MACARTHUR ASTRONOMICAL SOCIETY Inc.

Journal

PRIME FOCUS

Volume 4 Issue 7 **August 1999**

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PRESIDENT'S REPORT

Hullo fellow astronomy lovers. This is a very brief message because: Currently I'm rushed off my feet at a personal level and; I'm having megga problems with my computer. (Anyone got a 12 pound sledge hammer?) So please excuse the brevity.

It is very pleasing the way MAS has been involved with all the community star nights. The past month has been no exception. It reinforces my view of us as a friendly and community minded Society. Please keep up the good work.

Phil Ainsworth ■

VICE-PRESIDENT'S REPORT

I wish to personally thank our very own Peter Druery for his 'encore performance' of *Amateurs in Education*. I caught the original version when Science Week was on, the sequel last meeting was an extended and amended version of that talk which many people enjoyed.

At this point I also wish to acknowledge the fine efforts of John Rombi and Daniel Ross in assisting me with the Cobbitty Cub Scouts star night. (See story this issue.)

The Cataract night was great chance to meet the Wollongong Amateur Astronomy Club and they made us warmly welcome. Unfortunately, the weather was not so kind and only limited observing took place. However, the viewing of the Jewel Box and ω Centaurii through a 16" Dobsonian was enough to blow away the winter chills.

On our team was our usual Cobbitty crowd including the double star combination of the two Attilas.

I felt a kinship with the WAACERS as they like to be called, and invited them to have a peek at our Cobbitty site, to which MAS returns to complete next month's observing program as scheduled.

I would like to comment on the recent Prime Focus article "Armchair Astronomer Activities". I remember that some time back my interests revolved around 'Star Trek' repeats and old SF movies. I'm not a great reader of books or magazines. I still had an interest in astronomy though, and actually went to a meeting of an Astronomical Society. It did nothing for me, I didn't join and relegated myself back to the armchair.

Now I am a member of this Society and whatever we are doing, it must be enough to maintain one's interest. The membership is now confirmed at 60. Some members don't have telescopes or attend observing nights. Some I've never met! About a dozen are on mail-out and do not attend any meetings. Others are very active and there's everything in between, from receiving a mail-out to astro-photography and super-nova research.

My hope is that everyone is getting something out of the Society. Now here's the bad news: Since I've waffled on too much, the "Return of the Sky Hunter" articles might have to wait a while. In this issue, you will find the review of the Scout night titled "The Moon Wobbles", and a short story "Keeping the Faith."

I also received a phone call from my brother who was concerned about the appearance of the Moon. It looks different! I went outside and knowing it should be rather full, I noticed a good chunk of it missing. "Heavens above." A lunar eclipse! I hung up the phone quickly and raced outside to take some happy snaps. Yes, I stayed clear of the clothes line.

Noel Sharpe ■

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
Phone 02 46474491
e-mail:
eclipse@lightstorm.com.au

ASTRO COMPUTING:
Daniel Ross (02 9790 5838)

AMATEUR TELESCOPE MAKING: Dick Everett
Phone 02 96051564

COBBITTY OBSERVING SITE: Noel Sharpe
Mobile 0410 445 041 for checking field conditions.

TELESCOPES : NOVICE/INTERMEDIATE
Noel Sharpe
ADVANCED: Peter Druery.

ASTROPHOTOGRAPHY:
NOVICE: Noel Sharpe
ADVANCED; Peter Druery

KOSHIGAYA – BLESS YOU!

On 5th August, I accepted an invitation to show off the Campbelltown sky to a group of exchange students from our sister city Koshigaya in Japan. There were 15 students, boys and girls, aged from 16 to 20 years. When you added the adult hosts and some neighbour's families, there were over 30 people queuing up to look through the scope. (A very special thanks to Dick Everett who entrusted his 8" Dob to me for the night.)

What a great night it was, and sadly for everyone, far too short. It was held at a private property in Kentlyn, and apart from some northern glow from Sydney, the sky was dark and clear.

The Japanese students said they don't see any stars from Japan, so were thrilled to see the Australian sky. They particularly wanted to be shown the Southern Cross. Then when I showed them the Jewel Box, they were awed. But when the first girl looked at Omega Centauri, she simply said "Wow! That made it all worth while.

Though half of them spoke little English, the language of the stars spoke for itself.

I'm told MAS is welcome back anytime. As one boy said as he viewed ω Centaurii – Banzai!

Bob Bee ■

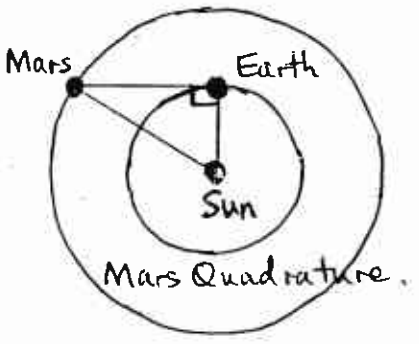
WHAT'S TO SEE THIS MONTH?

16th August – 20th Sept.

Well, I'm sure we all did see the partial lunar eclipse on 28th July, and equally sure we didn't see the total solar eclipse on 11th August (unless you were lucky enough to be travelling in Europe at the time.) But no use crying over spilt eclipses. What's on this month?

Mercury & Venus: Very difficult to view due to the proximity to Sun. best to wait till late September, unless you want to brave the chill in pre-dawn skies to see the mag. –4.5, 40" diameter Venus.

Mars is still shining red high in the sky at mag. 0.2, but setting a lot earlier. It is steadily drifting into the rich star fields of Scorpius. Mars is a long way away, and at a point in its orbit called quadrature. ie the angle between the Sub-Earth-Mars is 90°.



If you have enough magnification, you'll see that Mars is egg shaped (gibbous).

There will be an interesting 2o conjunction of Mars with the globular cluster NGC5897 on 18th August. This will be a comfortable view for binoculars (all international the one field of view). A possible Photo Opportunity for a wide field camera. At this time, it will be in Libra and only 2" arc from the 5th mag. star Iota Librae. A test for higher magnification?

In September, mars moves into Scorpius to have a duel with its namesake, Antares. On 16th september, Antares, Mars and the Moon line up, with Mars only 3° from Antares. Here is your chance to see how Antares got its name – 'The Rival of Mars'. You should be able to get the 6th mag. globular cluster M4, Antares and Mars in one filed of view. Photo Opportunity for a wide angle camera? But before this, on 12th September, Mars will have a 0.3° brush with 7th mag. globular cluster M80 in Scorpius. Definitely a major Photo Opportunity.

