MACARTHUR ASTRONOMICAL SOCIETY Inc.

Journal

PRIME FOCUS

Volume 3 Issue 2 **March 1998**

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The Horsehead Nebula in Orion
(Photo by D Malin – used with permission)

PRESIDENT'S REPORT

Despite the disappointment of our guest speaker not attending the last meeting, plus dull, cloudy skies until 10 o'clock, I feel the meeting last month still went very well thanks to the enthusiasm of Noel and all those members who attended.

This month we are holding our AGM, and I would like to thank all those who have supported me as President for the past two years. After the hopefully short AGM, we have as guest speaker Ken Peterson from North Sydney Astronomical Society, who will enlighten us on the topic of light pollution. Each club will have a representative for light pollution. One of our prominent members is soon to take up this position.

Next month's meeting promises to be one of the best, with special guest speaker Bob Evans. For those who don't know of this man's achievements in astronomy, come to the April meeting and hear what he is well known for across the astronomical community. (Hint: Supernovae). Tell your friends, relatives, family and anyone you know maybe remotely interested in astronomy, as it would be great to fill the room for this special guest speaker.

Important Astronomical Dates

1. **March 27th – 30th** -- Ilford Star Party -- A few members will be attending and I will give a brief overview of the weekend at the April meeting.

2.. **April 4th**—Macquarie Open Night, commencing at 6.pm. Helpers with telescopes or at our stand will be admitted free. Otherwise come along and enjoy the night. There is usually a HUGE crowd of the public there.
Guest Speaker is Fred Watson of the Anglo-Australian Observatory. The topic is called "Getting in on the act -- Australia's place in the 8 metre telescope era". If interested, please pick up a form for further details.

3. **April 10th**-- XVIII Annual Astronomers Convention-- I will be going and will report on the convention at the May meeting.

4. **April 18th** Balanglo State Forest with International House -- Come and view the stars in what appears to be a unique and very dark sky. Plus meet the friendly people of International House. Let me or Noel know if you can come with scope and help out.

4. **April 20th** -- Bob Evans, Super Guest.

5. **May 18th** -- Meeting, speaker yet to be confirmed.

Please contact us for details on star camps and star nights.

Latest News

* Exciting News -- ice has been found to exist on the Earth's closest heavenly neighbour, the Moon. NASA announced that hidden from the sun in a crater on the southern polar cap, lurks water ice. This is important for the next manned mission, so water is available for drinking and rocket fuel. Hopefully more information will be forthcoming in next month's Prime Focus.

* Andy Thomas the Australian born astronaut is now up on MIR with a tight fitting spacesuit. He will be spending 4 months up in the space station, then shortly coming to Australia and holding some talks in Sydney.

* Eugene Shoemaker finally makes it too the Moon. His ashes will be scattered over the lunar surface when Lunar Prospector ends its mission mapping the Moon.

* On February 15th Voyager 1 took over from Pioneer 10 as the spacecraft which is furthest from the Earth.

* Shuttle STS 90 had a successful launch with it's first female commander.

Phil Ainsworth (President) ■

APOLLO 13

It was Tom Hanks, Kevin Bacon or Bill Paxton who rocketed to stardom and not the Moon, but what a great suspenseful movie of a horrifying event in the history of the American space program.

However, on April 11th, Apollo 13 blasted off with the intent of taking three astronauts being James Lovell, John Swigert and Fred Haise to the Moon. By sheer bad luck, Ken Mattingly took over for Swigert who was believed to have been in contact with someone with the measles and so it was felt by mission command that he might contract the illness during mission..

After fifty six hours into the mission boredom quickly vanished on the Apollo 13 spacecraft as a huge explosion was heard by the three astronauts. Horror stricken faces watched the instruments tell them they were losing air and pressure inside the spacecraft rapidly. Because oxygen was necessary not only for breathing but also vital to operate the electrical equipment, no power was a severe and deadly possibility. Within 91 minutes the command Module would be lifeless, thus the crew thought they would be heading for a slow, cold death in space. However, two things went very well for them - Aquarius the Lunar Module and Jack Swigert.

The Lunar Module's power supply was separate to the command module's. By conserving power to 1/5th output, the astronauts could possibly survive for 90 hours.

Since the Command modules engines could not be fired, the astronauts took the safest route and spun around the Moon. Jack Swiggert devised numerous spare parts and a filtering system for the stale air that was coming into the LM. To make course direction changes, the Lunar Modules jets were used sparingly and also to hurry the return journey.

