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Journal

PRIME FOCUS

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PRESIDENT'S REPORT

Hello fellow astronomers, I unfortunately missed the last MAS meeting due to work (yet again). A big thank you to John Casey for giving what I have been told was a fabulous talk.

The sky lately has not been very favourable for viewing, I have been busting to see Jupiter through my 114mm Tasco, but alas my wife ordered me with my bronchitis and asthma to stay indoors, and like a good obedient husband I did as I was told.

Sorry about the hiccup in room availability last month. Apparently we did and do have the room booked for all of this year and next. I have dates Carol has booked it for us, so if anyone is in the room we can ask them to politely go as we have the rights to the room on the Monday nights. Sorry for any inconvenience caused by this mishap, it shouldn't happen again.

Many thanks to Noel for all his extra hard effort in speaking to the scout and stamp societies. All those who assisted on these nights your help was greatly appreciated. Whilst on Noel, I would like to say this Society throughout its early beginnings would not be as successful without the tireless efforts of our Vice President and jack of all trades man Noel Sharpe. I would also like to thank Bobbie and Pete Elston for their tea lady services throughout 1999 and providing a warm haven for our committee meetings. Also I would like to give my sincere thanks to Bob Bee for all his hard work with Prime Focus and minding MacDob and helping me through the last 4 years as President. It would be remiss of me to not thank Daniel for organising the room for our Society each month. To Peter Druery, Eric, Dick, Dave (projector), any and all the members for contributing and making the four years I have been president a very enjoyable time. As you may have guessed I will be resigning in March next year and leaving open the position of President. I feel during this year with shift work and my job I can no longer fill this position with any sincere time commitment. I wish whoever takes on this role all the very best for the future. I hope to remain on the committee and assist in the running of the club.

On a brighter note I hope to see many of you at the Christmas party on Sunday 5th of December at Pete and Bobbie's place for a BYO BBQ, drinks etc; swimming pool provided. The last few years it has been at my place, and I know how much fun and work it involves, so I would like to personally thank Bobbie and Peter for opening their home for us this year so we can celebrate Christmas together as a Society.

LATEST NEWS

Mars Polar Lander mission status report: October 22nd. Flight controllers have set the date of the 30th of November to do a final burn and set the spacecraft on its final trajectory toward Mars.. Polar Lander is working perfectly and barring any unfortunate mishaps (Martians firing at craft etc.) the spacecraft should land at the south polar cap on the red planet Dec 3rd (a national holiday for me anyway). The Mars Polar Lander apparently cannot fall to the same error as Mars Climate Orbiter as it has not been built in with the same erroneous unit conversion. The spacecraft will communicate directly (20-40 min time delay) with Earth it is hoped for 90 days.
The spacecraft is currently 18 million kms from Mars and travelling at 4.6kms/sec.
The Moon: Unfortunately no water has been found on the Moon. When Luna Prospector crashed into the Luna surface on July 31st it was expected to hit the target and cause a huge plume with water being part of the substance to show up. However, no water was detected. It is still hoped that water may be found under other craters in shadow. The reasons it failed could be as follows:

1. No water at all on the Moon
2. The water is hydrated minerals and could not be released by the impact.
3. The spacecraft missed its mark
4. Failure to have the plume monitored correctly.

The overall success rate was only 10%. This failure, however, didn't dampen the spirits of too many scientists as many other successful experiments yielded much positive data.

1. Hydrogen detected in the polar regions
2. The Moon's atmosphere (be it minuscule) was tested.
3. Mapping was more extensive leaving hardly any area on the Moon unmapped.

NASA unfortunately has no plans to revisit the Moon in the near future. However, privately funded projects and other countries are Luna bound in the next 4-5 years.

Galileo: The Galileo spacecraft has successfully flown within 611 kms of the surface of the Moon Io. (New pictures will be available on the net within the next few weeks.) The spacecraft feared damaged through the radiation of Jupiter put its computers into safe mode and rode the storm. On November 25th Galileo will fly within 300 kms of the moon. The mission is due to wind up however in February 2000.

The closest-ever image of Jupiter's moon Io, taken by NASA's Galileo spacecraft on October 10, 1999, shows a lava field near the centre of an erupting volcano. The image was taken from an altitude of 671 kms and is 50 times better than the previous best, taken by the Voyager spacecraft in 1979.

Visible in the image are new lava flows from the volcanic center named Pillan, an area with erupting lava hotter than any known eruption that occurred on Earth within billions of years. Scientists will be studying this image to determine the characteristics of the eruption, along with other data due to be sent back by the spacecraft in coming weeks.

Not surprisingly, fierce radiation took its toll on the spacecraft. Io's orbit lies in a region of intense radiation from Jupiter's radiation belts, which can affect the performance of or even knock out various spacecraft instruments. A mere fraction of the dose that Galileo received would be fatal to a human. Because of the radiation risk, the Io encounters were scheduled for the end of the two-year extended mission, after the spacecraft had already fulfilled its other mission objectives.

Most of the Io images were taken using a "fast camera" mode, where the camera itself pre-processes the image to average the brightness in adjacent parts of the picture. Galileo engineers say it appears that Jupiter's radiation caused the process to get out of sync, which degraded the quality of the images. Fortunately, images that were taken in other camera modes, including the newly released image, apparently did not suffer ill effects from the radiation.

"When we're flying the spacecraft through this high-radiation zone near Io's orbit, we have to plan for the likely radiation and figure out how to deal with it," said Galileo Project Manager Jim Erickson. "We used several different modes to see how each would work. Now that we know this particular camera mode didn't work well amidst the radiation, we'll use other modes from our six different types for the next Io fly-by."

That second Io fly-by is scheduled for November 25 at an altitude of only 300 kms.

Galileo's original mission was to spend two years studying Jupiter, its moons and magnetic environment. That mission ended in December 1997, then was followed by a two-year extended mission scheduled to end in January 2000. Galileo, the first spacecraft to orbit Jupiter, has revolutionised our knowledge of the giant planet and its moons and has provided thousands of colourful images.

During the October 10 Io fly-by, the radiation also apparently triggered a problem with Galileo's near-infrared mapping spectrometer. The instrument has a grating that allows it to measure different wavelengths of light as they are reflected onto a sensor. This enables the instrument to produce a spectrum of the light from objects it observes. During the fly-by, the grating did not move as it should have, which means that only one set of wavelengths was measured instead of the complete spectrum.

The resulting data provides maps at each of several wavelengths in very high spatial resolution. These maps can be used to show the distribution of materials on the surface and measure the temperature of the lava in Io's volcanoes, but detailed spectral information for identifying materials on the surface will be limited to the early part of the encounter where full spectral data were acquired.

The Galileo flight team is still evaluating the status of another instrument, the ultraviolet spectrometer, which has been acting up for two months. Since this instrument was not scheduled to be used during the Io encounter, it was switched off while engineers diagnosed its grating problem.

Additional information and pictures taken by the Galileo spacecraft are available at the mission's web site provided by NASA. //galileo.jpl.nasa.gov

Galileo was launched from the Space Shuttle Atlantis on October 18, 1989. It entered orbit around Jupiter on December 7, 1995. JPL manages the Galileo mission for NASA's Office of Space Science, Washington, D.C. JPL is operated for NASA by the California Institute of Technology, Pasadena, Calif.

Phil Ainsworth ■

VENUS GODDESS OF LOVE ?

She certainly is a fiery lady, but not as mythology would have you believe.

In a case study recently conducted by Colorado University, similarities between present day Venus and future Earth have been presented.

Venus currently has a surface temperature of 482° Celsius, the atmosphere is mainly made up of carbon dioxide and the clouds that cover the planet are made mainly of sulfuric acid. This, combined with the extreme atmospheric pressure, destroy in very little time every surveyor craft we have sent to the surface.