Jupiter is rising earlier and at mag. –2.8 is quite a sight. It is approaching opposition in October, so the views this month will be good. On 16th August. Jupiter rises at 11pm and by 20th September will be rising at 8.30pm

If you want to test your powers of observation, check out Jupiter's motion against the back drop of stars. It will become stationary on 25th August, then begin retrograde motion. Here's an opportunity to observe it in action from night to night.

There will be some nice near encounters with the Moon on 1st September (5° apart) and on 27th September (OK, that's next month) only 3.2° apart.

For Moon Dance enthusiasts, the four Galilean moons will be on the same side of the dance floor on: Aug 22 & 28, Sep 3, 4, 6, 13, 17 & 18.

Saturn rises one hour later than Jupiter. The good news is that by 20th Sep, it will be rising at 9.30pm. Like Jupiter, Saturn will start its retrograde motion during this month. If you're keen, you'll skip the rest of this paragraph and go out over the next few weeks and observe the actual date yourself. (For the less keen, it stops its motion on 31s August, then goes retrograde.)

Saturn, like Jupiter, has some soirees with the Moon during September, on 1 Sep (9.5°), on 2 Sep (5.6°). The best is on 28th Sep (only 2.4°).

Uranus & Neptune also have close brushes with the Moon. On 24 Aug, Neptune will be within 1° of the Moon, and on 25th Aug, Uranus is also within 1°.

Constellations:

For those who enjoy cricks in the neck, **Scorpius** and **Sagittarius** are directly overhead. Enjoy the rich star fields that indicate the direction of our galaxy's

central hub. Also enjoy the abundance of globular clusters. About one third of our galaxy's 150 odd globs are located in the trio of **Ophiuchus**, Sagittarius and Scorpius. And there are the popular nebulae in Sagittarius such as Trifid,, lagoon and Omega (Horseshoe).

This is the ideal time for studying Ophiuchus and its multitude of globs, plus a planetary nebular. (See the article re Ophiuchus in this issue.)

Aquila is well positioned. Though there are no exciting nebulae or clusters, it does have a fairly unique **purple** star. It is 15 Aquilae at 19hr, 5m, -4°. The primary of 15 is a 5.4 mag. yellow giant, but it has a 'purplish' mag. 7.2 companion which can be spotted in a small telescope.

Scutum (between Ophiuchus and Aquila) is the home of **M11** (NGC6705) at 18hr 51m, -6°, This is named The Wild Duck Cluster, and open cluster of some 200 stars, supposedly resembling a flock of wild ducks in flight. Visible in binoculars as a misty patch, increasing magnifications yield improved resolution. 100x gives a pretty result.

Capricornus is well placed for Messier hunters to spot **M30** (NGC 7099). You may or may not be aware (I wasn't) that this constellation has been nick-named by some southern astronomers as the "Bikini Bottom". I can see it. Is there a "Bikini Top" up there somewhere? Suggestions will be accepted.

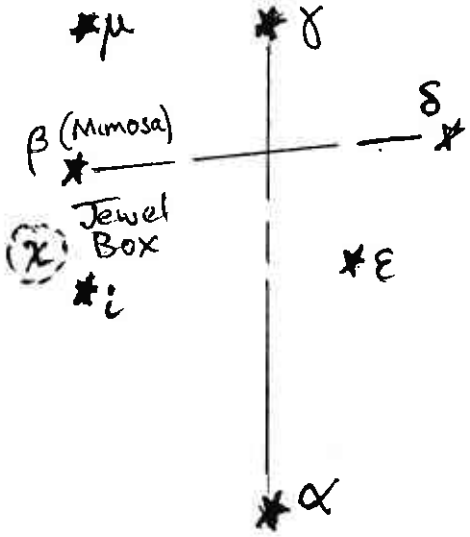
With that uplifting thought...

Good seeing.

Bob Bee ■

CRUX – Southern Cross

Crux is still very visible but getting lower in the South. Now is a good time to revisit it. Obviously R. Bernham never got Down Under as he has very little to say about our favourite constellation.



A few highlights are:

α **Crux** is a very fine double star with highly luminous B-type stars of mag. 1.39 and 1.86. The combined effect is a mag. 0.87 white star, 510 l.y. away. You only need a small scope (or large binoculars) to split it.

β **Crux** is a Cepheid Variable, called Mimosa. It is mag. 1.2, a blue-white giant and 490 l.y. away. It varies by 0.1 mag. every 6 hours.

γ **Crux** is a red supergiant 105 l.y away. It is mag. 1.6 and has an unrelated visible companion of mag. 6.5 which binoculars can pick up.

δ **Crux** is mag. 2.8 and 490 l.y. away. A blue-white star, it is the faintest of the four 'Cross' stars.

ε **Crux** is the "in between" star, mag. 3.6 and 160 l.y away. It is an orange giant.

ι **Crux** is a yellow giant 240 l.y. away. It is mag. 4.7 and has a faint 9.5 mag. companion which small telescopes can resolve.

μ **Crux**. Small scopes or good binoculars can see this well separated pair of blue-white giants. They are mag 4.0 (680 l.y.) and mag 5.7 (550 l.y.).

κ **Crux** (NGC4755), popularly known as **The Jewel Box** is one of the most beautiful open clusters in the sky. A mag. 4.0 star seen by the naked eye turns into an 'A" shaped cluster of at least 50 stars of various colours. A red supergiant (8.0 mag) is surrounded by mostly blue supergiants of 6.0 and 7.0 mag. The name 'Jewel Box', given for obvious reasons, is courtesy of John Herschel. The jewels are safely out of reach at 7,600 l.y.

Bob Bee ■

The Sun –Pt 2

John Casey 25/3/1999

The age of the Earth had now grown to many millions of years, and this represented a problem for the age of the Sun, which obviously could not be younger than the Earth. Physicists began to try to identify an energy source that could fuel such a long life- and could not find any. If the Sun was all coal, it would burn away in less than 100,000 years.

An unlikely contributor, in the 1840's, was Julius von Mayer, a German physician, who took a post as ship's physician on a vessel sailing to the East Indies, where on the trip he had to do the bleeding of patients to purify their blood, as was part of normal medical routine. He was used to cold Europe's different appearance between arterial and venous blood, with lung oxygenated arterial blood being bright red, and purplish blood for the venous blood returning to the lungs. In Java he found that both were bright red, and realised that this meant that the venous blood still carried a lot of unused oxygen, as the body needed less oxygen to stay warm in the tropics. He knew of work by Antoine Lavoisier that showed that warm blooded animals kept warm by a form of slow combustion of food with oxygen, and he made the great intuitive leap, to the conclusion that work, [done by the muscles], heat, including the warmth of the body, and other forms of energy, [such as the chemical energy released by burning food or coal] are all interchangeable- and that work or energy is never created, but instead only transformed from one form to another. For a time this work was ignored.

