking down the telescope's axis (DEC = 90). My finderscope covers a whopping 5.8° of sky so 'close enough' will do.



Now, with the binoculars, we need to find the stars located at the south pole that look a bit like a pot. The south celestial pole (SCP) forms an equilateral triangle with the two faint stars on the left side (see previous figure), and this is where you will be aiming your telescope's axis.
You can find this general area by either following the Southern Cross and its pointers, by using a compass offset to true south, or by star hopping from a star map. It's up there somewhere at 34°. Go find it! After a while, it really becomes quite easy (sort of).

Over the course of a year, this asterism will rotate through 360°, and on any given night will appear one way through the binoculars, and upside down through the finderscope. Add to this that there are two other brighter stars that can combine with the pot's handle to form another 'false' pot that is upside down (see figure below), and things can become confusing. Note that the 'true' pot has the middle star of it's handle towards the bottom and that the whole asterism looks like an 'S' for 'South'. And they think they've got it so good in the north with their pole star!



The next thing we need to do is get the above field of view in our finderscope (or polar-

scope). I do this by plunking the binoculars and tripod down just behind my telescope and then looking through the gap in the binoculars to try and figure out which way the telescope axis needs to be moved. Usually this is on the order of several degrees, so I have to move the whole tripod over (all the more reason not have worried about being level). Then, with luck, you'll see the above asterism through the finderscope. Remember, it should only require movement left or right as the tripod is already set approximately to 34 degrees.

Once this is done, get your finderscope's crosshair on the South Celestial Pole (SCP) by adjusting the tripod's finetuning controls (if it has any). The tripod is moved left or right, and up or down to achieve this (note - because we are looking south, left is east). My telescope has east/west fine tuning to move the axis left or right by small amounts, but to move it up and down I have to change the height of the tripod's front leg (a nuisance, but it works).
If you have a polar scope, you may well be able to achieve polar alignment without declination drift, but the polar scope *must* be properly aligned. I prefer declination drift because it goes directly to the source - the star's rotation - and you'll know for sure that you're polar aligned regardless of any misalignments your scope may be experiencing.

Declination drift then is the final adjustment. This process requires us to accurately monitor two stars for their drift in declination, ignoring all movement in Right Ascension (thus the name 'Declination drift'). You determine which direction declination is by rotating your eyepiece until a star follows your crosshairs as you slew north or south.

Then you select a star within 5 degrees of the equator and a half hour from the meridian and monitor its drift. If it drifts South, you move your telescope east (left when looking south). If it drifts north, you move the scope west (right when looking south). Then you select a star to the east, about 20 degrees above the horizon and close to the equator. If this star drifts south, you lower your telescope, if it drifts north you raise your telescope. After this, it's recommended you go back to a star near the meridian and check that declination drift once again. I generally watch a star's drift for 10 minutes at a time.

There is the easy way and the hard way to find a star that is within half an hour of the Meridian and 5 degrees of the equator. The easy way is to simply set your DEC setting to zero (putting you on the equator) and move the telescope in RA until it's at the top of its arc (just eye-ball it). This will put you well within the bounds required. Then all you do is locate a star in the finder scope, centre it and start tracking.

To locate the eastern star, I generally guess at 20 degrees (or use the hand-span method), but you can also use your RA circle by aligning it so that 6 o'clock is at the meridian. This puts zero hours to the east, and, because 1 hour equals 15 degrees, setting your RA at 1 hour and 20 minutes will put you at 20 degrees above the horizon. This eastern star also needs to be close to the equator, but as you've already got your DEC set to zero, it's only a matter of moving the telescope in RA over to the east to track this star.

When these stars stay on the DEC line of your illuminated crosshair for 10 minutes, you are very close to polar alignment. If you want greater accuracy, you can track for a bit longer. It should be noted at this point that there is no such thing as 'exact' polar alignment. As with all science, there are degrees of error involved and rather than trying to remove all error (a futile effort), a scientist will look to reducing those errors to an acceptable level. With this polar alignment method, I have managed accurate tracking for up to 45 minutes.

And that's it. Polar alignment made easy. There are many uncertainties in life. Polar alignment need not be one of them.

