TAURANGA ASTRONOMICAL SOCIETY NEWSLETTER

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October Meeting

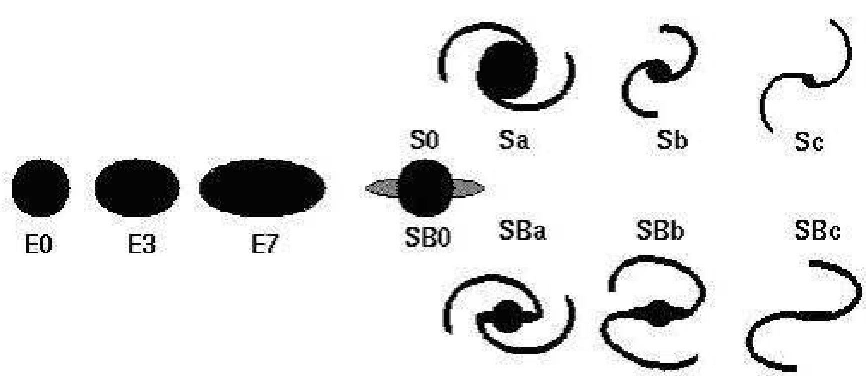
On October 22nd we were fortunate enough to have Roger Feasy from the Auckland Astronomical Society as our guest speaker. His talk for the evening was entitled "A Universe of Galaxies". Due to having a well advertised event the turn out was good with about half the audience being non members. This presentation was an overview of current knowledge on the subject of Galaxies and was aimed at the interested public without being too technical.

Roger began his talk outlining some early beliefs about the universe and speculation that was often based more on theology than actual observation. Leading into more modern times was the work of Edwin Hubble (1889 – 1953), who, using the largest telescopes of his day was able to establish that the spiral nebulae were in fact objects outside of our Milky Way galaxy. Until that time there had been much debate as to whether the Milky Way was the entire universe or were some of the nebulae observed actually other "island universes" in their own right (until this time all faint fuzzy objects were called nebulae, weather they were nebulae, star clusters or galaxies).

The method of observation used was called spectroscopy. In this method a spectrum was taken of the object being observed. The absorption and emission lines of the various elements within that spectrum were then studied. Subtle shifts in the location of known absorption lines within the spectrum were analysed to deduce distance. This shift is caused by the Doppler Effect lengthening the wavelength of light and pushing absorption and emission lines further towards the red end of the visible spectrum if the object is receding and towards the blue end if it is approaching as viewed from Earth. This effect is why a siren receding from you sounds deeper; it is due to the Doppler Effect lengthening the sound waves.

Hubble's work built on earlier observations by Vesto Slipher who in 1912 first measured the Doppler shift in spiral nebulae. Hubble's early calculations put the distance to the Andromeda galaxy (M31) at 900,000 Light years, putting it outside of our galaxy which at that time was believed to be up to 300,000 light years in diameter (estimate by Harlow Shapley 1921). This put an end to what had been known as "the great debate" where scientists had taken sides over whether they believed the milky way to be the entire universe or just one of many island universes.

In 1926 Hubble published a method of categorising galaxies based on their appearance. He started by breaking the galaxies into four basic groups, Elliptical (E0 being spherical through to E7 being elongated cigar shaped objects), spirals, barred spirals (similar to spirals but featuring a central bar) and irregular galaxies. This system for categorising is still in use to this day. We were shown many examples of the different types of galaxies using images taken from both ground based and space observatories.



Hubble diagram showing Elliptical Galaxies on the Left, Spirals Top Right and Barred Spirals Bottom Right

From his observations using the 100 inch "Hooker Telescope" he formulated what became known as "Hubbles Law" in 1929. This gave astronomers an insight into the possibility of an expanding universe, an idea that Albert Einstein had at first rejected when he published his "general theory of relativity" in 1915 (Einstein added a cosmological constant to balance the universe so it neither expanded or contracted in his formulae, he was later to call this one of the biggest mistakes of his life). Hubble had pointed out that the further away a galaxy appeared to be, the faster it appeared to be receding from us. This relationship was constant and "Hubbles Law" involved a value namely the "Hubble Constant" that set the relationship between distance and speed of recession.