...converting gravitational energy into heat is one possible source.

Another pioneer of thermodynamics was John Waterston, a civil engineer from Edinburgh, who published scientific papers in 1830s and 1840s, with some on the thermodynamics of the Sun. He stated that if chemical reactions could not supply enough heat for long enough to keep the Sun hot, then another energy source was needed, and that converting gravitational energy into heat is one possible source. Both Mayer and Waterston had considered the energy problem of the Sun, and both had suggested that the Sun might be kept hot by continuous supply of incoming meteors impacting the Sun and supplying their kinetic energy.

William Thomson, of well to do parents and university background, in 1846 took up the post of professor of natural philosophy at the University of Glasgow. He formulated the second law of thermodynamics in 1851, and developed the scale of temperature s starting at absolute zero, at -273 degrees C, that now is named after him -Kelvin-, as he was to become Lord Kelvin for his contributions to science, including his inventions, and the laying of the first successful telegraph cable across the Atlantic. Thomson was aware of Waterston's work, and he did his own calculations. This showed him that there simply could not be enough small rocky objects within the Solar System to provide the energy requirements over the ever increasing age of the Earth and Sun. Even the spiralling in of Mercury to the Sun would only give enough energy to keep the Sun hot enough for 7 years. If Venus was to follow, the Sun's heat would only last another 84 years. If Neptune was to spiral all the way in, the energy would only last some 2000 years! Thus infalling from outside the Sun could not be the answer.

In the 1860s Thomson was able to utilise gravitational effects much better, by considering the actual shrinking of the Sun under its own gravity. Independently, the German researcher, Hemann Helmholz, who was a surgeon at Potsdam, had in 1848 discovered the law of conservation of energy- from investigations into the heat

produced by muscles of animals [similar to Meyer]. This lead him on to other work in thermodynamics, and towards the debate on the Sun's source of energy. He concluded that gravitational contractions could keep the Sun radiating at current rates for 20 million years. Thomson did more calculations, with evidence of Earth's age extending all the time, and showed that the Sun could not be heated for more than 20 million years by gravitational effects, and no possibility of extending this time by a factor of greater than 10, and concluded that "inhabitants of Earth cannot continue to enjoy the light and heat essential to their life, for many millions of years longer, unless sources, now unknown to us are prepared in the great storehouse of creation."

...the Sun could not be heated for more than 20 million years by gravitational effects...

Thomson's calculations showed that the current heat output would require a shrinkage of the Sun's radius of 50 metres per century- not measurable from Earth by nineteenth century astronomers. How much heat is produced, on average, by the Sun? It produces 8.8×10^{25} calories per second, from a mass of 2×10^{33} grams, so it is only necessary , on average, for each gram of the Sun's matter, to produce 4.4×10^{-8} calories per second- far less than the heat you produce in your body by metabolism. Thus the heat output rate is low, but it must be sustained for millions of years, and no known chemical and or physical process could produce even this low rate on such a time scale.

Then, in the 1890s, such a storehouse of energy began to be discovered, when in 1895, Wilhelm Rontgen, a 50 year old professor of physics at Wurzburg University in Germany, discovered X-Rays. This happened whilst he was investigating cathode "rays" [streams of electrons] in an electrical discharge tube. In his darkened laboratory, a paper screen used in another experiment, that was coated with barium platinocyanide, glowed whenever the tube was turned on. This was announced on 1 January 1896, with dramatic evidence of a photograph of human bones seen through living flesh, using these X-Rays. Henri Becquerel was present at the French Academy of Science when this discovery was announced, and he decided to see if other phosphorescent objects could emit X-Rays. Amongst the crystals he set out to test were some uranium salts, including some potassium uranyl disulphate that he prepared 15 years earlier. These salts became actively phosphorescent when exposed to sunlight- they would glow for a while, before fading and needing reactivating by sunlight. He wrapped a photographic plate in two sheets of thick black paper, and lay it in the sunlight with the dish of phosphorescent material on top of the plate. If he placed a coin between the plate and the dish, a shadowy outline of the coin could be seen when the plate was developed. This he thought was X-Rays produced by phosphorescent materials in sunlight. But later he developed a film that had been near the dish, but not exposed to sunlight, and found the same effect. He then found that uranium metal gave the effect, even though it did not phosphoresce- energy was being radiated from the uranium.

After Becquerel's discovery of radioactivity, a pair of chemists, Pierre and Marie Curie investigated various radioactive substances, and in 1899 identified two previously unknown radioactive elements- polonium and radium, and in 1903 shared the Nobel Prize for physics with Becquerel. Both the Curies suffered radiation sickness, and even today their note books are considered too radioactive to handle.

(End of Part 2) ■

FOR SALE

60mm TASCO refractor, 900mm focal length (F15) on equatorial mount with slow motion controls. Has a solid wooden tripod adjustable for height and comes with three 1.25" eyepieces, 2X Barlow lens and an erecting eyepiece for terrestial use.

A 10x finderscope is cleverly built into the main tube and a solar projection screen is included.

Instruction book, observing guide and tool kit rounds out a very complete package.

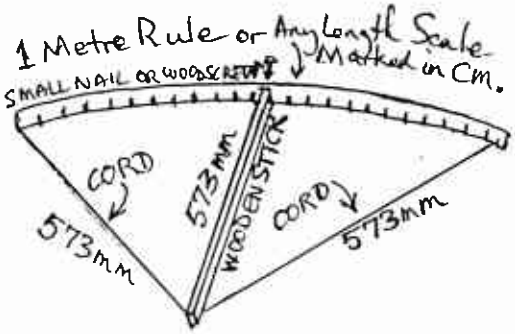
Absolutely as new! Excellent value at $350, but to a MAS member, only $300.

DICK EVERETT
(Ph 9605 1564 A.H.)

FOR THE NAKED EYE OBSERVER

Here's a simple gizmo for determining the angular separation of celestial objects.

To use it, hold the end of the centre stick to your eye and sight off degrees on the scale against the objects of interest. Each centimetre on the rule equals one degree on the celestial sphere.



(See Dick Everett for advice on how to see the stick markings in the dark)

BOOK REVIEW

"Worlds Unnumbered" (The Search for Extra-Solar Planets) -Donald Goldsmith. USA – 1997, 273 pages, $60.