Michael Fisher ■

Destination Moon – Pt 2

J Casey

The Apollo Missions

Apollo 7 was the first Apollo manned flight - an Earth orbiting mission in October 1968. Earlier flights tested the huge Saturn 5 rocket. Apollo 8 was also supposed to be an Earth orbit mission. However, NASA became aware from military intelligence satellite sources that the USSR was about to try to upstage them again, and they took a gamble and changed the mission to a Moon orbiting mission.

Apollo 8 made ten orbits of the Moon in December 1968 taking photographs of the far side and of a planned far eastern landing site, and found that it was unexpectedly rough. The spacecraft also experienced the gravity effects of the mascons.

Apollo 9 tested the Lunar Module in Earth orbit in March 1969, then in May 1969, Apollo 10 conducted a full dress rehearsal for the lunar landing by separating the LM and descending the LM to within 15 km of the surface, using both the descent and ascent engines, and after several separate orbits, returned to the Command Service Module and redocked.

The culmination of President Kennedy's initiative occurred on July 20, 1969, when the Lunar Module Eagle touched down on the Moon's surface, with only 10 seconds of fuel left in the descent engine. Commander Neil Armstrong and his LM pilot, Buzz Aldrin set up a small seismometer, and a laser reflector, then collected about 40 kg of rocks. The seismometer subsequently showed that the Moon is quiet, and that Moon quakes were small and rare. The laser enabled the distance between the Moon and Earth to be measured to within centimetres, and even to show the continental drift of tectonic plates on Earth.

The returned Lunar rocks were extremely dry - a complete absence of water bearing minerals. The rocks were either breccia (made up of fragments of older rocks and minerals), or basalt (a common lava rock on Earth.) However the basalt was unexpectedly rich in titanium. The soil included ground up lava bedrock and abundant glass fragments created by shock melting of small mineral grains during high speed impacts. The lavas of Tranquillity Base flowed 3.7 billion years ago according to radioisotope measurements. The soils appeared to be even older, at 4.6 billion years, but this was later found to be due to a natural relative enrichment in a radiogenic isotope of lead.

Because basalt lava forms by partial melting of certain types of rock, those collected by Apollo 11 showed that the interior of the Moon was not primitive in composition, but had been created by an earlier melting episode. The surface (regolith) layer is made of ground up bedrock, partially crushed into powder, and partially fused by impact melting. There was some evidence, in the form of tiny white fragments within the soil (that were clearly different from the bedrock), that these were pieces of highlands that were thrown to the Apollo 11 site by distant impacts. These fragments appear to be the unusual rock type called anorthosite. If this is so, then the early Moon would have been nearly completely molten. This concept has been called the magna ocean, and received reinforcement from analysis of subsequent mission rocks collected.

Apollo 12 landed in the eastern Oceanus Procellarum, only metres from Surveyor 3, in November 1969, where the maria and featured deposits were slightly less cratered (and therefore younger) than Apollo 11's Tranquillity Base. The basalts were lower in titanium, and demonstrated that different regions of the interior had melted to make the two types of lava at these sites. Apollo 12 lavas represented several different lava flows, and were almost 500 million years younger than the other site.

Apollo 13 in April 1970 was intended to be sent to the Fra Mauro highlands, east of the Apollo 12 landing site, but an exploding oxygen cylinder

crippled the command module, and the LM had to be used as a lifeboat to support the crew as the craft returned to Earth after looping around the Moon.

Apollo 14, in January 1971, was redirected to the Fra Mauro highlands, where the blanket of debris present was thought to be from that thrown out of the 1000 km diameter Imbrium basin. During two long moon walks , where the astronauts Sheppard and Mitchell trekked up slopes of a hill 3 km distant and 100m high, they explored the ejecta from the 1 km diameter Cone crater. Here deep rocks were collected.

The astronauts became disoriented and lost during these moon walks due to the crystal clarity of the vacuum, and lack of recognisable landmarks that made it difficult to judge distances. They walked right past the rim of Cone crater without seeing it, but did eventually return samples of the ejecta from Cone Crater. These rocks confused and enlightened the scientists who examined them, and are the most complex mixtures of older rocks collected in the Apollo missions. They were breccias containing breccias of even older events. Basalts were found as small fragments in these breccia that were 4.2 billion years old- nearly as old as the crust itself.