Venus and Earth are the only planets in the solar system with complex and evolving climates. Indications are that some 800 million years ago, massive volcanic eruptions covered the surface of Venus with a layer of lava some 10 kms thick. All this activity would have greatly contributed to the runaway greenhouse effect. It is thought that Venus may have been almost cloudless for the 100 million years prior to the eruptions. Calculations have shown that volcanism must have been active within the past 30 million years, to support the clouds at present.

Earth's fate will one day mirror Venus' in approximately 1 billion years, the Sun will begin to brighten greatly, causing our oceans to evaporate rapidly and our climate will succumb to the Greenhouse effect.

Earth and Venus are climatically very different at the moment, but one day may be identical.

John Rombi ■

VICE-PRESIDENT'S REPORT

Thank you to John Casey for last months presentation on electro-magnetic radiation, well researched and presented, and I might say good to get into some real science. It might even inspire me to write a serious article for Prime Focus.

The weather at the time of writing this article has been terrible, I've never seen as much rain, but as always I'm hopeful for some clear skies over Cobbitty. Speaking of which our observations will continue well into the new year, same arrangements ie; Saturday closest to "New Moon" plus 1 week after, caution at time of writing I'm not certain what the exact dates will be of, so please phone before coming down on site.

As this is the last Prime Focus for 1999, I would like to thank all who have assisted the club in its endeavours too numerous to mention but you all know who you are and I thank you immensely.

We also apologise for the inconveniences of our room cancellations, the best laid plans. We will try to avoid the double bookings in the future, but are indebted to UWS Macarthur for the use of the room.

Lots of things are happening at the moment, our presentations to the public are becoming very popular, but one thing we must have is more support from our members please.

We are also setting up our web site, www.macastro.org.au and with the observatory looking good for next year --- well it's all happening.

Good observing and all the best,

Regards,

Noel Sharpe. ■

IN BRIEF

A letter in ***Astronomy*** (October 99) smacks of 'only in America.' An amateur astronomer at an open night was showing a family the moon through his telescope. After being shown the spot where the US astronauts had planted the flag, the mother wanted to know why the flag couldn't be seen. He looked pointedly at his watch, then told her it was after 5 pm and the flag had already been taken down for the evening. Her reaction? "Oh!" and walked away.

REFLECTIONS

The naming of extra large telescopes is becoming a challenge for astronomers' imaginations. The original 'biggy' was Mt Palomar's 5m Hale Telescope. Though there were some slightly bigger ones, the next landmark was the 10m Keck (I and II).

The array of 8m scopes in Chile became the VLT (Very Large Telescope) and this set the future trend for ELTs (Extremely Large Telescopes.). It appears ESO has unveiled designs for OWL (Overwhelmingly Large) Telescope, a 100m giant. It will consist of 2,000 2.2m hexagonal segments.

With the weightlessness of space, there is even talk of a whopping 1 km diameter telescope. Though not given a name, I suggest it could be called the FLT (Frighteningly Large Telescope), or maybe Unbelievably Gigantically Huge (UGH) Telescope.

IN BRIEF

The September edition of ***Astronomy*** has a very useful article by Bob Berman called 'The Art of Sky Speak.' It gives a listing and explanation of the 'correct' pronunciations for the named stars and constellations. For example, Betelgeuse is pronounced "BET'l-jooz" and Rigel is "RYE-j'l". Very helpful.

It brought to my mind the very humorous time when Brian Henderson was reporting on the National 9 News about the discovery by Voyager of volcanoes on Jupiter's moon Io. Staring straight in the camera's eye, Brian informed the nation that "...volcanoes have been discovered on the moon ***ten***..."

I kid you not. Brian told me.

Official Dates for Cobbitty Field Nights for 1999

4/12/99 ***11/12/99***

The Sun –Pt 3

J Casey

The next leap in knowledge came from a New Zealand physicist, Ernest Rutherford, who, in 1903 measured the heat produced by radium, then went on to probe the structure of the atom, and deciphering the rules of radioactive decay. Rutherford showed that the radiation that Becquerel had discovered was actually a mixture of two types of radiation that he called alpha and beta rays, and that the alpha rays were helium atoms that lost two electrons. Helium itself had been first identified in 1868 by the British scientist Joseph Lockyer whilst pioneering the use of spectroscopy of the Sun. He found spectral lines in sunlight belonging to no known element, and named it helium after the Greek Sun God Helios. Rutherford, working with Frederick Soddy in Canada explained the radioactive disintegration of atoms, with each radioactive element having a set time in which half of the atoms would disintegrate. The question at that time was how an individual atom knew that it was time to decay. Rutherford received a Nobel Prize in 1908, -but for chemistry, not physics- "for his investigations into the disintegration of the elements, and the chemistry of radioactive substances".

Rutherford, together with R McClung then showed that the energy in the rays was enormous.

Meanwhile, Julius Elster and Hans Geitel, young German schoolteachers, showed that such energy could not be coming from outside the atoms, after they put radioactive substances into vacuum jars and down deep mines to shield them from effects of any energy sources from outside the Earth. By 1901 they had found that there is natural radioactivity even in the air and soil. It was then realised that the Earth could be kept warm from such an energy source.

...a hundred watt light globe output would be equivalent to one trillionth of a gram per second as mass

In 1903 Pierre Curie and Laborde actually measured the heat released by one gram of radium- it was sufficient , in one hour, to heat 1.3 grams of water from 0 C to the boiling point at 100 C. Rutherford then showed that the heat produced depended upon the number of alpha particles emitted by the radioactive substance. In 1904, Soddy established the rate at which a sample of radium produced helium. Rutherford then used this to date some rocks, by simply measuring their helium content and assuming non of it had escaped. This gave him the age of that rock as 40 million years old. Boltwood then went further, and looked at the overall products of radioactive decay- not just the helium. He obtained ages ranging from 92-570 million years for different samples of rock, but the results were wrong because of inaccurate data provided by Rutherford. After these errors were corrected the rocks were found to be 400 million to 2000 million years old.

By 1921, during a debate at the annual meeting of the British Association for the Advancement of Science, there was general consensus between physicists, geologists, botanists and zoologists that the Earth must be a few billion years old. Since then , the oldest rocks on the Earth's crust have been given an age of 3.8 billion years old, rocks from meteorites are 4.5 billion years- now considered the age of the Solar System itself.

In 1905, Einstein's first paper on special relativity was published , and included his now famous mass energy equation $E = MC^2$, but measurement would be difficult- a hundred watt light globe output would be equivalent to one trillionth of a gram per second as mass.

Arthur Eddington, a British researcher, was the first to successfully apply the basic laws of physics to what goes on inside a star. In 1919 he confirmed the predictions of Einstein's general theory of relativity by measuring the way light of distant stars were bent during a solar eclipse. Using data from Aston, who had invented a mass spectrograph and found that an atom of helium was 0.8% less than the mass of four atoms of hydrogen, he realised that this difference could fuel the Sun. But he also realised that one did not have to know the heating mechanisms within the Sun to determine its gross properties. He considered stars as gas clouds that follow the behaviour of an ideal gas- even though the average density of the Sun is one and a half times more dense than water.

Deep within the Sun, pressures and temperatures are enormous, and atoms are stripped of their electrons to become charged particles, or plasma, and some of their kinetic energy is converted into electromagnetic radiation. This radiation interacts with other charged particles, to be absorbed and re-radiated. This creates a radiation pressure that resists the pull of gravity. Eddington then showed that only stars within a certain size or mass range would be stable. These stars would have a mass of between 10^{32} and 10^{35} grams. A star cannot begin to glow with nuclear energy until it is bigger than Jupiter, and about one tenth the Sun's mass. If it is more than 100 Solar masses, gravity is insufficient to hold it together against the outward blast of radiation from its hot interior.