Within a short time, extra-solar planets have made the transition from 'a subject with no subject matter' to a rapidly expanding area of astronomical research, one of the most important in modern astronomy.

In this book, Donald Goldsmith, well known for his ability to write entertainingly about science, described seven ways to find planets around other stars, the manifold implications of the recent planet discoveries (could the new planets harbour life?), the difficulties of observing extra-solar planets, and the prospects for future planet discoveries.

24 colour full-page plates explain matters and techniques for finding extra-solar planets so clearly, even I could understand it. An excellent introduction to the most recent developments in astronomy. A compelling, beautifully written book.

There are only three copies of this book in NSW public libraries. (Liverpool, State Library, and Macquarie Uni.) Order it in your library through the interlibrary loan system.

Enjoy reading.

John Muszynski ■

Official Dates for Cobbitty Field Nights

4/9/99	**11/9/99**
9/10/99	**16/10/99**
6/11/99	**13/11/99**
4/12/99	**11/12/99**

COMING SPEAKERS:

September – Andrew James

October – John Casey

ECLIPSE AT 37,000 FEET

Hi Every one,
I managed to get rostered for the flight from Adelaide to Sydney, departing Adelaide right when the lunar eclipse was starting. We left Adelaide at 0820pm EST. I was hoping that nothing unforeseen would occur to delay our flight. I was the Captain operating the flight and was very excited about the prospect of seeing the eclipse from the air (a bird's eye view).

We took off on runway 23 out of Adelaide to the southwest with a great view of Adelaide and the southern beach suburbs at night. The sky was clear and as we turned

towards Sydney the moon looked fantastic. I climbed a little higher, actually as high as the aircraft was allowed to fly. Before our departure from Adelaide I told the engineers and ground staff about the eclipse so they were pretty excited.

We levelled off at 37,000 feet and at about 8.50 pm the eclipse was looking great. By about 9.30pm I thought it had reached its peak and also its optimum appearance as not only was the shadow on the moon very visible, we could see a very faint shadow over one third of the moons surface. I was told this was not visible from the ground.

Being in the astronomical mood, I addressed the passengers explaining to them about the eclipse and invited any astronomers aboard to press their flight attendant call button and I would arrange for them to come to the flight deck to view the eclipse. Well, this was a bad move on my part as I had 145 passengers on board and I reckon 144 were amateur or professional astronomers (Yeah Sure!). So the flight was hectic as the flight attendants spent about forty minutes shuffling people in and out of the flight deck. Many passengers just used it as an excuse to see the cockpit at night. Can't blame them really!

Anyway it was great observing the thrill that people got doing what amateurs like us do all the time, but they did it at 37,000 feet.

Once we started descending we lost sight of the moon. The sky was lovely and clear, the lights of Sydney finished off a great flight . I only wish I had Bobbie and the kids with me.

Pete Elston.

LUNAR ECLIPSE II

My experience of the lunar eclipse on 28th July was from a more humble height – 10 ft.

I decided, "What the heck, let's do it right". So at 8.20pm I took my cup of tea, my walkman and headphones, binoculars and pad & pen onto the front verandah - one floor up. It was cold.

I have never tried to sketch as I observed before. I have to hand it to those pioneer astronomers, pre photography, who sketched their observations of the Moon, Mars, Jupiter etc. It's not easy. But it's fun.

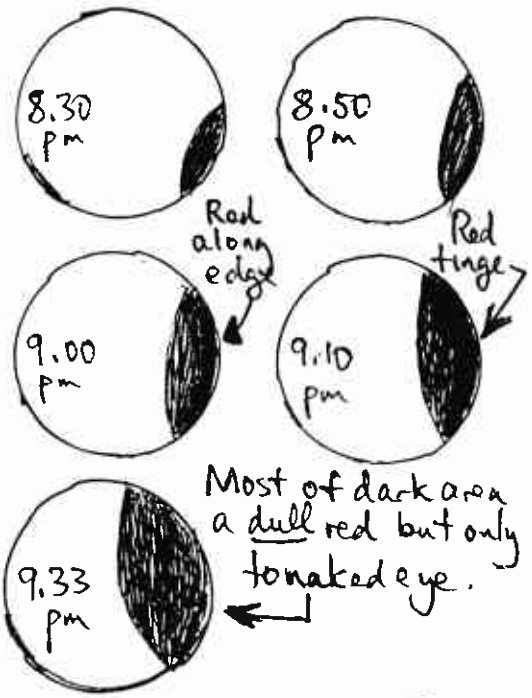
With Pavarotti warbling Verdi in my ears, I watched the Earth's shadow slowly creep across (or more accurately, bite into) the face of the full moon. Every 10 minutes, I made a sketch (under moon light) of my impression of what I saw.

I had stuck my neck out in my Heavens Above! column and said that it should appear a dull coppery red. Thankfully I had covered myself by using Forrest Gump's "like a box of chocolates" line. It wasn't as red as I had expected. We obviously got the nougat, not the Cherry Ripe.

Still, there was some red there, mostly on the outer perimeter of the shaded area. Also, the red was fairly obvious to my naked eye, but reverted to a dirty brown-black in binoculars. Any ideas why, Mr Druery?

All in all, it was an enjoyable (but cold) hour. I called it quits at 9.35pm. I didn't feel the need to watch it in reverse.