The last three Apollo missions, 15, 16, and 17, used an updated and expanded spacecraft, and each carried a Lunar Roving Vehicle to allow for a new scale of exploration. The orbiting command modules also carried a special package of cameras and sensors to study the Moon from orbit. Two cameras and a laser altimeter measured the topography and shape of the Moon, took high resolution colour stereo photographs, and measurements of X Ray fluorescence and gamma rays allowed the determination of chemical composition of the lunar surface. Other instruments could detect and pin point the emission of gas from some areas, and this suggests that the deep interior of the Moon may still contain small pockets of volatile elements.

All three missions carried an advanced ALSEP package (Apollo Lunar Surface Experiment Package) that created a long-lived geophysical network that sent data back to Earth until the network was turned off six years later (because of lack of further funding.)

The Apollo 15 mission was sent to the rim of the Imbrium basin of the Hadley-Apennine landing site in July 1971, with the huge chasm of the sinuous Hadley Rille at 2 km wide and 900 m deep winding across the mare plain. The three astronauts, Dave Scott, Jim Irwin and Al Worden had received extensive training in geology, and they explored this area for 3 days, doubling the time outside of the LM and travelling 5 times farther. The rover carried a drill and coring rig, so as to take deeper samples. A computer on the rover kept track of where they were at any time, so that they could rest and conserve air and water whilst travelling to distant sites and not get lost.

Apollo 16, in April 1972, landed at a highland site, near the ancient crater Descartes. The crew, John Young, Charles Duke and the command service module pilot Ken Mattingly were all given extensive training in volcanic terrains on Earth in preparation for this mission. But instead of volcanic rocks, they found almost every variety of impact breccia imaginable. It is now thought that impact processes caused the terrae to look like a patchwork quilt, with volcanism playing a minor role.

Apollo 17 was the final mission, after budget cuts were made to the program. This mission landed in the Taurus-Littrow valley, near the rim of the ancient Serenitatis basin, where mare lavas partly flood an ancient mountain valley. The astronauts on the surface were Gene Cernan and Jack Schmitt, with Ron Evans piloting the command module in orbit. Jack Schmitt was the only professional geologist in the Apollo crews.

In this final mission they travelled farthest (30 km), and explored the longest (over 25 hours) and collected more samples (more than 120 kg). They found and sampled giant boulders that had rolled down the mountain in a landslide that had been triggered by the impact that formed the crater Tycho, which was over 2,200 km away. They also found a beautiful orange soil that glistened in the light, in Shorty Crater. The orange material turned out to be an unusual black and orange glass that formed 3.6 billion years ago when liquid rock sprayed out of a huge fountain like eruption.

The seismic experiments have shown that the Moon has an aluminium rich crust about 60 km thick. Beneath this is an iron and magnesium rich mantle. Magnetic field measurements have shown that local areas of the crust are magnetised, but the Moon does not possess a global magnetic field like that of the Earth. This and the low bulk density (about 3.3 g/cm^3) suggests that the Moon has no liquid iron core.

Russia's Moon Effort

The USSR launched Luna 1 as a Moon flyby in January 1959, then followed this with a hard lander, Luna 2 in September 1959. Luna 3 made world headlines when it successfully photographed the far side of the Moon for the first time in October 1959. Luna 4 in April 1963 missed the Moon. Luna 5 was intended to be a soft lander, but crashed into it in May 1965, as did Luna 7 in October 1965, and Luna 8 in December 1965. Luna 6 was a softlander, but missed the Moon.

They were more successful with Zond 3, which took pictures of the far side in a flyby in July 1965 and with Luna 9, which made the first successful soft landing, and their television pictures showed a surface covered with a thin layer of dust but like hard packed sand below. Luna 10, in March 1966 became the first lunar orbiter.

More orbiters were launched - Luna 11 in August 1966, Luna 12 in October 1966 and Luna 14 in April 1968. Luna 13 was the second of their successful soft landers, and landed in December 1966.