One of the great things about this is that it allowed scientists to work backwards, to reverse engineer the universe if you like. An expanding universe of galaxies implied that they were all expanding from something and by working back through space and time the age of the universe could be determined (the fixing of the Hubble Constant and thus the age of the universe was the principle reason for the "Hubble Space Telescope" who's observations have now placed the age of the universe at 13.7 billion years).

Edwin Hubble was an observational astronomer who reported his findings and what they appeared to show. He left the in-depth interpretation of the data to other scientists.

The interpretation of his work was hotly debated and a number of possible models for the universe emerged. Roger outlined some of the old theories such as Fritz Zwickey's "Tired Light" theory and the theory of an "Oscillating Universe". Eventually the mainstream opinion fell into one of two camps. On the one side there was the "Steady State" universe championed by Fred Hoyle which basically contended that the universe was neither expanding nor contracting and has always been how it is. And on the other there was what's become known as the "Big Bang" theory in which the universe began as a single point containing all the energy of the universe that expanded from nothing to form everything that we see it today. The term Big Bang was actually coined by Fred Hoyle in the 1950's and was first used as a derogatory remark.

As more and more observational evidence has come to hand the Big Bang model has become the most widely accepted theory to explain the creation of the universe. It is consistent with Einstein's theory of relativity and received a big boost in 1964 with the discovery of the cosmic microwave background radiation, a prediction made by the theory and its advocates such as George Gamow. It is in effect the afterglow of the big bang itself. This background radiation is not completely even (it is not what scientists would call a "black body" radiation); there are slight differences in the temperature of various points in the sky. This was a necessity in order for galaxies to form and was first mapped in 1989 using the COBE (COsmic Background Explorer) satellite and latter in more detail and with grater precision using the WMAP (Wilkinson Microwave Anisotropy Probe) satellite.

The theory has it that quantum fluctuation within the primordial fireball, that was the universe just after the Big Bang caused some areas to gather more matter than others. In time this clumping led the first generation of stars and galaxies to form. These were comprised almost entirely of hydrogen as it is believed that only small traces of elements heavier than hydrogen were created by the Big Bang itself. Astronomers call elements heavier than helium metals and can use the amounts of metals within a star or galaxy to infer its age.

The science of examining the universe on the very largest of scales has become known as Cosmology and has galaxies as its smallest unit. Roger showed us a number of slides that mapped out the large scale structure of the universe and had been compiled by several very large surveys of the heavens such as the 2DF and the Sloan Digital Sky Survey. These revealed that the distribution of galaxies in the universe is not uniform but forms patterns with strings and voids and looks almost like the structure of a sponge.

The structure of our galaxy was shown in detail as well as the structures of other nearby galaxies that had been imaged by various space born telescopes in ultraviolet, visible and infrared light. There is also plenty of evidence coming out that cannibalism plays a big part in the evolution of galaxies such as ours.

Dwarf galaxies also appear to be numerous throughout the universe and Roger's talk featured images of a number of nearby dwarves, some of which have only been discovered in the last decade or so. Due to their size they are often very dim objects that are difficult to detect.

Roger's slides also had a number of animations within them. The first was a computer generated model of what happens when two galaxies collide. Unfortunately due to technical difficulties we were unable to view this. One animation we did enjoy was viewing the stars circling the black hole at the centre of our galaxy. Current observations suggest that every galaxy has a black hole at its core. A black hole is a super massive object that is very small but has a huge mass. Because of this they have a huge gravitational effect that prevents anything, even light, from escaping it's influence once it has passed the "event horizon". This is in effect the point of no return.

The object has a mass of 2.6 million solar masses and is located in the centre of the galactic bulge. The animation uses time lapse photography taken of the region over many years. One star in particular orbits in an ellipse and really shoots sharply around the point that is believed to harbour the hole.