Battling the cold and hypothermia from only living in 38 degrees F, they tried to maintain warmth by keeping together and putting on space boots and all there equipment.

Also a major concern was the food supply, it was running low, but by rationing they felt with some apprehension that they could survive the three day journey back home.

Before re-entering Earth's atmosphere, the crew returned to the command module and turned on its power and separated from the Lunar Module, which had been there life boat for the past three days. Upon quick inspection of the CM the astronauts saw the huge hole made by the explosion. Houston commented, "If You Can't Take Better Care Of This Spaceship, We Might Not Give You Another One."

The chances for a mishap and disaster were many, but with luck and skill a miracle was performed as they splashed down in the Pacific Ocean on April 17th, just 6.6 kms from the recovery ship.

Phil Ainsworth ■

ODE TO STARLIGHT by *NS*

The sky is clear, and with plenty to see
Its beauty does abeckon.
So I'll run inside and grab my gear
And I'll be outside in a second.

But I don't travel light, and it gives me a
fright to lug my Big Bertha around,
I've heard 'em say, there's a better way
And I'm sure their advice is sound.

So here's the fable, forget your cables
And counterweights that make you faint,
Forget your alignment, it makes for
confinement
And lugging makes your back ache.

For all is required and very desired
Is the quick get up and go.
So grab a chair and run downstairs
And observe the heavenly glow.

The matters above might sound jocular
And is definitely meant that way,
For equipment you'll need is simple, indeed,
And I herald the fantastic binocular.

The 'Those Without Scopes' Society

STEPHEN HAWKING'S UNIVERSE

This is a superb 6 Part series on Astronomy and Cosmology on the ABC, Saturdays at 6pm - 7pm.

At the time of this issue, 4 Parts have passed. But there are still 2 to go.

Don't miss it!

Q: What is an astronaut's favorite meal?
A: Launch

Q: What types of tunes do planets like to sing?
A: Nep-tunes

VICE PRESIDENT'S REPORT

I think it's wonderful that at last month's meeting many new members joined us and combined with the existing membership renewing.

I believe that this year will be one of our best yet.

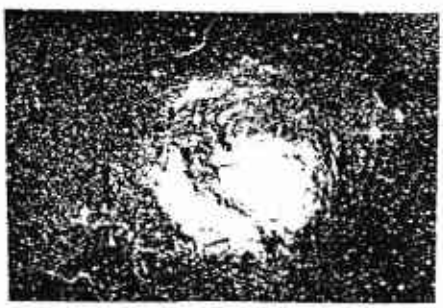
The decision to provide the option of mailing the Society's Journal has proven very popular and already has been taken up by several new members.

Thank you to all who have indicated participation in the display/open nights. This information helps us to be an effective and well organised Society and I must thank Eric Brown for compiling our new Membership forms.

Last month's meeting highlighted a few areas on which I'd like to comment, namely that our membership is very diverse, ranging from young children, teenagers, adults and seniors, both male and female, combined with various skill levels ranging from almost novice to very expert and everything in between.

It is my hope that during the course of our 3rd year, our members will find various activities, discussions, articles and guest speakers to make belonging to our Society a worthwhile and, indeed, an enjoyable experience.

Noel Sharpe (Vice President) ■



The Lagoon Nebula
(Photo by D Malin – used with permission)

TOP 10 REASONS FOR ABANDONING A SPACE STATION

10. Breakfast, lunch and dinner-- pork and beans in a tube
9. Ships computer says "I don't know what leak you are talking about comrade Dave."
8. Space Station's warranty expired 3,834,621 miles ago
7. You just used the last gaffer tape.
6. Antenna mishap, locked onto shopping channel.
5. Mission Commander shaves head and says "Make it so."
4. Robot keeps waving arms around stating" Danger, Danger, Will Robinson."
3. The last collision not only set off the emergency warning signal, but also ruined your last pair of clean boxer shorts.
2. James.T. Kirk has just beamed aboard and seems really annoyed about something.
1. Mission Control is dialling The Microsoft Help Desk.

NOTICE BOARD

* Names Tags will be provided to members at the April meeting.

* Please note (those who have not renewed or joined up) that membership fees are due at the end of March. However, the Committee has extended payment deadline to end of April. So, if this applies to you, please pay promptly. If not paid up after April, you will be non-financial and will need to pay the $10 joining fee to rejoin. Remember, it costs money to operate your Society.