A new series, Zond 5 and 6 orbited the Moon and returned to Earth in September 1968 and November 1968 resp., and were followed by the first attempt to land a soft lander with a sample return. This lander, Luna 15, crashed in July 1969. It had been intended to land and return a scoop of soil before Apollo 11 landed to steal this first from the Americans. However, the Soviets were more successful with Luna 16, which successfully landed on Mare Fecunditatis, and returned about 100 grams of soil by means of an ingenious drill core that wound into a ball shaped return capsule in September 1970. The soil from this site consisted of mare regolith, and included several fragments of lava that were large enough to date. These were relatively high in aluminium and erupted onto the surface 3.4 billion years ago. Fragments of impact glass were present. Luna 20 in August 1976 did a similar sample return, this time from the Mare Crisium, and contained basalts that were also high in aluminium, but low in titanium, and between 3.6 and 3.4 billion years old and were similar to basalts found at the Apollo 17 landing site. More sample return missions were launched, but Luna 23 failed in October 1974, but followed with another successful mission with Luna 24 in August 1976, which returned a 2 metre core sample from the interior of Mare Crisium.

The Soviets landed their first surface rover in Luna 17, in November 1970, and another, in Luna 21 in January 1973. These small rovers were remotely controlled from Earth, but had crude instruments. They gave TV images and some data on soil physical properties, and operated for considerable distances.

The USA Post Apollo Activities

After the Apollo landings, and cut back in funding, NASA lost interest in the Moon, and had no clear long term goals.

NASA concentrated its efforts instead on the Space Shuttle as a cheaper means of reaching low Earth orbit. Further funding cutbacks compromised its design, and instead of completely reusable liquid fueled rockets throughout, solid fuel, strap on boosters were used. Once lit, these could not be shut off or controlled, and were the cause of the Challenger disaster in January 1986. The first Space Shuttle flight was in April 1981.

In January 1984, President Reagan announced that he was directing NASA to build a permanent space station, but little happened after that. Then, on July 20, 1989, the 20th anniversary of the Apollo 11 landing, President George Bush announced his Space Exploration Initiative, with completion of the space station, a return to the Moon - this time to stay, and a manned mission to Mars. However, the "90 Day Study" by NASA estimated the cost at between $500 and $600 billion dollars. Congress killed the SEI in the budget appropriations process in 1992.

President Reagan had set in motion within the military, his Star Wars, Strategic Defence Initiative during the 1980s, and out of this came a concept called "Brilliant Eyes", the brainchild of Edward Teller, at Lawrence Livermore Laboratories. There was a problem in developing these systems because of the 1970 Anti-Ballistic Missile Treaty. This prohibited testing of space based defence hardware in low Earth orbit.

Discussions in a Washington bar in 1989 with colleagues on how to carry the testing needed lead to the concept of testing the systems in deep space - to use the Moon and an asteroid as targets for the sensor testing. Thus NASA and the Strategic Defense Initiative Organisation of the Department of Defense signed an agreement to conduct a joint mission to the Moon and a near- Earth asteroid.

The mission was named "Clementine", after the song "My Darling Clementine", which was about the daughter of a miner in the California gold rush. The mission would assess the mineral content of the Moon and the asteroid, so the name was appropriate., and after the flyby, the spacecraft would head off into deep space - just like in the song " You are lost and gone forever Clementine".

Contrary to usual NASA projects, this was a lean and mean project - it had to fly within 3 years of approval. It was launched on January 25, 1994, after only 2 years! It was built by the Naval Research Laboratory and had no more than 300 people working on it, and cost only $80 million, including the launch vehicle (a surplus ICBM Titan 2 rocket.) Clementine arrived at the Moon on February 19, 1994, in a polar orbit. After making 330 orbits, and taking over 2.5 million pictures, Clementine blasted out of Moon orbit on May3, 1994 and set out to encounter the asteroid Geographos. On the way a malfunction in the on board computer made it spin out of control, and forced the cancellation of the asteroid encounter. It re-orbited the Moon on July 20, 1994, and entered solar orbit exactly 25 years to the day after Apollo 11 landed on the Moon.

The data that Clementine sent back on the Moon was amazing. It photographed, gave global composition and topographic mapping of the whole Moon in 11 wave lengths, all chosen to get the most information on mineralogy. There are high resolution images in infrared, and thermal images of selected regions.

Unfortunately, Clementine is now lost and gone forever, and we must wait anew for another military or political objective to carry science back to the Moon.

References: - Most of the information in this article came from the book "The Once and Future Moon" by Paul Spudis (available from Campbelltown Library as 523.3/SPU).