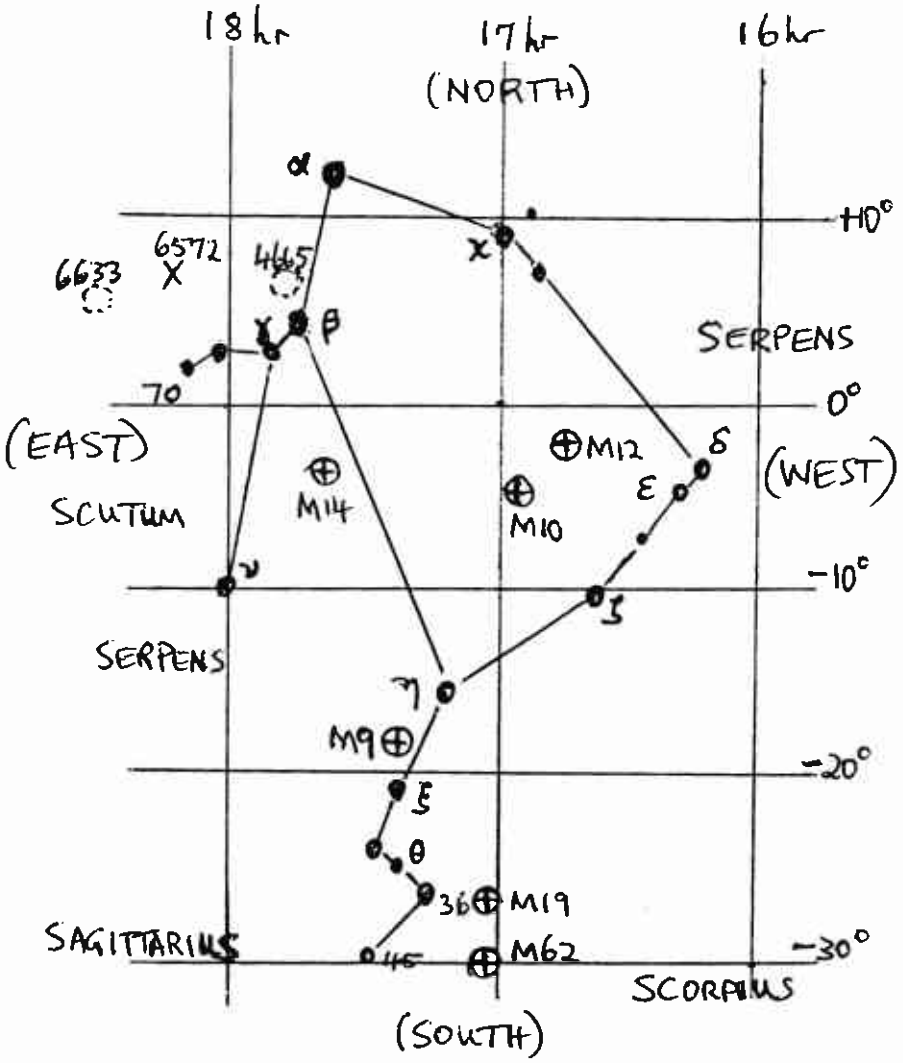
My humble sketches appear below. They don't show anything you don't know, but are an interesting record of my first effort to sit through an eclipse (OK, half way) and draw what I saw.



Bob Bee ■

OPHIUCHUS

The Serpent Holder



Ophiuchus represents the mythical healer, encoiled by a serpent, the symbol of his power to raise the dead. [This used to be the symbol doctors had on their cars until drug thefts became fashionable.]

The snake is represented by the split constellation Serpens which appears on both sides of Ophiuchus.

The constellation itself, at least to the novice, does not have a distinctive easily recognisable shape. The best way to find it is to first find Scorpius and Sagittarius. Bisect them and immediately to their north you will find Ophiuchus. The brightest star, α, is the one furthest from Scorpius and Sagittarius. (ie most northern).

The three stars α, β and γ form an approximately straight line from north to south pointing towards Sagittarius (the Teapot) with β and γ close together (about 2° apart) and α another 8° away.

δ, the 2nd brightest, is about 20° west and 9° south of β. δ, ε and ζ also form a distinctive trio north of Scorpius which act as a sky mark for Ophiuchus.

Ophiuchus has some celebrity stars (not all of which are visible to humble amateur telescopes) as well as some challenging globular clusters.

In fact, Ophiuchus is reported to contain 20 globular clusters, the most found in any constellation. When you consider that Sagittarius and Scorpius contain 17 and 8 resp. (the 2nd and 3rd highest scores), this means the one area of sky encompassing Ophiuchus, Sagittarius and Scorpius contains about 1/3rd of the known globular clusters in the Milky Way. This is probably because that region is the direction of our galactic core and the globular clusters seem to concentrate towards it.

Some of the stars are:

α (mag 2.1), white, 59 l.y.
β (2.8) yellow giant, 110 l.y.
γ (3.8) blue-white, 115 l.y.
δ (2.7) orange giant, 160 l.y.
ε (3.2) orange giant, 125 l.y.
ζ (2.6) blue-white, 550 l.y.
η (2.4) blue-white, 68 l.y.

Some stars of particular interest are:

ρ (rho): a multiple star viewable by small scopes. A close pair of mag. 5.0 and 5.9 can be split by high magnification. But also have wide companions mag. 6.7 and 7.3 viewable in binoculars. A bit of a mixed bag. [16hr 26m, -23°]

70 Ophiuchi is a famous binary star and has been studied closely over the years since its discovery by Sir William Herschell in 1779. Its components, mag 4.2 and 6.0 have been described in many different colours by different astronomers, variously as: yellow and red; gold and violet; gold and rusty orange. See what you think.

Both are dwarf stars and only 16.5 light years away, giving plenty of scope for detailed study of their binary orbit. Perturbations in this orbit has led to suggestions of a third component with a mass about 1% of our Sun. Due to its small size, it has been suggested that it may actually be a massive planet about 10 times the mass of Jupiter. The debate over this continues. [18h 5m, +2°]

RS Ophiuchi is a recurrent nova star. It is one of only a few that flare up to naked eye brightness from otherwise obscurity. Normally 12th mag, in 1898, 1933, 1958, 1967 and 1985 it flared to naked eye level at about 5th magnitude. [17h 50m, -7°]

Barnard's Star: The 2nd closest star to our Sun after α Centauri, Barnard's 'Runaway Star' is only 6.1 light years away. It was discovered in 1916 by E. Barnard, mostly by its dramatic 'proper motion' which is the greatest known. Its annual motion, in a northerly direction, is 10.29" per year, or about 1° in 351 years.

Barnard's Star is a mag. 5 red dwarf, class dM5, with a diameter of 225,000 km (about 1.6 times Jupiter's).

An interesting piece of trivia is that Barnard's Star has an equally large radial velocity (towards the Sun). In 8,000 years time, it will be 4 l.y. away, closer than α Centaurii. [17h57.8m, +4°34'... for now]

The NGCs

M9 [NGC6333] is the smallest globular cluster of a set of four: M9, M10, M12 & M14. At mag 8, it is conveniently found mid-way (with binoculars) between η and ξ Ophiuchi and appears as a small but bright globular. It shows a more concentrated centre than its three cousins. M9 is thought to be one of the closer globs to the galactic centre (7,500 l.y. from it) and is estimated to be about 26,000 l.y from our Sun. [17h 16m, -18° 28']

While you are there, take the time to search the area within 2° around M9. There are a few other globs close by, namely NGC6342 (mag 11), 1.2° to the SE and NGC6356 (mag 8.5) 1.2° to the NE.