COSMOLOGY MODELS: FROM DEITIES TO THE BIG BANG, OR PLASMA CONTINUUM – PART 3

by John Casey

The Sun and its Fusion Reactor

The fusion of hydrogen into helium takes place in the central core region of main sequence stars like the Sun, and in more intermediate zones further from the core in more evolved stars. For stars like the Sun, as main sequence stars, about 70% of the energy released is from the proton-proton fusion of hydrogen into deuterium and helium [the PP1 cycle], 29% from fusion of helium to beryllium, and beryllium into lithium [the PP2 cycle], and 0.1% from the PP3 cycle of beryllium forming boron. The CNO cycle, where fusion to carbon, oxygen and nitrogen occurs, accounts for most of the remaining 0.9 %, and requires temperatures of the order of a hundred million degrees K, and densities of around 10,000 grams/cubic centimetre.

Other Stars and their Energy Sources

For the more massive red giants, this CNO cycle occurs in larger amounts in the central core area, and stabilises these stars for periods of 10- 100 times shorter than the PP1 cycle does for main sequence stars. [The PP1 cycle in these stars occurs further out towards the surface in these more massive stars, where the pressures and temperatures are still right for these fusion reactions to occur, and unreacted hydrogen still remains]. The reduced burning time explains why there is such a difference [reduction] in numbers of stars in the red giant stage compared to main sequence stars. As these and more massive supergiants rely on even higher temperatures to resist the gravitational collapse at their core, they become rarer still. The reason is that the energy available in the central core from parent-daughter fusions becomes less as higher atomic mass elements are created.

This is because there is less difference in mass between the parent and the daughter, and it is this missing mass that is converted into energy according to the $E=MC^2$ equation. [For the fusion of four nuclei of hydrogen into one of helium, the mass loss is 0.7%, and 1 gram of hydrogen would, with fusion, release 630 billion joules of energy]. Also, for these ultra high temperature reactions [billions of degrees K], an increasing proportion of the energy is radiated as nil rest mass] neutrinos, at near the speed of light, and these do not interact with the matter above, so the energy is lost without upholding the temperature of the mass above.

For stars with central core temperatures of 3-4 billion degrees K, for elements from silicon up, photo-disintegration reactions produce even heavier elements by quasi-equilibrium reactions that are a succession of photo- disintegrations and fusion reactions of the fragments. With temperatures at 4-5 billion degrees K, these reactions proceed up to iron. That is as far as normal fusion reactions can go- beyond iron, the reactions are endothermic- absorbing, instead of producing heat. Many heavy isotopes cannot be synthesised by these slow neutron capture reactions, and instead are formed by the explosive stellar phases such as supernova, where rapid neutron capture mechanisms come into play - when there are large neutron fluxes available.

Other Theories- The Steady State

From the combination of nuclear physics and the Big Bang GUT theory, a convincing story has emerged for the development of the universe, but this does not show that the theory is necessarily correct. As mentioned before, Hoyle showed that the heavy elements could be created without the need for the Big Bang. In 1957, he and co-workers published a detailed theory showing how stellar systems could produce all the known elements, and in proportions very close to those observed to exist from nova and similar supernova high energy gravitational collapse and explosion. There were some problems with this theory too- It would not give the high level of helium as exists today by present rates of star formation and burning rates, and some light elements like deuterium lithium beryllium and boron should have been completely consumed.

But the steady state model was also in trouble. The steady state theory supposed that the universe was homogeneous, both in space and in time. However, around 1961, with the improvements in detection and narrow beam focussing in radio astronomy and radar bought about by military research, so that improved sensitivity observations showed that as one looked further out into the universe [and therefore backwards in time], there were more and more radio sources. This showed that the universe was changing- evolving with time, and therefore was not in a steady state. Then, in 1964, some radio sources appeared to be identified with tiny starlike objects- or quasars. The red shift of these was extremely high- and so they were far away - but the light from them was so great, that they were radiating enormous amounts of energy. In some cases the energy output would have been 100,000 times that of an entire galaxy.