Measuring The Distances to the Stars – Pt 2

Spectroscopic Parallax: As you are aware stars can be categorised by their colour and luminosity. Colour is determined by the star's surface temperature and its luminosity by its subsequent size.

TABLE RB.1: RELATIONSHIP BETWEEN INTRINSIC BRIGHTNESS, TEMPERATURE AND DIAMETER OF THREE M-TYPE (Red) STARS

	DWARF	GIANT	SUPERGIANT
Absolute Luminosity Relative to Sun:	0.01	100	10,000
Temperature:	3,000°K	3,000°K	3,000°K
Approx. Diameter Relative to Sun:	0.4	40	400

Table RB.1 above shows that a star's colour is not a unique indication of its size.

The luminosity of a star is characterised by its Absolute Magnitude, which is defined as the Apparent Magnitude the star would have if it was 10 parsec (32.6 l.y.) from Earth.

If a star was exactly 10 parsec away, its Absolute Magnitude would equal its Apparent Magnitude (by definition).

See Table RB.2 for some examples.

The purpose of this technical explanation is that once astronomers have been able to identify the Spectral Class (colour) and Luminosity (Absolute Magnitude) of a star, it is possible to calculate the distance to that star.

The tool used to do this is the so-called Inverse Square Law of Light. That is, if a source of light is twice as distant as another identical source, its apparent brightness is reduced by a factor of 2 squared = 4. Three times distant, 9 times fainter etc.

Combined with the definition of Absolute Magnitude, and a knowledge of the logarithmic scale of Magnitude (see Table RB.3), a complex looking but relatively simple formula for calculating the distance to the star can be used.

TABLE RB.2: MAGNITUDES OF SAMPLE OBJECTS

OBJECT	APPARENT MAGNITUDE	ABSOLUTE MAGNITUDE
Sun	-26.8	+4.8
Full Moon	-12.5	
Venus (brightest)	- 4.4	
Sirius	- 1.4	+1.4
Alpha Centauri	- 0.3	+4.7
Vega	0.0	+0.5
Antares	+1.0	- 4.0
Andromeda Galaxy	+3.5	-21.2

TABLE RB.3

BRIGHTNESS - MAGNITUDE VALUES

Intensity Ratio	Magnitude Difference
1:1	0.0
1.6:1	0.5
2.5:1	1.0
4:1	1.5
6.3:1	2.0
10:1	2.5
16:1	3.0
40:1	4.0
100:1	5.0
400:1	6.5
1,000:1	7.5
10,000:1	10.0
1,000,000:1	15.0
100,000,000:1	20.0

The formula used is:
$M = m + 5 - 5 \cdot \log r$

Where
M = absolute magnitude
m = apparent magnitude
r = distance in parsecs
(m - M) = Distance Modulus

If we know the value of m and M, we can calculate the distance r as:

$$\text{Log } r = \frac{(m - M) + 5}{5}$$

or $r = 10^{[(m-M)+5]/5}$

A simple example helps to explain it.
We have identified a star as a particular spectral and luminosity class which should have an Absolute Magnitude of M= +5. (eg a Class G2 V like the Sun).

The observed Apparent Magnitude m = +10.
What is the star's distance?

Method 1: Distance Modulus (m-M) = (10-5) = 5
Therefore, the star is 5 magnitudes fainter.
Therefore, 100 times less intense (refer to Table RB.3) than it is at the standard distance of 10 parsec. By the Inverse Square Law of Light, the star must be Sq.Root (100) = 10 times more distant than the Standard Distance
= 10 x 10 = 100 parsec.

Method 2:

$$\log r = \frac{(m-M) + 5}{5}$$

$$= \frac{5 + 5}{5} = 2$$

Therefore, $r = 10^2$
= 100 parsec.

*

The darling of astronomers is the **Cepheid Variable**. No other star type has been more instrumental in allowing astronomers to make the leap to calculate distances outside our galaxy. This will be the subject of the next article on "Measuring Distances to the Stars."

Answer to Trivia Question:

The Keck twins are a pair of 10 metre telescopes at the top of Mauna Kea extinct volcano on the island of Hawaii. They are located 80 metres apart and can be operated independently or in concert, giving the largest pair of binoculars on Earth.