Eddington also found that all stars in the same family as our Sun, the so called main sequence stars, regardless of their mass or luminosity, must have the same central core temperature- about 15 million degrees K. This is because there is a feedback process that maintains equilibrium. If the star shrinks a little, it would get hotter, as gravitational energy is turned into heat, then this increases the rate of fusion, releasing more heat, until the star returned to its original size. The temperatures needed to start up fusion of other elements are much higher than the hydrogen to helium conversion, so these reactions must wait until the hydrogen in the core is used up and allow a gravitational collapse to bring the temperature up to the next star sequence.

Deep within the Sun, pressures and temperatures are enormous...

But theoretically, scientists could not understand how these fusion reactions took place at such a low temperature as 15 million degrees Kelvin. The answer had to wait till 1928, when the Russian George Gamow showed how an alpha particle, stuck in a "potential well" in the nucleus of an atom between interplay of the strong nuclear force, and electrostatic forces, through quantum uncertainty, could smear out the wave packet, to tunnel through this barrier and escape. Even at the temperatures of the centre of the Sun, most protons are not moving fast enough to tunnel through the electrical barrier. But because the temperature is an average, and some travel slower, and others faster, there are a few travelling up to five times faster. Even these particles must hit almost exactly head on to break through the barrier. Only about one proton in a hundred million is travelling fast enough even for a head on collision to do the trick.

In spite of there being collisions between protons within the centre of the Sun at millions of collisions per second, it takes on average 14 billion years for a collision that results in two protons interacting and spitting out a positron whilst within tunnelling range of each other, to form a stable deuteron. Two protons within one nucleus do not form such a stable nucleus without the loss of a positron. Thus only one in 10^{22} collisions initiates this p-p chain, and only 0.7% of the mass of each set of four protons is converted into pure energy when the helium -4 nucleus is formed. Because of its huge mass, however, the Sun converts about 5 million tons of mass into energy each second.

So far, the Sun has only converted about 4% of its initial stock of hydrogen into helium in its 4.5 billion year life.

Further evolution of the Sun will result in expansion of its outer layers. This is because four atoms of hydrogen slowly turn into one atom of helium, and there are less particles contributing to the gas pressure pushing the outer layers outward. There is a shrinking of the core region, making it hotter, and this contributes more heat to the outer layers, which then expand. Over its life so far, the Sun has expanded about 40%, and within another 1.5 billion years it will be 15% brighter. In another 6 billion years, the Sun will undergo considerable change. Almost all its hydrogen in its core will have been converted to helium, and hydrogen burning will progress out in a shell around the core, causing the surface layers to expand to more than three times its present size.

The increasing area available to shed this energy will cause the temperature in the luminous outer layers to drop and turn dark red in colour- the Sun will become a red sub giant. Over periods of hundreds of million years it will continue to swell to 100 times its present size, to become a true red giant. At this time, contractions of the core will have driven up the core temperature to 100 million K, and a new nuclear fusion will commence, as helium burning starts. This is very sudden, and the energy release will blow most of the outer layers away, sweeping past the planets and carrying their atmospheres away too.

Helium burning is much more complicated than hydrogen burning- helium nuclei [alpha particles], cannot combine in pairs to form a stable nucleus, as the product of two helium 4 nuclei would be a beryllium 8 nucleus, which is extremely unstable. Instead, three alpha particles must collide, with the third striking within ten millionth of a billionth of a second after the first two alpha particles collided. But with all the collisions, this does happen, forming carbon 12, and pushing the synthesis of elements further up the atomic table. Carbon burning occurs at temperatures of about 500 million K, oxygen burning at a billion K, and producing silicon, sulphur and other nuclei.

Further synthesis of elements occurs up to iron 56 by contractions to even higher temperatures, but with less energy released until at iron 56 reactions cannot proceed without input of energy. This is as far as it goes for the Sun, as it is not massive enough to supernova, so it will settle down quietly to be a white hot ball of iron, a so called white dwarf. Thus Anaxagoras's guess about the composition of the Sun as a ball of hot iron would be right, he was just far ahead of his time.

SECTION LEADERS

The following members have offered themselves as leaders (or coordinators) of those members with special interests in particular fields

DEEP SKY:
Pete & Bobbie Elston
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ASTRO COMPUTING:
Daniel Ross (02 9790 5838)

AMATEUR TELESCOPE MAKING: Dick Everett
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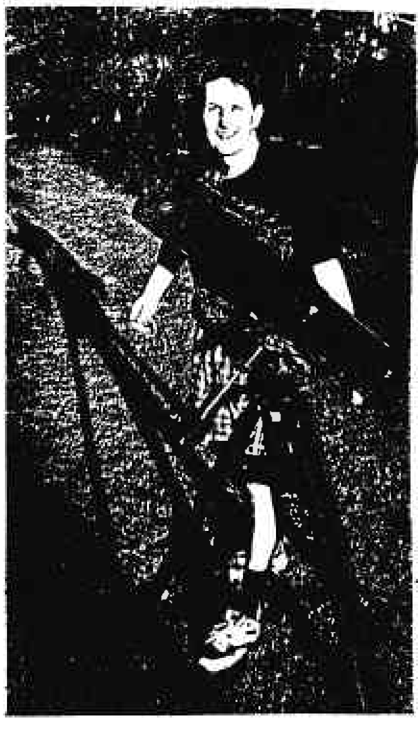
TELESCOPES : NOVICE/INTERMEDIATE
Noel Sharpe
ADVANCED: Peter Druery.

ASTROPHOTOGRAPHY:
NOVICE: Noel Sharpe
ADVANCED: Peter Druery



"Mars, anyone?"

Observations Book Review - Messier Marathon Field Guide By Harvard Pennington

Hands up, all the frustrated beginners and more experienced astronomers who after the initial excitement of a new telescope or resurrection of one kept in the cupboard for many years (the last one is me) have wondered what next ? What do I look for? Where do I begin ? Speaking to one of our section leaders is a start. Unfortunately we cannot have their wisdom on tap 24 hrs a day. Most of our members have an interest in looking for deep sky objects, but are thwarted by the above insecurities.

After being encouraged by Pete and Bobbie Elston to look for the most well known objects – the Messier Catalogue - I searched for a good book that I could have by my side to review and take out on field trips.

After an initial introduction by the Author, he shows how to set up your telescope to give the best results. Unlike your star wheel, it shows in great detail with separate star maps how and when to locate the objects first with – naked eye and star hopping – then your finder scope - finally with a low power eyepiece. A detailed diagram also shows you what each object looks like.

Even though finding Messier objects is not a race, it will greatly improve the speed at which you can find these objects and also identify the constellations that they are in.

This book is written in simple language by an astronomer that had suffered all the disappointments and frustrations that we all have experienced.

I highly recommend it

It retails for $49.95 from Bintel.

John Rombi ■

A POCKET FULL OF SKY

Oh what wondrous sights are seen when looking through the telescope: planets, star clusters, giant gas clouds, craters and mountain ranges of lunar proportions.

If only you could share these observations with friends and colleagues at a moments notice, night or day, say at a dinner party or work place. Well you can and it's called astrophotography, the art of photographing the night sky.

When I first joined MAS, I was really impressed with some very fine photographs taken by members. It inspired me to one day lay claim to try to take a few good photographs myself of the night sky. That was four years ago and finally I've been successful.

Now I carry around "A Pocket Full of Sky", a handy record of viewings that can be shown at a moments notice. So how is it done ? What does it cost ? And could you be bothered to do it at all?

I was hooked with a simple Lunar shot, done with a 35mm SLR camera, through my telescope for ½ second using something called a hat. So let's look at this beginning more closely.