Galaxies do pose some problems to modern science. Not least of all is the issue of missing mass. Observations and calculations showed that the stars at the outskirts of spiral galaxies were moving too quickly to hold their orbits. They should be flung off into space if calculations of the galaxy's mass are correct, but they don't. The current belief is that the visible material we see and are made up from baryonic matter is in fact only about 10% of the mass of the universe. The rest is so called "dark matter", the current theory has it that most of the matter in a galaxy is in fact made up of this dark matter and it is this that keeps things together.

Roger's presentation was very well received by all who attended. He was great to listen too and was clearly a master of his topic. Roger stayed on at the end to answer questions and expand on some of the topics over the customary cup of tea.

November Meeting

Last November Ted gave us an informative introduction into astrobiology and why complex life may be rare in the universe. Below Ted outlines the factors presented during the talk that were used to support this view.

RARE EARTH FACTORS

Right Time in Universe's History
* The most distant known galaxies are too young to have enough metals* for formation of inner terrestrial planets as large as earth.
* Early included history hazards energetic quasar-like activity and frequent supernova explosions.
* Too few chemical elements needed for life
Star in Right Kind of Galaxy
* Not Globular Clusters
* Although they contain up to a million stars they are too metal - poor to have inner terrestrial planets as large as earth.
* Most solar mass stars have evolved to giants that are too hot for life on inner planets.
* Stellar encounters perturb outer planets orbits
* Not Elliptical Galaxies
* Stars are too metal - poor to have inner terrestrial planets as large as earth
* Solar mass stars have evolved into giants that are too hot for life on inner planets
* Not Small Galaxies
* Most stars are too metal - poor to have inner terrestrial planets as large as earth.
Star in Right Position within Galaxy
* Not in the Centre - Energetic process impede complex life
* Not on outer edge - Many Stars are too metal - poor
* Not in Spiral Arm - Energetic process impede complex life
* Remains near corotation circle
* Low Eccentricity galactic orbit
* Low number of transient radiation events
Right Mass of Star (G Dwarf)
* Long enough lifetime (Several Billion Years) for life to evolve
* Low ultraviolet radiation output
Planet Right Distance from the Star (Goldilocks Zone)
* Allow Habitat for complex life.
* Allow liquid water near surface
* Far enough away to avoid tidal lock
* Allow high oxygen and low CO_2 concentration in atmosphere
Right Planetary Mass (Terrestrial)
* Retain atmosphere and oceans
* Enough heat retained for plate tectonics
* Solid and molten iron core
* Enough sulphur in core to retain molten state of iron to create electromagnetic field to protect from solar winds
Right Crust Composition and Depth for Plate Tectonics
* CO_2 - Silicate thermostat.
* Build up land mass for biodiversity
* Enough chemical elements needed for life
Oceans
* Enough to stabilise CO_2 and temperature

The Right Amount of Carbon
* Enough for life
* Not enough for runaway Greenhouse (CO_2) effect
Atmospheric Properties
* Maintenance of adequate temperature, composition and pressure for plants and animals
* Transparent for Photosynthesis
Evolution of Oxygen
* Product of Photosynthesis.
* Not too much or too little
* Evolves at right time
Biological Evolution
* Successful evolutionary pathway to complex plants and animals
The Right tilt
* Seasons not too severe
Moon
* Large enough
* Right Distance
* Stabilising tilt of Planet
* Right planetary rotation period that avoids chaotic variations in it tilt
Stable Planetary Orbits
* Planets not to close
* Near circular orbits and/or do not create orbital chaos
Jupiter sized Neighbour
* Clear out comets and asteroids
* Not to close, not to far
Low Giant Impacts
* Few giant impacts
* No global sterilising impacts after initial period

This is a re print of an article that I wrote for the Auckland Astronomical Society and was printed in their journal in September 2004.

Zeiss Performance on a Tasco Budget

Well, almost. Do you want to view the splendours of the universe but can't afford a telescope? Or perhaps you are looking for a DIY project that's a little different. Whatever the reason, telescope making is a lot of fun, provides a satisfying and relaxing past-time and with a little care a complete novice can enjoy clear views through good quality optics for only a small capital outlay.