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Seeing Through Mist

In an article in *Astronomy*, Bob Berman wrote:
"Good transparency and good seeing do not usually go hand in hand. A light mist or fog – signs of poor transparency – often is the signal of a homogeneous atmosphere that offers good seeing."

What do our resident observing experts think of that? ■

What's to See This Month? March 18 – April 15, 2001

Mercury is already in the morning sky rising about 1 hour before the Sun. It will have a 2° close encounter with the very thin crescent moon on the 23rd, and Venus will dance at dawn with Mercury during April 7 – 12, passing 10° on the left and slightly above and below.

Venus the Evening Star disappears this month around March 30 but will become the Morning Star and remain so until early next year. Your last chance to view the disk in the evening through your scope.

Trivia answer
Who was the first person to notice the Orion Great Nebula in 1610? Galileo made his observations of Jupiter the same year but missed M42! Nicholas Peiresc found M42 in November 1610 with a telescope given to him by the president of Provence France. Peiresc was a lawyer, public official and churchman very involved with studying natural science himself and getting others involved. He was also the first person in France to see the Galilean moons of Jupiter

Earth is at the Vernal (Autumn) Equinox on the 20th March, which means the daylight hours are equal in length with the night hours.

Mars is the most interesting of the planets this month. At the moment it is 7° north of Antares in Scorpius and is at quadrature phase. This means that the angle between Earth, the Sun and Mars is exactly 90°. With only 89% of the disk illuminated the Red Planet looks slightly egg-shaped, but it is growing brighter. Mars will travel towards M8 **The Lagoon Nebula** and remain almost stationary for the next two months. It will be just under 6° from it at 10 pm on the 15th April. The Full Moon, Mars and Antares will form a long flat triangle on the 11th April. On the 12th a ¾ Moon will be 7° above Mars and about 8pm the following night 6° below. At 10.30pm on the 13th a last ¼ Moon will line up with Mars and Antares to form a straight line.

Jupiter continues to race with Saturn and the Pleiades, but because of retrograde motion is sliding further behind as they all head down hill to the western horizon. Zeus (Jupiter) makes interesting shapes with the Moon and Aldebaran throughout the month. A clear night will still allow you to see the bands on the giant which circulate at different speeds from each other. The bands are actually clouds containing different elements such as methane or ammonia and the action of ultra-violet sunlight causes the gas to give off different colours. Fierce winds stream the clouds into the bands we see.

Saturn is causing a shadow on its own ring system? Look on the eastern side of the planet limb where the rings black out before disappearing round the other side. On 29th March the crescent Moon will slide past Saturn just 2° away.

Uranus and Neptune are both in retrograde motion still in the morning sky travelling with (Capricornus) the Sea Goat. On 22nd March a close pass of the shrinking crescent Moon with Uranus is visible. One of my own memorable moments was to look through a 300mm scope and see the disk and colour of both these planets two years ago. Worth getting up for the opportunity. **Pluto** is visible near Mars if you have a giant mirror (like 40 cm) in your scope

Trivia Question

If the Solar System revolves around the Sun; is the Centre of Gravity of the Solar System in the Sun?

Comet 24P/Schaumasse has brightened from 13 to 11th mag and is located in Taurus. By the 20th March it will be less than 1° from the Pleiades. Come on comet hunters!

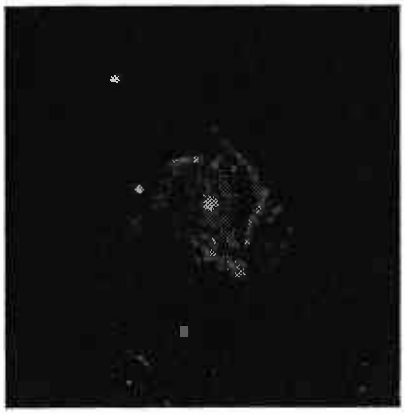
New Moon is on March 25 and Full Moon on April 8.

Meteor Showers

The Virginids originate from near Spica. Best seen in morning hours till April 15.
ZHR about 5 but should leave slow trails. April 15 will bring the pi –Puppids with

slow speeds, persistent trails, brightness, and occasional fireballs. Sounds terrific, can't wait!

Messier Objects If you don't know where to find M's, try Virgo up above now, look in the area where Virgo and Coma Berenices meet near the tail of Leo. About 20 galaxies in a 20 deg. circle. A sample below.