M10 (NGC6254) forms a pair with M12. If you imagine a line between β and δ, M12 is found about 1/3rd the way from δ. M10 is about 3.5° SE of M12. At mag 7, it is easily observable (I picked it out easily with my binoculars) and has a bright compressed centre. It is 14,000 l.y. away. [16h 57m, -4°]

M12 (NGC6218) is the 'partner' of M10. Also 7th mag, but a looser structure with no significant central concentration. In a scope, more distinct outliers can be seen. As globs go, it is 'different' and well worth a study. It is 18,000 l.y. away. [16h 47m, -2°]

M14 (NGC6402) completes the foursome. More difficult to resolve (if at all with amateur scopes), at mag 9 it is one mag fainter than M9. It lacks a distinctive central concentration, with distribution generally smooth across its whole diameter. [17h 35m, -3°13']

M19 (NGC6273) is one of the most oblate (ie flattened) of the known globular clusters. R. Burnham gives it a mag. 7 (which is brighter than M10, 11 & 12). It is thought that M19 is imbedded in the galaxy's central hub, and is only 3,000 l.y. from it. I'd be interested to hear from anyone who can spot it and give their

impression of how 'squashed' it appears. [16h59m, -26°11']

M62 (NGC6266), another globular cluster, is strictly speaking in Scorpius, but it is right on the border, so worth looking at while studying Ophiuchus. It can be found about 7° SE of Antares, or about 3.5° south of M19.

It has been described as the 'most comet like' of all the Messier objects. At mag. 6.5 it is a very dense cluster, imbedded in a rich field of Milky Way stars.. It has also been described as a very unsymmetrical cluster (as opposed to oblate?)
[16h 58m, -30°]

NGC6572 is a nice treat, a 9th mag. planetary nebula appearing in medium telescopes like a small green-blue eclipse, estimated to be 2,000 l.y. away.
[18h 12m, +7°]

NGC6633 is a change from the Globs. At last, an Open Cluster! Binoculars will show these 30-odd stars as an irregular scattering, 1000 l.y. away. [18h 28m, +7°]

IC4665, another open cluster, this time about 25 stars of 7th mag. or fainter. Best viewed in binoculars, they occupy a moon-sized area and are about 1,400 l.y. away.
[17h 46m, +6°]

Bob Bee ■

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

It's a great scope to learn on. Very easy to use, with finger touch controls. Even our experienced scope owners are surprised by the views offered through MacDob.

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 form the scope. This goes toward the upkeep of the instrument.

WANTED – A COMET

Remember when MAS first began, we were met with a rash of comets. [Aside: What is the collective noun for comets? A halley of comets? A coma of comets? Suggestions accepted for next issue of Prime Focus.)

After Halley's in 1986 and Shoemaker-Levi 9 in 1994, then Hyakatake and Hale-Bopp... then what? Nothing! Sorry, Messrs Williams and Lee, yours don't really rate up there as crowd pleasers (jealous as I am of your achievements). They were nothing to stop battles or sacrifice virgins over.

So, where are the comets lately? The big ones. The "ooh" and "aah" ones? Apart from Hollywood's 'Deep Impact' and (God help us) 'Armageddon', they've been very thin on the hyperbola lately.

But because of this, I think there is a big one around the corner. The statistics demand it. We've been too long without a decent "Doom Comet" headline, without a fiery chariot for Peter, Frank or Noel to click shutters at.

Is there a rip snorter lurking past the Kuiper belt, waiting to burst upon the Internet?

If there isn't, there Oort to be.

Bob Bee ■

OH BE A FINE GIRL/GUY KISS ME RIGHT NOW SWEETHEART

At last week's meeting, someone asked the question – why are stars different colours? That's a very good question, and cuts right to the core of understanding a lot of astronomy. The colour of a star is not only aesthetic – it tells us a lot about the star.

A star's temperature can be directly inferred from its colour. An exact scientific analysis of the star's light spectrum, using a spectroscope, will give highly accurate temperature values. However, for general purposes, our experiences on Earth give us an idea of how stars' colours change with temperature.

Heat a lump of iron and it will progressively glow a dull red, then a bright red, then orange, yellow and finally, when hot enough, a blinding white. Stars are the same, even though not made of iron. To go further, the tip of a very hot acetylene torch will glow an intense blue. This flame is even hotter than the white hot iron.

So, the coolest stars are red and as they are hotter (their surface temperatures, not their nuclear core), they go through a sequence of orange, yellow-white, white, blue-white and the hottest are blue.

The subject of star spectral classes, luminosities, sizes and masses is a very complex and integrated one. This article deals only in simple terms with Spectral Classes (Colour). A future article will deal with Luminosity Classes (size and brightness.). For further details (which, by the way, are fascinating and rewarding if you can follow the physics), refer to any reasonable astronomy encyclopaedia or reference book.

So, where does the *sexist title* of this article come in?
In order to identify the type of star in terms of its surface temperature, astronomers used letters for progressive ranges of temperatures, starting, naturally, with A. However, as knowledge grew, letters had to be suppressed or added and the sequence of letters changed to its current non-sequential form: O B A F G K M R N S.

In order to remember the order of letters (equal to the progressive order of temperatures from hot to cool), some wit devised the mnemonic:

Oh Be A Fine Girl/Guy Kiss Me Right Now Sweetheart. (You'd never get away with that now – the PC rot has well and truly set in.) Usually, the R N & S are omitted as they are sub-branches of the K and M classes. We are left with the tamer **OBAFGKM.**

Further, each Spectral Class of star can be sub-divided into ten sub-classes. Types O are identified by suffixes 1-5, then a-e. Types B to M have sub-classes designated 0-9.

For example, our Sun is a Class G2 star with a surface temperature of 5,500 deg.C. A G8 star (such as Tau Ceti) would be slightly cooler. Betelgeuse, that reg giant in Orion, is Class M2, while Orion's ankle, the blue-white Rigel is a Class B8.

In the following table, the colour and temperature ranges for each spectral class are shown.

TYPE	COLOUR	TEMP Range °C
O	Blue	40.000- 25,000
B	Blue	25,000- 11,000
A	Blue White	11,000 - 7,500
F	White	7,500 - 6,000
G	Yellow /wht	6,000 - 5,000
K	Orange	5,000 - 3,500
M	Red	3,500 - 3,000

Also, although the colour gives us a sure indication of the star's temperature, it also can give us an idea of the age of the star. Generally, blue and white stars are young, yellows are middle aged, and reds are getting old. However, as in all rules, there are exceptions. And that's what makes astronomy so interesting.

Bob Bee ■

THE MOON WOBBLES

I was feeling a little daunted by our latest foray into the public education arena, this occasion at the request of the Cobbitty Cub Scouts.