Black Holes

But, in spite of the huge energy output, the light intensity varied over periods of less than one year. This implied that they could not be more than a light year across, but a galaxy is typically 100,000 light years in diameter. The energy output was so great that even a supernova could not pack so much energy into such a small space. Fred Hoyle then proposed that this phenomena was a black hole- the collapse of an enormously massive object, with a mass at least a million solar masses. Back in the 1930s Robert Oppenheimer had calculated that a sufficiently massive object could exert such high gravitational forces that it could overcome the repulsive strong force in the nucleus of atoms, causing a crushing of the atoms, and that the continued contraction might collapse entirely, through to a singularity- a point of almost no linear dimensions.

...but the steady state model was also in trouble...

Because of the enormously strong gravitational field, theoretical study of them could only be undertaken using Einstein's general relativity equations that take into account the curvature of space under such a field, so the Big Bang theoreticians renewed their efforts on this related field.

Superclusters

But the Big Bang theory was in trouble too. In 1991, two major flaws were uncovered. In January 1991, Will Saunders, and others at Oxford,

unveiled a map of the location of galaxies, based upon observations by the Infrared Astronomical Observatory satellite. This showed, beyond doubt, the existence of supercluster complexes, whose size was so great that they could not have developed in the time since the Big Bang. Changes to the Big Bang theory attempted since to explain these superclusters, but could not do so without upsetting the extreme smoothness of the microwave background. The period of 10-20 billion years ago for the Big Bang was based upon the measured distances of galaxies, and the speed at which they are receding from one another.

But the Big Bang theory was in trouble too...

Supercluster formation would, in the time since the Big Bang, require galaxies to move at sustained speeds of 2000 km/second for the Big Wall, and 3000 km/sec for the Tully Complexes, and 5000 km/sec to hollow out the void volumes observed in our clumpy universe. However, the average speed of galaxies is only 500 km/sec. The Cosmic Background Explorer Satellite [COBE] was launched by NASA in November 1989, and its observations showed that there were no variations in the detected brightness verses frequency from that of a black body spectrum. Big Bang theorists required at least a 1-2% distortion of this spectrum to account for the energy tied up in the expanding to the clumpy matter distribution as present today.

Then in April 1991, George Fuller and his colleagues of the University of Washington, demonstrated that the abundance of helium was considerably less than that predicted by the Big Bang, and to get this right by "adjustments" to the theory, would then throw out the amount of deuterium and lithium by a factor of 4 to 10. Then there is the problem of 'Dark Matter". The clumpiness of the universe , if caused by gravitational effects only, would require more matter to cause the contractions and movements, than can be seen as objects emitting light. Less matter means less gravity, and hence a slower growth of large galaxies. For the movements of galaxies and other considerations, the amount of matter required would indicate that 99% of all matter is unobservable. The actual density required is 10 atoms per cubic meter, but observed mass only accounts for 1-2 % of this. Dark matter would be indirectly observable by its mass and the effect this mass would have on rotation rates on galaxies, etc. But observations in these areas also show less than one hundredth the required mass.

The Search For Black Holes

Recent searches for black holes may hold some of the answers on such dark matter. Astronomers are now utilising the fact that two thirds of all stars belong to binary pair systems-double stars. When gravitational collapse occurs to one which is less than 3 Solar masses, it will collapse to a neutron star. Above this limit collapse continues to a black hole. But it appears that black holes come in at least two size ranges- ie 3-10 Solar masses, and supermassive versions of > a million Solar masses.

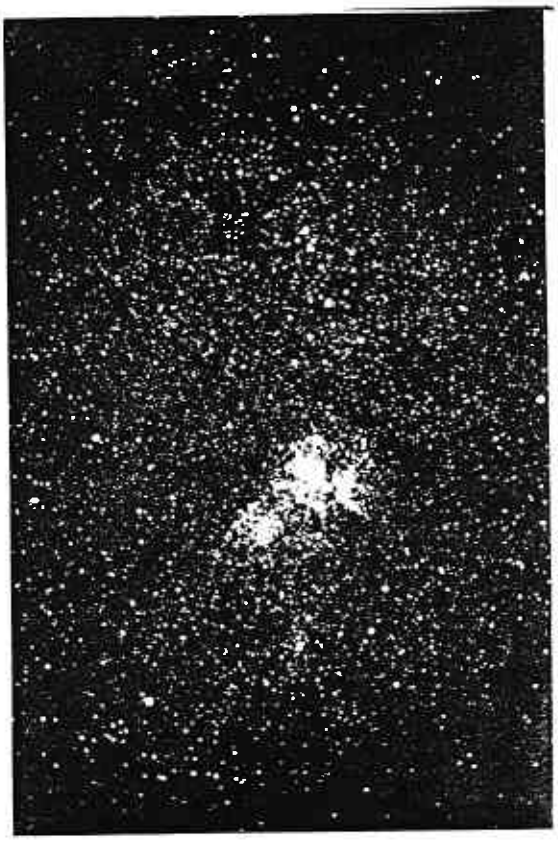
A distant spiral galaxy, NGC4258 is one such supermassive candidate at a mass of 36 million Solar masses- and it is less than a light year across, and is radiating maser radiation-microwave equivalent of laser energy from water molecules exposed to intense radiation,