The telescope can be of any type to take simple Lunar photography, all you need is a S.L.R. (single lens reflex) camera with a cable release ie; an old fashion manual camera that has a lock up mirror. The cable will engage the shutter and release it when you decide, ie; timed exposures. For Lunar work 100 speed film works well but you must have a special camera adaptor. When connected, the telescope's mirror or objective lens will act as the camera lens. Keep exposures to say ½ - 1 second while using the "Hat trick". By that I mean place some cardboard over the objective before engaging the shutter, then activate the release, wait a few seconds, remove 'The Hat' for ½ second then replace it and disengage the shutter using the cable release. We do this to eliminate vibration which will definitely occur, the result being a poor quality blurred image.

The above description is an excellent entry level to astrophotography. You require no equatorial mount, no dual axis drives or polar alignment, just a simple connect, shoot and record.

The cost at this stage is the camera purchase, (various prices here), but don't spend more than $200 – adaptors and T-rings are about $80 - then you have the cost of the film and of having it processed.

Why be bothered ? Why not! From most humble beginnings vast vistas of our galaxy can be recorded. In my most recent attempts I recorded some fine shots and I summarise the following.

- All photographs @ 5 minutes timed exposure.
- Very accurate polar alignment using a special small telescope in built into the polar axis shaft of the telescope's mount.
- Much attention to balancing the telescope which by now is loaded to capacity.
- The hat trick used, focus as best as you can using the glass screen of the camera.
- Have a reliable camera, you'll get a result and learn by your failures. Keep accurate log entries of every exposure.
- It takes much hard work and long hours, but in the long run it's worth everything to have "A Pocket Full Of Sky"

Noel Sharpe ■

FROM THE EDITOR...

"The time has come the walrus said, to speak of many things..."

So we come to the end of our 4th year. Doesn't time fly? ? I was looking over my folder of back issues, and it's hard to believe that we've actually produced 40 issues of Prime Focus. And they're all at Campbelltown Library, under Local studies LS 502.5 MAS, if you want to catch up with some you've missed.

This Journal would not be the success it has (and is) if it were not for the talents and commitment of those who have contributed articles over those four years. It's dangerous to name names, so if I overlook you, please forgive me. But Phil A, for your President's Reports and Latest News. Noel for your VP Reports and your dry & wry articles, Peter D for your optical expertise, John C for your epics, Dick E for your technical hints, Dave M, Daniel R, Attila K, John M, Linda M, Ursula B, John R. And others.

What depth of talent and knowledge our society has. I just need to get you to put it on paper or PC and get it to me. Let's hear from you soon in 2000. And in the meantime...

Happy Christmas

A CHRISTMAS COMET

A Short Story

The inaugural Christmas Day was shaping to be an unmitigated disaster. The mistletoe, imported at energy-consuming expense, hung wilting beneath the mess hall lintel, doomed never to bless a stolen kiss. The festive tree, crafted from beaten aluminium foil, glowed an unholy and unseasonal purple, and the turkey, freshly defrosted and richly marinated, was a masterpiece of cordon black at the bottom of a smoking baking dish.

After all the organisation, project management, mega-budget expense and sheer gutsy determination to be where they were at all, the impending inevitable failure of a simple birthday celebration was absolutely galling.

"Cheer up Peter, it's not that bad." Valerie Sharpe, the project's Medical Officer, tried her clinical best to soothe the team leader's mounting depression, while desperately fighting back a case of the giggles.

"Isn't it?" Peter Davids turned from the fluorescing tree, tendrils of corona crackling from the wings of the tinselled angel perched on its apex. "My people are as far from home as one can hope to be. The very least I can do as their leader is give them a sense of Christmas. It will anchor them to their origins, make home... and family... closer." He cast a despairing look at the turkey ashes. "And it's a nightmare."

"Peter, it's not as if most of the team hold your same sentiment for Christmas." Sharpe tentatively reached a hand out towards the tree, but the eerie rising of the down on her arm doused her curiosity. "Face it. They are all scientists. I'm sure they won't be as disappointed as you fear."

"You think so, do you?"

The M.O. ticked off her still tingling fingers. "Boole is a mathematician who published a book called 'The Statistical Improbability of God'. Our biologist Verrier is Vice President of the French Communist League. Smirnoff is... Smirnoff and never let's us forget it, and I'm, at best, an agnostic on a good day. The other three areologists are so absorbed in their experiments I doubt they know what month it is, let alone what day." She tried a confident smile. "I really doubt that the birthday of baby Jesus will rate highly on their list of personal priorities."

Peter Davids turned to gaze out the triple thickness glass of the spartan accommodation module, past the nuclear power plant, the laboratory, the air scrubber unit and the communications pod with its five metre dish aimed at an invisible point in the pink sky. "Davids' Town" one of them... he thought it was Smirnoff... had dubbed it on its completion Lord only knew how many months ago.

The barren red rock strewn landscape that spread for kilometres to the horizon... a horizon dominated by the monster volcano which was incredibly two hundred kilometers over that horizon... had never seemed so alien as at that very moment. He thought about his team and his abortive attempts to give them a Christmas they probably didn't want.

Suddenly he felt alone. Perhaps, he mused ironically, life on Mars was finally getting to him.

It was a nameless barn sized chunk of dirty snow, hurtling erratically from between Saturn and Jupiter like a hapless pinball bouncing off invisible cushions. Smirnoff saw it first, to no-one's surprise, and commented on how it appeared to approach and then hang motionless over the colony. "But then," he added bluntly, " that won't last. At 60,000 kilometres per hour, it'll soon be gone towards Earth to be named Comet Blah Blah by some lucky amateur astronomer."

With nothing better to do that night, the protein concentrates that subbed for the cremated turkey making a poor dinner to linger over, all eight donned their suits and ventured into the sub-zero temperature and cruelly thin atmosphere to watch the star shining over Davids' City.

But Smirnoff was wrong. As they watched in astonishment, the comet blazed brighter and brighter, casting eerie shadows amongst the complex of buildings, and they were all suddenly afraid. While they silently contemplated the option, and then futility, of trying to run for shelter, the comet plummeted into Mars' thin but effective upper atmosphere, boiling off as it went until, finally, it was a comet no more.

Valerie Sharpe sobbed quietly in relief as the twenty kilometer wide cloud from the melted comet rained down on them. Literally. But as the comet's atomised debris approached the barren ground, the sub-zero temperature snap froze the water vapour into bizarre icy flakes, a reincarnation of its original muddy crud.

And so it snowed that Christmas eve, and eight worldly, lonely scientists watched in silent awe.

Inevitably, scientific curiosity stirred the group and Verrier led the rush to fetch containers to capture comet samples for future testing. History would be made this day. Valerie Sharpe and Peter Davids were the last to move, reluctant to turn away from the white blanket slowly settling on the ground like icing sugar over a cake.

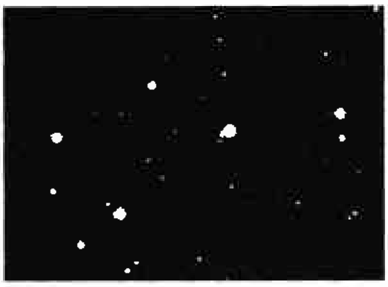
"Don't get too carried away with the symbolism, Peter," Valerie warned as they headed for the lab module. "Remember what I said earlier about your team's indifference to Christmas."

But Peter's mind was too far away to hear or heed.

It was a busy morning collecting comet snow and a tired but happy team fell gratefully into their beds as the Sun rose on Christmas Day over Olympus Mons.

Peter was the last to retire. Preparing for bed, he smiled in the dark as he suddenly remembered Valerie's words of warning. But his smile, if anyone could have seen it, was tempered by a frown of concern. His leadership was about to be sorely tested. Did he dare drink the concoction Smirnoff had left with the dehydrated carrot on the mess table, and what on Mars was he going to put in those seven socks he'd found hanging over the common room space heater?