M61 mag 10.0 100,000 light years dia. Four supernovae observed within since 1926. Looks like Oz don't you think?

Now lets sail off to the **Constellation of the Month**

Vela is the Sail division of Argo Navis an ancient huge ship named by Ptolemy which sailed the southern horizon. If you were in the northern hemisphere that is. The ship was broken up because of the number of naked eye stars and its huge size in the eighteenth century. Argo Navis the Ship of Jason and The Argonauts, was divided into Vela (the Sails), Puppis (the Stern), and Carina (the Keel). Because Johann Bayer originally lettered the stars of complete Argo; when the ship was broken up, the Greek letters went with the pieces. Alpha (Canopus) and Beta in Carina, while Gamma (Regor) and Delta are in Vela

Objects of Interest

The two constellations meet where κ and δ Vela join with ι and ε Carina to form **"The False Cross"**

However the 'star' of the show is Gamma Velorum, or **Regor**. Nobody seems to know what the name means, except that it is Roger spelled backwards.

This is a spectacular star in every sense. 840 light years away, visually it is strikingly hot blue-white, mag 1.7, and a multi system. Binoculars show a companion which is an impressive hot class B star, 10,000 AUs or a minute of arc from Regor. In fact the mag 4 companion is called Gamma 1, and Regor (or is it Roger) is really Gamma 2. Through a telescope these two are breath taking, but there's more! 90° from Gamma 1 there are several faint 8-9 mag stars in a radiant. Very pretty in 26 mm. But still there's more.

Looking from the distance of the B class star Regor itself is double. Too close to be split by a telescope a hot O class giant (quite rare) and a Wolf-Rayet star (very rare) orbit each other every 78 days. The Wolf-Rayet has blasted ¾ of its outer mass away in powerful emission radiation and is estimated to be in the last stages of supernova preparation. Together they are "the spectral gem of the southern skies".

δ Vela is an easy bright white double 2.0 / 5.1 and **λ Vela "Suhail"** is an orange super-giant 300 light years away

2547 An open cluster about 20' dia two degrees south of Gamma, about 17 min in size. A bright group of 50 mag. 7 stars, grouped in small arcs and knots, including a small twisted cross.

IC2395 Another fine open cluster about 5 degrees east of Gamma. 30 stars grouped in 20' area dominated by a 5.5 mag star. About 3000 ly away. **2660** is a small galactic star cluster of compressed knots 1° north of IC2395, at 7000 ly. There are several small clusters in this area.

Less than ½ way between delta – gamma just above an obvious cluster of bright stars, you can find - **"IC2391** a large naked eye cluster of 50 stars. At 590 ly they cluster around an interesting 3.6 mag. blue-white star o (omicron). o Vel. is an example of a Cepheid variable" (Quote Bob Bee)

3201 is a Globular Cluster with some star lines like jets of water from a fountain.

3132 "The Eight-Burst Nebula" A blue-white mag. 9 planetary nebula 40' dia. about 10° east of Suhail. So named because of concentric rings as if there have been several outbursts of gaseous material in sequence within the oval outer circle..

There are some 40 Open Clusters in Vela but these are the more obvious:

Good Sail-ing IC

ASTRONOMY OVER CHRISTMAS & NEW YEAR

10.12.2000
After 11.00pm, when the sky was clear enough I took my telescope out and saw that Saturn, Jupiter and Aldebaran make a beautiful triangle and the near full Moon was between Jupiter and Aldebaran.
Then I saw Jupiter through the telescope with its Moons. Despite the Moon light I saw it clearly.

25.12.2000
Now I found some more time for astronomy. After 11.00pm I went out to our backyard. Saturn, Jupiter and Aldebaran form a longer flattish triangle now. I observed Jupiter with my scope and its Moons are different now. I can see only 3 Moons.
With my binoculars I see the Pleiades beneath Jupiter and Taurus with Aldebaran above Jupiter. The sky was beautiful with Orion next to Taurus, then Canis Major with Sirius and all the other constellations, but I was tired from all the Christmas celebrations and stopped observing.