according to Jim Moran, of the Centre for Astrophysics in Cambridge, Massachusetts. Andy Fabian, of the University of Cambridge is using a different approach, and using the Japanese X-ray satellite called ASCA, he is studying the X-ray outbursts of a galaxy known as MCG-6-30-15. Iron atoms in the accretion gas spiralling into the black hole radiates at a precise 6.4 k electron volts, but Doppler effects are blue shifting the radiation at the side where the gas is coming towards us, and red shifting it at the other side as it moves away from us. Fabian believes that he is studying emissions from gas at 20 times the radius of the event horizon-the point where even light gets swallowed by the black hole. His tentative conclusions from the data is that the black hole itself is spinning., dragging nearby space around with it.

At the lighter end, V404 Cygni is an ordinary star whirling in orbit around a dark object of 12+/-2 Solar masses. Nova Scorpii 1994 is another contender with a mass of 7 +/-0.5 Solar masses. Near the centre of the Crab Nebular, [the remnants of a supernova explosion in 1054 AD] lies a rapidly spinning pulsar that could be another candidate.

John Casey ■

This is the third part of John's Multi-part epic. Stay tune for the final Part 4 where he discusses the Plasma Continuum Model of the Universe.



Eta Carina and Nebula
(Photo by Peter Druery)

THE FOURTH ALTERNATIVE

Just as you think you had it all figured out, they up and throw a new one at you.

After years of reading and attending lectures, I was pretty certain I knew the score. The Universe is either going to: a) continue to expand, possibly at a slightly reducing rate, but never stop; or b) it will gradually come to a gentle halt, and hover there, forever unchanging; or c) it will gradually slow down, stop, then start to collapse, eventually causing a Big Crunch.

When you think about it, that effectively covered all the possibilities (excluding the Steady State Theory, of course).

But no, some astronomers have discovered a new possibility. Now I know they didn't set out to discover this. In fact, I suspect that they are as surprised, yea, even alarmed, as everyone else. But discover it they did. Or at least their data suggests so.

What is this surprise? Well, according to the High-z Supernova Search team, led by Dr Brian Schmidt at Mt Stromlo and Siding Springs (ye gods! An Aussie did it), measurements of the speed of expansion of the more remote parts of the universe (ie the older universe) turn out to be slower than that of the closer (ie younger) parts of the universe. Now stop here and read that last bit again.

Yes, that's right. Their data says that the younger Universe is expanding FASTER than the older universe. To be specific, the universe is expanding 20% faster today than it was 7 billion years ago.

BINGO! That's Alternative 4.

Now, the good astronomers already have an 'explanation' for this strange situation. Anti-Gravity. The mass of the universe is actually 'repelling' itself to give a greater push outwards.

Needless to say, there is some degree of healthy scepticism over this finding. Obviously the data will have to be triple checked, maybe even remeasured. However, if there is any basis of fact in it, it leads to all kinds of exciting speculations. I'm sure we will hear a lot more about it.

I suspect that they are as surprised... even alarmed, as everyone else.

BUT, WHY WAIT?

Why should we wait for the big boys to come up with the answer? I'm sure the collective minds of MAS members can come up with plausible explanations. I'd be pleased to hear from members any thoughts on this latest bombshell and also any suggestions of what is causing it.