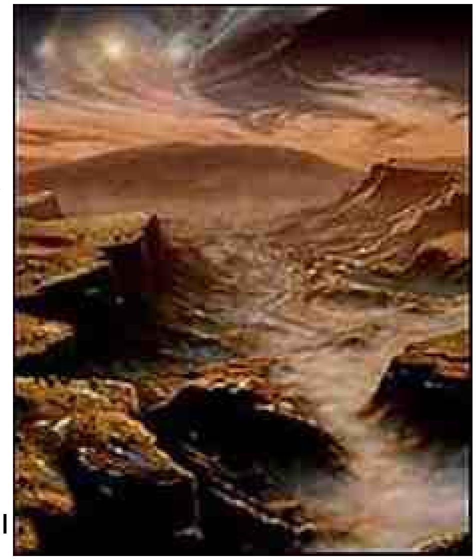
I have to admit that one of my main reasons for making my own telescope instead of buying one off the shelf was cost. I realize that telescopes are now reasonably affordable. However, if I could build an instrument which could perform as well and would cost even less then that was the path I would take.

In January 2003 I started grinding my first telescope mirror. I had read through a number of books on the topic to get a feel for what would be involved then purchased a copy of Tony Dodson's book "How to build a 6-inch Newtonian Telescope". Tony gives an easy to follow description of how to make a 6-inch F9 mirror with a spherical figure. It is a lot easier to polish and test than the parabolic figure found on faster mirrors (mirrors with a shorter focal ratio) and the novice has a high chance of success if they stick to the design parameters set out.

Probably the hardest part of making the primary mirror was finding the materials necessary. On advice from a telescope maker from Christchurch I approached a local glazier for a mirror blank. What's needed is a 155mm diameter disk cut from a sheet of 19mm thick plate glass. The kind of cut required is what adds the cost to your blank. I found that an "Arris circle" is just about perfect for the job. This is a circle with the edges ground smooth and an approximately 3mm bevel around both edges and costs around $25.00 all up for a 6-inch disk.

For a tool to grind against I used a plaster tool which is made from plaster of Paris coated in epoxy resin with a top layer of hexagonal flooring tiles. The epoxy resin is relatively expensive yet the one litre I purchased has allowed me to make three mirrors so far and there is still some left. The silicon carbide grit used for the grinding turned out to be the biggest cost. This set me back approximately $120.00 to purchase 1 kilogram of each grade from 80 through to 600.

The problem is that commercial suppliers don't sell in quantities smaller than a kilogram yet for a 6 inch mirror you only need between 30 and 200 grams of abrasive, depending on what grade you are using. The upside of this is that all that left over material is a great reason to grind more mirrors!



Mirror grinding is covered in detail in Tony's book but I would like to stress it's a straightforward process which only requires time and a little care for a nice smooth spherical surface to be produced

Polishing requires making another base and covering it in "pitch". There are a few suppliers who provide these materials who advertise in the "Sky and Telescope" and "Astronomy" magazines. Unfortunately, they are in America, we're in Aotearoa and freight isn't cheap. However, a good pitch can be made from mixing pine rosin and Stockholm tar. The tar is easy to get and is stocked by Wrightsons farm supplies - a 600ml bottle will set you back the princely sum of $8.00 but the Rosin I found somewhat harder to procure. Luckily a local telescope maker in Mt Roskill was able to give me a small supply (in exchange I was able to give him some tar). I used cerium oxide as the polishing agent and found a spectacle maker who was able to sell me a small amount for $10.00.

After completely polishing out my mirror which took around 20 hours of work, I tested it using a Ronchi screen made from a strip of aluminum and some very fine wire used for rewinding washing machine motors. On first inspection I found a depressed zone but a further 30 minutes polishing had this sorted and the Ronchi screen showed nice straight lines. After testing the uncoated mirror in the telescope I was satisfied that it was ready for aluminizing (coating the polished glass surface with a thin coating of aluminium).

The rest of the telescope was basic Dobsonian. The tube was made from 200mm diameter PVC storm water pipe with a coating of mat black paint with sawdust mixed in to provide an interior coating free from reflections. The focuser uses 32mm PVC waste water pipe as a draw tube. The spider is of the "curved vane" variety and is made from a strip of scrap steel. However, I found that the steel used as strapping on packets of wood is nearly ideal as it is a thin spring steel which naturally forms a nice curve when bent.