*



The Pleiades Star Cluster M45
(Photo HST/NASA)

***MACDOB*, the Society's own 6" Dobsonian telescope, is yours for the borrowing if you are a financial member of MAS.**

If you are toying with the idea of buying a scope, why don't you borrow MacDob to get a feel for a reflector, what you can see with it, and how it feels to use.

But be warned, once you've used our 6"', you'll want to go out and buy your own (or maybe even make one. See Dick Everett about that.)

To borrow MacDob, see Bob Bee at a MAS meeting or call him at home on 46251623.

Borrowings usually go from meeting to meeting, and you are encouraged to bring it along to one of the set Cobbitty nights.

There is no hire cost, but you are invited to make a donation (no set amount) to reflect the pleasure you gained from the scope. This goes toward the upkeep of the instrument.

WHAT'S TO SEE THIS MONTH?

(15th Nov – 31st Dec)

NOTE: *Since we are now into Daylight saving, all times given in this article are in terms of Eastern Summer Time. (ie advanced by 1 hour).*

IN BRIEF:

On 16th November:
- Mercury rises at 5.45am.
- Transit of Mercury across Sun's disc.
- Venus rises at 3.45am
- Mars sets at midnight.
- Jupiter rises at 5.20pm
- Saturn rises at 6.40pm
- Uranus rises at 1.15am
- Neptune rises at 12.30am.

NOW SOME DETAILS:

Mercury has a long awaited and rare transit of the Sun on 16th November. (Yes, that's tomorrow morning.) Unfortunately, from Sydney we will only see a 'grazing transit' as Sydney is below the line of complete transit. ie You'd have to be north of Cairns to see a complete transit.
(For full details of the history and reasons of transits of Mercury and Venus, refer to pages 95 – 97 of *Astronomy 99*.)

Warning Warning Will Robinson – Do NOT view the Sun directly as it WILL cause blindness unless you use special Sun viewing equipment.

Transits of Mercury occur only about 13 times each century. (More often than those of Venus which occur at 8, 121.5, 8 and 105.5 year intervals. The next transit of Venus is due in June 2004.) After this one, the next Mercury transit is due in May 2003.

For the remainder of this year, Mercury's viewing is pretty ordinary being a morning object and well imbedded in the twilight.

Venus is a morning object all November & December. It is still very bright at –4.3 to –4.1 mag., with a gibbous (more than half, less than full) shape in binoculars or telescope.

On 4th December, there will be a nice arrangement with the 26 day old Moon 3.8° from Venus , then another 4° on to Spica in Virgo.

Mars is travelling from Sagittarius to Capricornus, but is still well positioned for viewing every evening before it sets around mid-night. It's now about 240 million km away, but still a ruddy glowing God of War at mag. 0.8 to 1.0.

Mars continues its close encounters, this time coming within 0.5° of M75, an 8th mag Glob. Cluster bordering Sagittarius and Capricornus on both 24th and 25th November.
Photo Opportunity Then it comes within 2° of Neptune (mag 7.9) from 27th to 30th Nov, and within 0.6° of Uranus (mag 5.9) on 14th Dec.
Photo Opportunity

M75, probably the most remote Glob. Cluster in our Galaxy, approx. 60,000 l.y. away. Apparent dia. 6". Need a professional scope to resolve stars. (Photo HST/NASA)

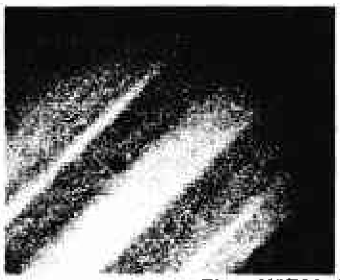
Jupiter is visible in the evening all November and December, a great time for viewing is gas giant.
[A very sobering statistic is that Jupiter and Saturn contain 92% of the total mass of all 9 planets. Uranus and Neptune account for 7% and Mercury, Venus, Earth, Mars, Pluto and asteroids have the remaining 1%. So when you look at Jupiter and Saturn, think... BIG!]

Jupiter is blazing away at mag. –2.7 and its four main moons are always a treat to watch. [If you also listen carefully, you may hear its inner moon singing "Io, Io, Round Jupiter We Go" as it goes off to work, volcanoes snorting.]

Jupiter's retrograde motion across the sky ends on 21st

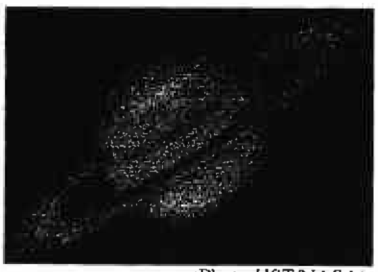
December, and it resumes its west to east motion.

At approx. 10pm on 18th December, Jupiter will be a cosy 3.5° from the gibbous Moon. Photo Opportunity


(Photo HST/NASA)

Jupiter and Io's shadow
(This is for Peter D)

Saturn is also viewable the entire evening for this period up to the end of December (and also January 2000.) Though its opposition is past (6th Nov) it is still very close and a sight to see at mag. –0.2 with its glorious rings still very open. Even with my 12x50 binoculars I was able to see Saturn as an orange circle with a distinct set of 'jug ears'.


(Photo HST/NASA)

As a Photo Opportunity, on 19th December, Saturn and the Moon will be a mere 2° apart.

Titan, Saturn's largest moon, has an orbital period of 15 days, 23.3 hours [say 16 days.] At opposition it has a magnitude of 8.3. It is 5150 km diameter, compared to our Moon's 3476 km. This makes Titan the 2nd largest moon in the solar system (Ganymede is largest at 5262 km dia.) and larger than Mercury at 4879 km diameter. You might be able to spot Titan on a good night with binoculars and definitely with a small telescope.

Uranus, at mag. 5.8, is setting at 1am on 16th Nov to 10.15pm on 31st Dec. At this magnitude, if you know where to look, you can spot it in binoculars and small scopes. Where? On 16th Nov. it will be at 21hr 03m 10s, -17°31'33".
On 31st Dec, it will be at 21hr 09m 52s, -17° 1' 0".
(The latter is approximate, but you'll be doing something else on that night anyway.)

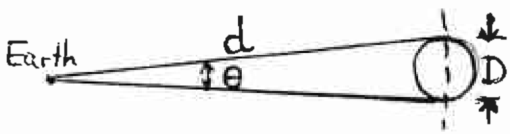
Neptune is mag. 7.9 to 8.0, setting at 12.30am on 16th November to 9.30pm on 31st December. Definitely for scopes only. Where?
On 16th Nov, it will be at: 16hr 16m 25s, -19°29'36".
On 31st Dec, it will be at: 20h 21m 23s, -19°13'0".
(The latter also approx.)

The Leonids Meteor Shower: Do you feel the déjà vu? I'm not predicting anything, but some people think that it may be on again (?) this year, and November 17th is tipped as THE date (for Australia). Based on the evidence of previous displays, maximum Leonid activity coincides roughly with the moment when the Earth crosses the orbit of Comet Tempel-Tuttle. In 1999 this occurs at 01:45 GMT on the morning of 18th November. It's up to you, it may be worth losing a few hours sleep for a possible 'shower of the 1/3rd Century'. I think I will. After all, I can't count on being around in 33 years time.

Predictions for the number of meteors per hour which will be visible at the peak of the 1999 Leonid shower vary dramatically, from a modest display of only a 200 or so, to sub-storm levels of 10,000-odd. A best guess might be in the region of 800-2,000 meteors an hour, translating to one meteor every few seconds, certainly not a storm, but still a very impressive sight.

An important point to note is that given the recent unpredictability of the Leonid shower, it is always worth observing on the mornings before and after the scheduled maximum, just in case you miss something unusual.