I had a plan which required one to be entertaining, informative and very quick. The plan evaporated when we were greeted by a dozen very enthusiastic 6 to 10 year olds all of whom were bright eyed, bushy tailed and full of beans.

John, Daniel and I were made warmly welcome and the youngsters gathered excitedly into a circle waiting with anticipation. My props were assembled into a 'magic box' and drew immediate attention.

The dimensionally scaled version of the Sun, a large orange 'bouncy ball' was immediately confiscated and last seen doing the rounds. The Moon, a golf ball donated by John Rombi almost became a lethal weapon. Improvisation was needed and needed quickly.

Knowing to fight battles one only can win, I declared a halt to the theoretical proceedings and directed the very eager beavers to the observation area.

They descended at warp speed towards the telescopes. However, a wave of the 'magic wand ' halted them in their tracks. Well, it was one of the flashing red strobe torches we use on the observing field to guide the cars in and out. It was totally effective and drew their attention like 'wow Mister, why are you doing that?' 'What's that for, can I have a go?' At last I had control.

I now relayed my orders – children proceed orderly in groups of three and make your way to the telescopes. It worked. The Cubs were well behaved and as keen as mustard.

Just a small example follows of how young children can brighten our souls and completely bamboozle the best of us. Please consider your responses to the following – to assist you along the way, I've included mine.

(Cub) "I go to a Catholic school and the Nuns say that the stars in the sky are heaven."
(My reply) "I think they might be right. The stars are very beautiful and I think Heaven would be beautiful too."

(Me) "I will now aim my telescope at the cluster of stars called The Jewel Box."
(Cub) "It that anything like the thunderbox? We have a thunderbox at the back of the shed and it really smells a lot.
(Me) "The Jewel Box is nothing like that."

Two young Cubs joined forces and played a game of piggy back, and being very unsteady tried to view with the Cub on top trying to look through the finder and the Cub below viewing the telescope.
(Me) "I often piggy back my camera on the telescope and balancing is a real problem."

...YOUNG CHILDREN CAN BRIGHTEN OUR SOULS AND COMPLETELY BAMBOOZLE THE BEST OF US...

What more can I say? If you want to get some much needed perspective on things, then please join us on one of these events. It was a wonderful experience, the cub scouts were well supervised and well behaved. We were generously thanked with the appropriate cub scout traditions.

I've applied only minimal artistic license in this story and you can confirm with John and Daniel. But if I had to pick the most defining moment, it would be this:

Whilst observing the Moon the tripod of the telescope was accidentally bumped and caused the image to vibrate. A very excited youngster announce his discovery to his accomplices, and all and sundry were now tapping the tripod, exclaiming "The Moon wobbles, the Moon wobbles." My reply? "I surrender."

Noel Sharpe ■

KEEPING THE FAITH

The wind was howling and I was shivering. This was a cold winter with frost that greets you in the morning and rain at night to bring you home.

The bed was covered in thick blankets and quilts and looked invitingly warm and secure. Some hot chocolate and naturally a good book.

The cover is well worn, with hand drawn illustrations adorning the aged yellow pages. The subject, of course, is astronomy. It's a cosy feeling holding in your hand someone's painstaking labour, but this is no ordinary book. It belongs to one of our members who has entrusted a family heirloom upon myself, albeit temporarily.

The book was published in 1909 and I'm looking back on 90 years of earthly existence. The book details movements of the earth, Moon and stars across our skies. It also describes planets and nebulae as science knew them international the early 1900s.

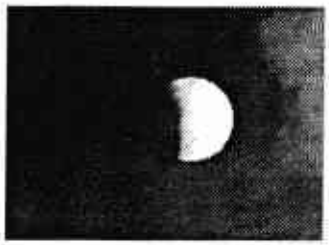
The book is called 'Astronomy' by Sir Norman Lockyer and my kind regards go to George Cruikshank who has given me an opportunity to read it.

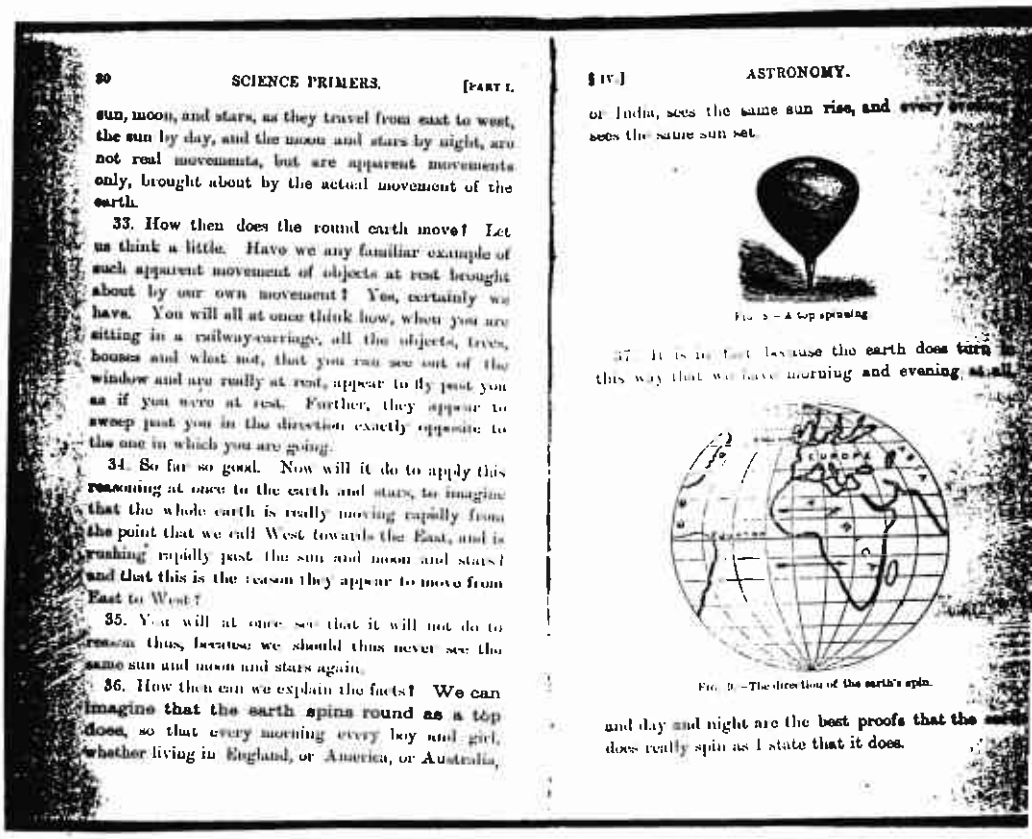
I would imagine few detractors who would disagree that we losing things of value to this computerised, sanitised and homogenised modern way of life in this information superhighway called 1999. Take a break, relax and have a cause to reflect.