2.1.2001
After Christmas we went for a trip to our friends' property at Coomba Park on Wallis Lake near Foster. Tonight I took my scope out at 10.30pm.
The half Moon is in the west and the sky is clear. Here we can see a lot more stars than in Sydney. The Pleiades and Taurus can be seen with the naked eye. When I started observing Jupiter the position of the Moons had changed again.
Then I had The Pleiades in the scope. It is wonderful and view clear. I observed Taurus with the binoculars and then the Moon with the scope until it set at midnight.
I could clearly see the surface of the Moon, especially the Sea of Tranquillity and the larger craters. I observed Orion and Canis Major with the binoculars. I then swept my binoculars through the sky at 11.45pm to observe the other objects in the sky.

2.1.2001
In the south the Southern Cross is a bit higher in the sky now and Alpha Centauri is shining a beautiful orange. I found with my binoculars N.G.C. 2070- the Tarantula Nebula in the large Magellanic Cloud. Then I observed the Orion Nebula and Sirius again. On the way through I found some star clusters between them and Monoceros. They are beautiful clusters. Unfortunately I could not identify them by name. Tiredness set in and I called it a night.

3.1.2001
Tonight our friends visited us in our caravan and we celebrated my father's 100th birthday. He died 20 years ago and lived all his life in Germany (my mother still lives there).
Then we all went out and looked at the starry sky. We looked north toward Orion and saw a huge fireball. My friend said that it was a message from my father. I think it was a coincidence, but still beautiful - natural fireworks on my father's 100th birthday.

Ursula Braatz ■

Art Meets Astronomy

There was a fascinating article in the papers about how astronomers helped crack an age-old mystery of exactly when Van Gogh painted "The White House at Night." The painting shows a bright star with a yellow halo in the sky. After locating the house itself north-west of Paris, astronomers showed that Venus was in the position shown in the painting about 8pm on 16th June, 1890, just six weeks before Van Gogh killed himself.

So, 'ears to the astronomers!

Shape of Things to Come

In a future issue, we will start another of John Casey's in-depth articles – "The Search for the Building Blocks of Matter." (Where does he find the time?) Here is a foretaste:

"Astronomy is remote observation by collection of light of distant objects. The amount of information that the photons of light bring of that distant world is amazing - but both the generation and the detection of these photons are tied to the properties of electrons, which both emit and eventually absorb these photons - for light is electro-magnetic radiation. To understand the most massive objects in the universe, we need to study the smallest objects in the universe - for the most massive is still only untold numbers of these atoms and the forces within these hold the whole universe together..."

Are We All Having Good Time?

In his President's Report, Noel mentioned Ian Cook going shutter happy at the Airfield Star Night in February. Actually he's quiet a good photographer. More please, Ian.

Anyway, here are a couple of his shots, providing emulsified proof that people actually do have a good time at these star nights, and not a bottle of port in sight.

Here are new members, the Considine family, enjoying Michael's new 8" Dobsonian.

Ned Pastor with John Rombi's high magnification beast. "Watch your eye while I adjust this do-dad."

Observing Tip

Here's something I intend to try out some night to solve the ongoing problem of systematically and accurately recording my telescope observations. And the key word is 'recording.'

I got this idea from the February 2001 issue of *Astronomy*, in an article by Ken Hewitt-White. I quote: "A mini-tape recorder lashed to the finder of the larger scope allows me to record impressions right at the eyepiece."

What a great idea! Saves walking back and forward between the scope and your observation log on your table (if you have one.) As it turns out, I have a small dictation recorder which I got for my writing but have been neglecting. It is voice activated, so would be ideal for this purpose.

Also in the February 2001 *Astronomy* (actually, there's a wealth of great material in this issue) is a very detailed description of things to see in three apparently indistinct southern constellations. Again, I quote: "Pictor, Dorado and Mensa contain no star as bright as mag. 3.0 and just four stars brighter than mag. 4.0. Yet this apparently barren area holds a wealth of impressive deep-sky objects for backyard observers."

This article certainly raised my eyebrows and had me diving for my observation planning schedule. Bring on the next (cloudless) star night. The interesting thing was that there wasn't an M object listed – perhaps to do with Messier's proclivity to stay in France. But there were stacks of NGCs, from Open Clusters, Globulars, Nebulae and galaxies.

Dorado, by the way, means 'Swordfish' which prompts this poem by Eugene Field:
"I never lost a little fish –
Yes, I am free to say,
It always was the biggest fish
I caught that got away." ■