Answers to questions posed last month:



From geometry, for the radius d (km) and the angle θ (radians), the subtended arc D (km) is given by the formula $D = d \times \theta$.
By inverting, $d = D/\theta$.

So at opposition for Jupiter, we know the diameter of Jupiter (D) = 142,984 km, and its apparent angular diameter is 49.75 arcsec.(")
Now 1" = $\pi/(3600 \times 180)$ radians = 4.848×10^{-6} rad.
$\therefore \theta = 49.75 \times 4.848 \times 10^{-6}$
$= 2.412 \times 10^{-4}$ rad.
$\therefore d = 142{,}984/(2.412 \times 10^{-4})$
=592,802.653 km. Whew! This calculation is very sensitive to decimal round offs, so it may be out by 10 or 20 thousand km. However, the main accuracy depends on the value of Apparent dia in ".

We do the same calculation for Saturn at opposition. We know D = 120,536 km, and θ = 20.25". Using the same formulae, we get d = 1,227,769,614 km.

(Apologies for the maths.) This simple (?) formula can now be applied to all the planets at any time of their orbit, not just at opposition. From the monthly data given in *Astronomy 99* (or next year's *Astronomy 2000*) in the 'Appearance of the Planets' box, it gives the apparent angular dia.(θ) in arc-seconds for each planet that month. Using the known diameter of the planet (D) in km, calculate

$$\boxed{d = D\,(\text{km}) \times 2.063 \times 10^{5}/\theta}$$

(2.063×10^{5} is simply the inversion of 4.848×10^{-6}. It makes the calculation simpler.)

This expression is reasonably exact and can easily be set up on a spreadsheet for quick reference if you ever want to know how far away a planet is.

Bob Bee ■

The Seven Sisters

One of the most beautiful and famous star clusters is viewable from December to February in our Northern sky. This star cluster is so prominent and eye catching that it pops up in the legends and folklore of nearly every culture in the world, back to remote antiquity.

I'm talking about the Pleiades – the Seven Sisters. To quote Tennyson from 'Locksley Hall':

"Many a night I saw the Pleiads,
Rising through the mellow shade,
Glitter like a swarm of fireflies,
Tangled in a silver braid."

If you go look North-East, about 30° above the horizon you'll see a beautiful collection of stars resembling a small saucepan with handle (up-side-down) or even a baseball cap. They cover an area of sky about 2 to 3 Moon diameters.

The naked eye can see from 6 to 9 stars in the group, depending on your eye and the darkness of the sky. The ancients used it as an eye chart. If you could see 7 stars, you had 20-20 vision.

The Greeks named the seven main stars after the nymph daughters of Atlas and Pleione. The two stars at the tip of the handle are the proud parents themselves.

References to these stars abound in the cultures. In the Old testament in Amos Chapter 5, verse 8, we read "... Him that made the stars, the Pleiades and Orion..." The Australian Aboriginals have a number of stories about Pleiades. In one, the stars are Ngamma Gama, the seven sisters who are chased by the hunter through the bush to try and catch a wife.

To be totally different, the Japanese describe them as *Subaru*, meaning 'as string of jewels' and they appear in stylised form on the badge of that car. In fact, Jewels are as common a description as sisters, a 13th century Persian poet Sadi describing "*...necklaces of Pleiades seemed to hang upon the branches of the trees...*"

It's a pity to interrupt the poetry with the scientific facts that the Pleiades is actually a cluster of about 200 stars (revealed in binoculars and telescopes) and are all about 360 light years away. They are mostly 'new born' giant blue-white stars, less than 50 million years old. That is, they are very young, very large, and very, very hot.

But, after all, they are nymphs. No wonder they are a beauty to behold. ■

KNOW YOUR TELESCOPE

In this article we will take one aspect of telescopes at a time and attempt to explain its use or significance to the user.

Some formulae will be given from time to time, remember to convert all units to the same system of measurement before calculations begin.

For some silly reason telescopes are referred to in a mish-mash of metric and imperial measurements, often in the same mouthful. Consider: aperture is usually quoted in inches while focal length is specified in millimetres, also commonly – a '12.5mm 1 ¼" ' eyepiece! No one calls it a half inch eye piece and who would expect to fit it into a 32mm focuser?

Bearing this in mind lets look at the first of our telescope parameters – focal ratio.

FOCAL RATIO

$$\text{FOCAL RATIO} = \frac{\text{Focal length}}{\text{Aperture}} \qquad FR = \frac{F}{D}$$

A convenient term that's often used together with the aperture to describe a telescope eg. 8" F6, 4" F10 etc. It's derived by dividing the focal length of the telescope by its aperture. Telescopes of low focal ratio are sometimes referred to as having 'fast optics', a photographic term for denoting relative exposure times. Fast optics are good for astrophotography as well, but don't convey any benefits for visual use. Imagine brightness at the eyepiece for any given magnification is determined almost entirely by unobstructed aperture. Optics with low focal ratio are more difficult to make well (they have steeper curves) and will exaggerate the aberrations that all optics exhibit to some degree, possibly needing expensive eyepieces to correct these faults. For visual use telescope, length is the only disadvantage to high focal ratios.

MAGNIFICATION

$$\text{MAGNIFICATION} = \frac{\text{Focal length of telescope}}{\text{Focal length of eyepiece}}$$

$$M = \frac{F}{F_e}$$

To the uninitiated magnification is probably the least understood thing about telescopes. We can obtain almost any magnification with a telescope by simply changing the eyepiece for one of a different focal length. Magnification is simply the telescopes Focal Length (FL) divided by the FL. of the eyepiece used. Increasing magnification narrows the field of view and reduces the amount of light reaching your eye. High magnification is mainly used for planetary and lunar observations and is usually limited by atmospheric conditions. Most experts recommend using the least amount of magnification necessary for any observation. As a general guide to high magnification levels the often quoted rule of thumb says use no more than 60X the aperture in inches. This suggests an upper limit of 480X for 8" telescopes, but in practical terms it is rare to find sky conditions good enough to support 300X.

Real or Actual Field of View

$$= \frac{\text{Apparent Field}}{\text{Magnification}} \qquad \left(Rf = \frac{Af}{M}\right)$$

You will see many eyepieces advertised as having so many degrees of 'apparent field'. Commonly used **PLOSSEL** eyepieces for example are mostly quoted at about 50 degrees while some expensive eyepieces may have over 80 degrees. The field of view you will see in any eyepiece is determined by dividing its apparent field by the magnification it provides with your telescope. That is to say an 82 degrees Nagler at 50X will show 1.64 degrees of actual angular field, whilst a 50 degrees PLOSSEL at 50X will show 1 degree of field.

EXIT PUPIL

$$\text{EXIT PUPIL} = \frac{\text{Aperture}}{\text{Magnification}}$$

or $XP = \frac{D}{M}$

Calculated by dividing magnification into aperture, the exit pupil is the size of the image that the eyepiece presents to your eye. You can see it if you direct your telescope at a bright, evenly illuminated subject and stand back a bit. It will appear as a bright circle of light hovering slightly behind the eye lens. From the equation you can see that its diameter reduces with increasing magnification, and so extended objects become dimmer, less light reaches your eye. Knowing the diameter of the exit pupil has value – see "The Richest Field" in Prime Focus soon.