I'll toss a couple in the ring for starters:

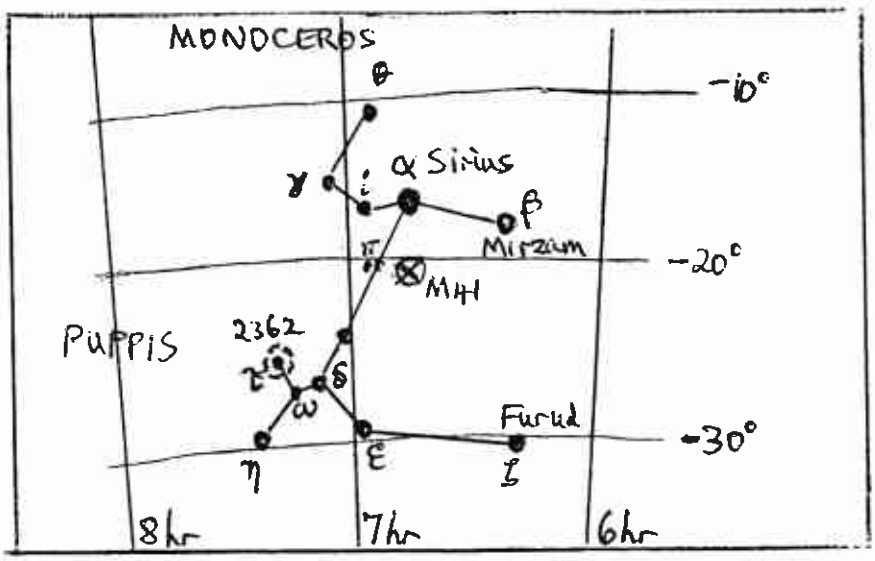
1. Dark Matter is actually anti-matter, therefore causing anti-gravity. But it didn't start till recently when it got dark.

2. There is another larger super-universe in a spherical shell all around our universe and *racing inwards*, thus causing ours to accelerate outwards. It would be interesting to speculate what happens when they meet.

Let your imaginations soar.
I'm on 02 46251623 or e-mail me on robert.bee@nswgovgrid.telememo.au

Bob Bee ■

CANIS MAJOR (THE GREATER DOG)



Here's your chance for some really 'sirius' star gazing.

As I've noted before, the constellation namers really indulged in painting a mythological tapestry across the sky. As you go from one constellation to another, you find another piece in the overall story being told.

In this case, Canis Major represents one of the two dogs following Orion on his adventures. The other, Canis Minor, is really only a pup (not to be confused with Puppis, which is a stern).

Again, as is often the case for us 'Down Under' types, we don't recognise the shape, as it is upside down – unless you are good at picking dogs playing dead.

Canis Major (let's call it CMaj from here on – one of Beethoven's favourite keys, by the way) has a number of interesting features and a unique claim to fame – the brightest star in the sky.

α (Alpha) Cmaj is called Sirius. This is Greek for 'scorching' or 'searing'. Either way, it is the brightest star in the sky at mag. –1.47. It's also the 6th closest at 8.7 l.y. Sirius is a Class A1 white star, with a white dwarf companion (mag 8.5) that orbits every 50 years. Unfortunately the primary is so bright that the white dwarf can only be seen by 200mm+ scopes in exceptionally clear skies, and even then only at maximum separation. No chance this millennium. [6h 45m, -17°]

β (Beta) Cmaj is called Mirzam, 'the Announcer', and at 850 l.y. away, is a mag. 2.0 blue giant. [6h 23m, -18°]

δ (Delta) Cmaj is Weza 'The Weight'. At 2300 l.y. it is a mag. 1.8 yellow supergiant. [6h 08m, -26°]

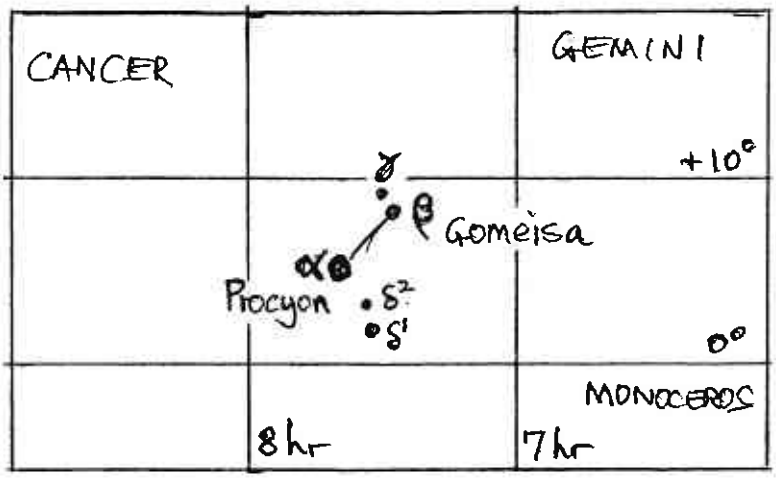
ε (Epsilon) Cmaj, called Adhara 'The Virgins'. A blue giant mag. 1.5 star at 490 l.y. It has a companion (mag 7.4) which is difficult to see in small scopes. So, the obvious question is how did the ancient astronomers know there were **two** of them? Mmmm? [6h 59m, -29°]

Did you notice how all the stars in this group have names like characters out of ***XENA – WARRIOR PRINCESS***?