Correct me if I'm wrong but I'm yet to hear the expression "curl up and go to bed with a good laptop". It's just not the same. So 'keep the faith' and delete the laptop for a book of your choice next time the wind is howling.

Noel Sharpe ■

Noel's Photo of the Lunar Eclipse (sans Clothes Line)





30 SCIENCE PRIMERS. [PART I.

sun, moon, and stars, as they travel from east to west, the sun by day, and the moon and stars by night, are not real movements, but are apparent movements only, brought about by the actual movement of the earth.

33. How then does the round earth move? Let us think a little. Have we any familiar example of such apparent movement of objects at rest brought about by our own movement? Yes, certainly we have. You will all at once think how, when you are sitting in a railway-carriage, all the objects, trees, houses and what not, that you can see out of the window and are really at rest, appear to fly past you as if you were at rest. Further, they appear to sweep past you in the direction exactly opposite to the one in which you are going.

34. So far so good. Now will it do to apply this reasoning at once to the earth and stars, to imagine that the whole earth is really moving rapidly from the point that we call West towards the East, and is 'rushing' rapidly past the sun and moon and stars? and that this is the reason they appear to move from East to West?

35. You will at once see that it will not do to reason thus, because we should thus never see the same sun and moon and stars again.

36. How then can we explain the facts? We can imagine that the earth spins round as a top does, so that every morning every boy and girl, whether living in England, or America, or Australia,

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or India, sees the same sun rise, and every evening sees the same sun set.

FIG. 8.—A top spinning.

37. It is in fact because the earth does turn in this way that we have morning and evening, as all

FIG. 9.—The direction of the earth's spin.

and day and night are the best proofs that the earth does really spin as I state that it does.

THE PLANETS:

I don't suppose there are many amateur astronomers who are NOT watching this fascinating show on the ABC, Wednesday 8.30m- 9.30pm.

There have only been three episodes so far and those 3 hours of video tape will NOT be erased for quite a while.

This is not only a visually stunning account of our neighbouring planets, but a historical account of the scientists, the politics, the hardware that has made history in the last four decades. Example: ask your friends about the melted lens cap on Venus.

Bob Bee ■

THE 25 NEAREST STARS

	STAR NAME	CONSTELLATION	SPECT. CLASS	APP.MAG.	DIST. l.y.
1a	Proxima Centauri	Centaurus	dM5e	11.0	4.2
1b	Alpha Centauri A,B	Centaurus	G2,K1	-0.01,1.33	4.3
2	Barnard's Star	Ophiuchus	dM3	9.5	6.0
3	Wolf 359	Leo	dM5e	13.5	7.7
4	Lalande 21185	Ursa Major	dM2	7.5	8.2
5	Sirius A,B	Canis Major	A1,dA5	-1.44,8.67	8.7
6	Luyten 726-8 A,B	Cetus	M6e,dM6e	13.0,12.5	8.7
7	Ross 154	Sagittarius	dM4e	10.45	9.4
8	Ross 248	Andromeda	dM5e	12.29	10.3
9	Epsilon Eridani	Eridanus	K2e	3.73	10.7
10	Luyten 789-6	Aquarius	dM7e	12.2	10.8
11	Ross 128	Virgo	dM4	11.1	10.9
12	61 Cygni A,B	Cygnus	K4e,K5e	5.22,6.03	11.1
13	Procyon A,B	Canis major	F5,dF	0.37,10.7	11.2
14	Epsilon Indi	Indus	K5	4.68	11.4
15	Struve 2398 A,B	Draco	dM3,dM3	8.90,9.69	11.5
16	Groombridge 34 A,B	Andromeda	M2,M5	8.08,11.0	11.7
17	Tau Ceti	Cetus	G8	3.5	11.8
18	Lacaille 9352	Pisces Aust.	dM1e	7.39	11.9
19	Luytens=BD+5 1668	Canis Major	dM4	9.92	12.3
20	CD-39 1668	Microscopium	M0	6.69	12.5
21	Kapteyn's Star	Pictor	dM0	8.9	12.7
22	Kreuger 60 A,B	Cepheus	dM3,dM4	9.8,11.3	12.9
23	Ross 614 A	Monoceros	dM5	11.1	13.1
24	BD -12 4523	Ophiuchus	dM4	10.1	13.3
25	Van Maanen's	Pisces	dF5	12.3	13.8

Legend: A,B are the components of a binary or triple star
d (as prefix) = dwarf star
e (as suffix) = emission spectrum.

Note: Due to minor discrepancies in multiple sources used, these values of Spectral Class, App. Mag. and Distance may be treated as 'best average'.

THE 25 BRIGHTEST STARS

	STAR	DESIGNATION	APP.MAG.	SP	DISTANCE l.y.
1.	Sirius	α Canis Majoris	-1.46	A1	8.7
2.	Canopus	α Carinae	-0.72	A9	74
3.	Rigil Kentaurus	α Centauri	-0.27	G2	4.3
4.	Arcturus	α Bootis	-0.04	K2	34
5.	Vega	α Lyrae	0.03	A0	25
6.	Capella	α Aurigae	0.08	G6	43
7.	Rigel	β Orianis	0.11	B8	910
8.	Procyon	α Canis Minoris	0.34	F5	11.4
9.	Achernar	α Eradani	0.49	B3	69
10.	Hadar	β Centauri	0.6	B1	320
11.	Betelgeuse	α Orionis	0.7	M2	310
12.	Altair	α Aquilae	0.77	A7	16
13.	Aldebaran	α Tauri	0.8	K5	60
14.	ACrux	α Crusis	0.83	B1	510
15.	Antares	α Scorpii	0.92	M1	520
16.	Spica	α Virginis	0.98	B1	220
17.	Pollux	β Geminorum	1.15	K0	35
18.	Fomalhaut	α Piscis Austrini	1.16	A3	22
19.	Deneb	α Cygni	1.25	A2	1500
20.	Mimosa	β Crusis	1.28	B0	490
21.	Regulus	α Leonis	1.34	A0	70
22.	Adhara	ε Canis Majoris	1.48	B2	570
23.	Castor	α Geminorum	1.60	A1	49
24.	Shaula	λ Scorpii	1.62	B1	330
25.	Bellatrix	γ Orionis	1.64	B2	470