RICHEST FIELD

Eyepiece F/L for Richest Field = $\dfrac{\textbf{Exit Pupil FL}}{\textbf{Aperture}}$

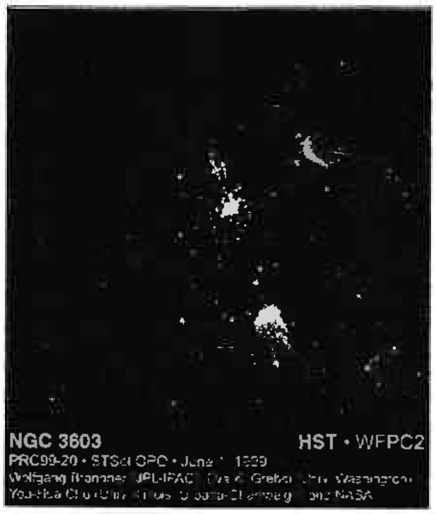
or $\mathbf{FRP} = \dfrac{\mathbf{XpF}}{\mathbf{D}}$

There exists a practical limit to enlarging the actual field of view with any telescope. As magnification is reduced and the field expands, so does the exit pupil become larger and the field of brighter. There is no benefit to increasing E.P. past the size of the dark adapted pupil of your eye otherwise you can't capture all of the light, and the field will become dimmer again. The fully dilated pupil will usually be 7mm when you're younger and will reduce with age. Over 50 years old you will probably have only 5mm. Whatever the case the magnification that produces the E.P. corresponding to the dilated pupil size is known as the "Richest Field" or sometimes as the 'normal' magnification and it sets a sensible limit to your lowest mag. Eye piece.

EYE RELIEF

Another measure of eyepieces, eye relief determines how close you have to place your eye to the eyepiece to see all of the field. This is a factor of eyepiece design and whilst it encompasses a comfort factor to most observers, it will be of vital concern to those who must use spectacles. Eye relief reduces as eyepiece focal length reduces, and in some cases can be as short as 4 or 5 mm. Using a Barlow lens will usually lengthen eye relief and has the benefit of allowing the use of a longer F.L. eyepiece (likely to have more eye relief to start with) for the same magnification. If you need it there are some expensive eyepieces that maintain 20mm or more of eye relief throughout their entire range of focal lengths eg. Lathanums, the Pentax range and Televues' Radian and Nagler 4 series.

By Dick Everett ■



This photo of a star nursery in NGC 3603 (which loses all its glory in photocopied B&W) is set to become the Hubble photo of the decade. Watch for the posters.

PRACTICAL CONSIDERATIONS OF NEWTONIAN TELESCOPE DESIGN

- EASE OF USE
- COST
- MOBILITY
- IMAGE QUALITY
- INTENDED TARGETS

EASE OF USE

A telescope that's easy to move around and set up is much more likely to be used often. There is little benefit in one that stays indoors. A smaller scope you exercise weekly will give much more enjoyment than a light bucket that is exposed to the stars occasionally.

Dobsonian mounts score highly in this regard.

COST

Your choice here comes down to whether this exercise is about making a telescope for less than the cost of purchasing one or having a high performance instrument.

You can make a high performance scope! You can also make a telescope for less than you would pay for a mass produced item, but they won't be the same telescope. I'd suggest that the effort of constructing is best repaid by providing you with a better telescope.

MOBILITY

With local light pollution, keep in mind that you will probably want to carry your scope some distance looking for better skies. Make sure it will fit in your car and that you can handle it on your own.

IMAGE QUALITY

Assuming high quality optics, I.Q is very dependant on focal ratio. The higher F numbers convey benefits in Newtonian telescopes. The longer the focal ratio the smaller the secondary mirror needs to be for a given field of full illumination. Thus we suffer less from obstruction to the light path providing more light to the eyepiece and better resolution in the image. Obstruction also reduces to some extent increasing aperture since part of the intercept distance is fixed regardless of mirror diameter.

(Intercept = tube radius + focuser height.)

Furthermore mirrors with higher F numbers have less pronounced curvature, thus they are easier to make well and can be expected to exhibit lower levels of optical faults, ie less coma and/or spherical aberration.

To get the best result from low focal ratios will require higher quality eyepieces. (at higher prices).
Being practical limits focal length to dimensions: will it fit in the car and how high is the eyepiece at zenith? As a rough approximation tube length and eyepiece height at zenith will be about the same as the focal length, so unless you plan to carry a step ladder Focal length will be restricted to around 1500mm (5 feet) or less.

This explains the popularity of 10" F5, 8" F6 & 6" F8 telescopes. A 10" F8 would be magic but only if you're built like a basketball star and drive a large van.

INTENDED TARGETS

The perfect all purpose telescope is an unattainable dream, so some thought should be given to intended use.

For solar system observations we need very good detail resolution, but since the objects have relatively high brightness we can afford to sacrifice some aperture for a larger F number. Smaller apertures suffer less from atmospheric disturbance as well, so for this purpose we'd favour the 'long thin' telescope.

Deep sky subjects however, are dim and usually extended across a field, so we need to grab every photon possible. Detail resolution is less important here because of the extended nature of the objects. In this case we would favour a 'short fat' one. Ergo the light bucket.

Another consideration is that long focal lengths make high magnification easy and wide fields more difficult and visa versa for short focal lengths.

Magnification

$$= \frac{\text{focal length of telescope}}{\text{focal length of eyepiece}}$$

Actual field of view

$$= \frac{\text{apparent field of eyepiece}}{\text{Magnification}}$$

This can have quite significant an effect upon eyepiece cost, will you need an 82° Nagler or a 2.5mm Lanthanum to provide the view you want?

Taking these factors on board, can we come up with some compromises?

From the viewpoint of mobility and ease of use, most of us will be limited to less than 1500 mm focal length and no more than 10" aperture. Above F5 optical aberrations are manageable, but the higher the F number the better.

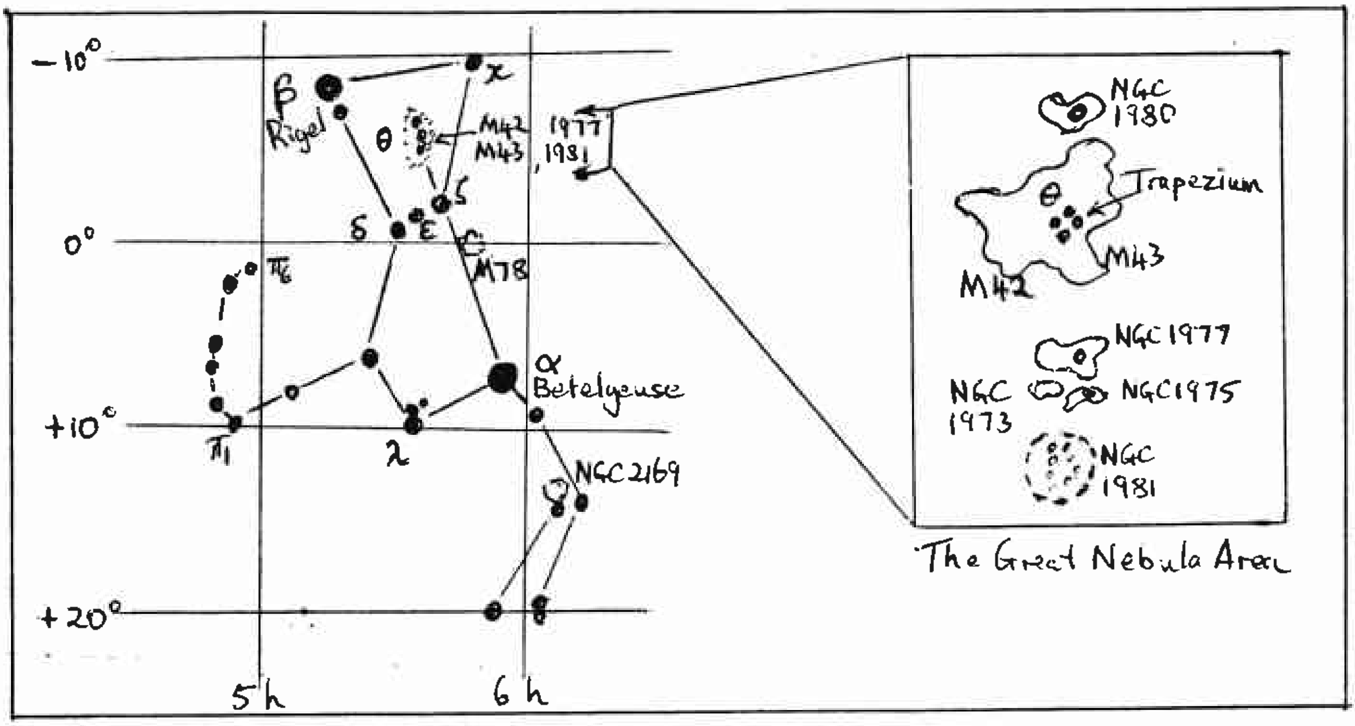
Careful design and a low profile focuser should provide significantly less than 20% obstruction – compare this to the widely used Cassegrain telescope at typically about 30% obstruction.