M41 (NGC2287) is a large open cluster, bright enough (total mag 4.5) to be seen with the naked eye under good conditions. Located about 1/3rd the way between α (Sirius) and δ (Wezen), it is quite delightful in binoculars or a small telescope at low magnification. With a telescope at low power, you should be able to see individual stars bunched together in small clumps, or bunched in curved shapes. [6h 47m, -21°]

NGC2362 is a nice compact cluster surrounding one of its own members, τ Canis Major. τ Cmaj lies about 5000 l.y. away and is a mag. 4.4 blue supergiant. NGC2362 contains at least 60 stars which can be seen in small telescopes. Can you spot them in your binoculars?

CANIS MINOR (THE LESSER DOG)



There's not much to this constellation – only two stars. Looks more like a dog's bone than a dog.

It can be found about 23° east of Betelgeuse (in Orion).

β (Beta) Cmin – though it has a name (Gomeisa), it's 'just' a star. Mag. 2.9, blue-white, 150 l.y.

α (Alpha) Cmin is called Procyon, and is worthy of some note. At mag. 0.34, it's a yellow-white Class F5 star. Like Sirius, it is one of the closer stars (the 14th) and is 11.4 l.y. away. Procyon also has a white-dwarf companion (now there's a coincidence) but it is even more difficult to see than Sirius's.

Bob Bee ■

QUESTION & ANSWER: If you have any question about astronomy you'd like answered by our 'panel of experts', why not contact the Editor(Bob Bee) on phone (02) 46251623, fax (02) 9284 3569 or e-mail (robert.bee@nswgovgrid.telememo.au). We will publish an answer in the following issue of Prime Focus.

BASIC TELESCOPE HINTS

An important function of our Society is to provide an educational environment to assist our members, and in this regard many articles have been written over the past 2 years.

In this issue of our Journal, it would be timely to revisit some fundamentals when using your telescope, as many new members have made reference to getting better use out of their scopes.

This article is mainly for those who lack long term experience and with telescopes that have tripods.

Let's begin:

You must remember to tighten all nuts and bolts and screws on your tripod. The unstable tripod will make observing very difficult and the scope will not behave as well as it should.

Always locate yourself on level terrain, avoiding rocks and gravel. Of particular importance is the point where the telescope mounting attaches to the top of the tripod. Often this is where the bolts are loose. For those with an equatorial mount, it makes for difficult movement of the scope when using the slow motion controls.

The above hints should take care of the shake and rattle, but what about the roll?

Again, for those with an equatorial telescope (usually identified by counterweights and cables), correct balancing of the scope will allow for the smooth performance of the gearing system. Your instruction booklet should contain the information you need for balancing. However, in my experience, problems can be caused simply by the night air.

The scene is a clear sky. It's about 11.30pm and you notice that things are getting a bit damp. The dew will make the scope tube roll or slide within its cradle for those scopes equipped with such devices. Again, you must retighten the locking bolt after centering the tube. These are basic hints but always remember – don't over-tighten. Br firm and gentle, using a small spanner with a little pressure often helps.

Some Other Hints:

* You must have your finder scope perfectly aligned. You'll be lost without it.
* Remember that low power is best when starting your observing.
* Don't forget Aerogard, a seat, thermos, and always be prepared for cold weather as even in January around 1am, it still can get cold.

Conclusion:

Any questions you might have, please ask the Society. Our members have a wealth of knowledge and we have all been there before. If you would like hands on experience, bring your scope to our regular camps or to the Monday meeting.

Noel Sharpe ■

MACDOB: THE SOCIETY'S 'SCOPE

The Committee has appointed Bob Bee 'custodian' of our 150mm MacDob, meaning he will issue and receive the 'scope from those who wish to borrow it. There is no hiring fee for MacDob, but cover maintenance costs, you are invited to make a voluntary donation consistent with the pleasure that MacDob has given them.
Contact Bob on (02) 46251623 for your loan of MacDob. ■