Next issue: the design for a typical Newtonian telescope, with the pro's and con's of various component choices.

Dick Everett ■

ORION - The Hunter

This constellation was the first to be discussed in Prime Focus, back in February 1996. I think it is a good constellation to end the millenium with.



November to March each year is the time of Orion the Hunter, one of the most magnificent constellations in the sky. In November, we see Orion as a very large constellation about 30° above the horizon to the North East. In later months it will start the night further west.

Because we see it upside down, it resembles a large saucepan with a handle at the top right. Look for the three distinctive bright stars in a near horizontal straight line, and the small group of stars forming the handle. You will also see a bright white star, Rigel, above the 'saucepan' and a bright red star, Betelgeuse, below it. They are part of Orion too.

Now if you stood on your head and saw it as the Northern Hemisphere does, you would see ...the Hunter. The stars depict a tall man with his arms raised, holding some weapon. The three bright stars in line are his belt (the famous Orion's Belt) while the 'handle' is his sword hanging from the belt. Rigel is an ankle, while Betelgeuse is one of his armpits. Quaint!

This is such a striking image that every culture has a story about it, usually to do with national heroes or warriors. Australian Aborginals call him Marigu-Jarn, the hunter who chased the seven sisters in Pleiades. Even J.R.R. Tolkien mentions Orion in his classic Hobbit tales as the 'Swordsman in the Sky'.

One version of Greek mythology has it that Orion was killed by a sting from the Scorpion. You'll notice that Orion and Scorpius are never in the sky together, to make sure he doesn't get stung again. Wise man!

This constellation is full of marvellous stars and nebulae. There are too many wonders to cover in this short article. So tighten your *belt*, get a grip on your *sword*, and here we go...

To quote Tennyson, from 'Locksley Hall':

"Many a night from yonder ivied casement, ere I went to rest,
Did I look on great Orion, sloping slowly to the west."

α **Orionis** is Betelgeuse (pronounced BET'l-jooz) and forms one of Orion's shoulders, though its Arabic name means 'armpit of the giant.' It has an apparent magnitude of +0.5 and is approx. 425 l.y. away. Betelgeuse is a red supergiant of spectral class M2. It is one of the largest stars known. It is so large it would neatly fill the orbit of Mars.

β **Orionis** is Rigel, the ankle of the giant. It has a magnitude of 0.1 and is approx. 1000 l.y. away. Rigel is spectral class B8, a hot blue-white supergiant. Note the colour contract with Betelgeuse. Rigel actually has a 6.8 mag. companion star but it is too faint to spot with a small scope because of Rigel's glare.

δ, ε, ζ Orionis are the three immensely luminous stars that form the Orion Belt. They are members of the great Orion Association, about 1500 l.y. away. There are mag. 2.2, 1.7 and 1.8 resp. They are all giant blue-white stars with prodigious luminosities of 20,000, 40,000 and 35,000 times our Sun.

δ Orionis (the western most of the three) is actually an eclipsing binary star, with both components of the same size and type. It varies in mag. by 0.2 every 5.7 days.

ζ Orionis (the eastern end) is in fact a triple. The main pair are mag. 1.9 and 5.5, with a 2.6" separation. There is also a faint 10th magnitude wide companion

M42 (NGC1976) is the showstopper. The Great Nebula in Orion, and, to quote Burnham: "generally considered the finest example of a diffuse nebula in the sky, and one of the most wonderfully beautiful objects in the heavens." Amen.

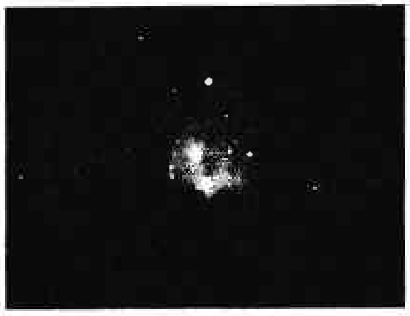
This is a treat to watch in any type of optical instrument. A single misty star (θ Orionis) to the naked eye, the humble binoculars will reveal a hazy nebula about a small starry patch, like fireflies through a fog. As you increase aperture, more detail of plumes and swirls of gas becomes available. Also the famous Trapezium, a group of four stars (θ) believed to be a mere 300,000 years old. In fact, the Nebula is a veritable nursery of new born and proto-stars, adding their luminance to the nebula's glow.

(Photo AAO – used by permission)

Tennyson captured the magic of the nebula when he wrote:

"... *regions of lucid matter taking form,*
Brushes of fire, hazy gleams,
Clusters and beds of worlds,
and bee-like swarms
Of suns and starry streams ... "

M78 (NGC2068) is a patch of nebulosity north of ζ Orionis, around two 10th mag. stars. Though easily located in small scopes, it reveals little detail to the eyeball observer.



NGC1977, NGC 1981 etc.
In the general area around M42, there are many other gaseous nebulae, each worthy of study, but usually overlooked because of M42 stunning show.
eg NGC1977 is just north of M42, around a 4.6 mag. blue giant star 42 Orionis.
NGC 1981 is a nice cluster of about 20 6th mag. stars, found north of NGC1977.

Of course, bringing up the rear is the famous Horsehead Nebula. This is 'found' just south of ζ Orionis, a black absorbing dust cloud protruding into a strip of emmision nebulosity. Alas and alack, this is very difficult to spot with the eye through a scope. Long time exposures for photos are usually needed.

Bob Bee ■

Solar System Basic Data

Object	Mean Distance from Sun		Equatorial	No. of	Mass	Volume	Av. Density	Length of Year	Axial Rotation	Inclination
	x 10^6 km	A.U.s	Diameter (km)	Moons	(Earth = 1)	(Earth = 1)	(Earth = 1)	(Earth Days or Years)	(Days)	to Ecliptic
Sun	-	-	1,392,530	-	332,946	1,300,000	0.256	-	25.4	-
Moon	-	-	3,475	-	0.0123	0.02	0.615	27.32d	27.32	5°08' 40"
Mercury	57.856	0.387	4,879	0	0.055	0.06	0.917	88.0d	58.65	7°00' 00"
Venus	108.132	0.723	12,104	0	0.816	0.86	0.949	224.7d	-243.0	3°23' 38"
Earth	149.492	1.000	12,756	1	1.000	1.0	1.0	365.26d	0.9973	0°0' 0"
Mars	227.780	1.524	6,794	2	0.107	0.15	0.713	687d	1.03	1°51' 01"
Jupiter	777.776	5.20	142,984	16	317.9	1323	0.240	11.9y	0.41	1°18' 28"
Saturn	1,425.983	9.54	120,536	18	95.2	752	0.127	29.5y	0.44	2°29' 29"
Uranus	2,867.760	19.18	51,118	15	14.5	64	0.227	84.0y	-0.72	0°46' 22"
Neptune	4,492.800	30.70	49,528	8	17.4	54	0.322	164.8y	0.67	1°46' 38"
Pluto	5,745.000	39.67	2,302	1	0.003	0.007	0.429	249.9y	-6.39	17°09' 00"