The finder is made from an old pair of binoculars which were badly out of collimation and had a reasonable coating of fungus on the prisms. Binoculars like these can be found at garage sales or advertised from time to time in the "Trade and Exchange" and can be purchased cheaply as they are more expense than they are worth to renovate (unless you can do it yourself). The eyepiece from the half of the binocular that is not used for the finder will produce a suitable eyepiece for your main scope once it has been inserted into a modified 35mm film canister.

The wooden parts were all made from Medium Density Fiber board (MDF) and particle board. The bearings throughout are from a scrap of PTFE plastic which was found in a scrap bin at a plastics supplier for $2.00. PTFE is the same plastic that is marketed as Teflon by Dupont and has numerous household and engineering applications.

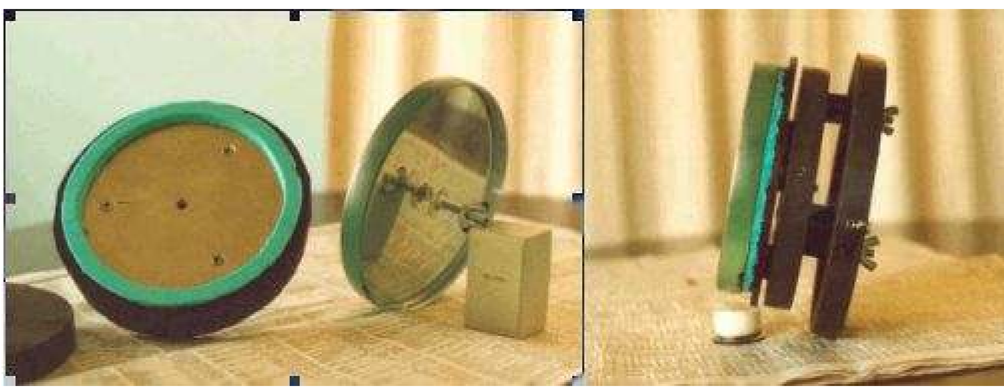
In all the project had cost me around $350.00 from start to finish and had taken about four months though I had lost a lot of time trying to find materials. Incidentally my second project a 6-inch F4.5 cost just over $100 from start to finish using left over materials from my first effort.

After a lick of paint and final assembly the scope was ready to see "first light". Luckily I had managed to complete the project with a whole day to spare before the May 2003 Waharau dark sky weekend. So how did it perform? Well the deep sky views totally surpassed my expectations especially when used with a high quality eyepiece borrowed from another observer. The views of the eta Carinae and Tarantula nebula were fantastic as were the globular clusters omega Centauri and 47 Tucanae. I was really happy with the results of my efforts and a lot of that satisfaction came from the fact that these great views were from an instrument I had fashioned with my own hands.

About the only room for improvement that I noticed early on was that the planets were not as clear as they could be. Jupiter showed its four major moons and belts but they were poorly defined and looked a bit mushy; Saturn showed its rings and the Cassini division could be made out with a bit of imagination. Then, in November 2003, I had one of those Eureka moments.

This came after reading an article in that month's edition of "Sky and Telescope" magazine by Ernie Pfannenschmidt. The article was called "An Inexpensive Micro flexed Newtonian Reflector" and outlined how a spherical mirror could be modified into a parabolic figure by using a machine screw bonded to the back of the mirror to mechanically flex the mirror. The article noted that this simple flex technique works best on mirrors with slow focal ratios (an F9 mirror is a slow mirror; an F4 is a fast one). After reading the article I was confident that this technique would improve the views through the 6-inch F9.

First-up was to gather the necessary materials. An off-cut of 5mm thick aluminum plate purchased from a sheet metal workshop for $5.00 would form the base of my "flex cell", an M6 machine screw and wing nut would provide the tension needed on the back of the mirror, and a ring of 7mm thick foam rubber 10mm wide was cut to form the support ring for the mirror. To bond the machine screw to the back of the mirror I used Super Strength Araldite. This is epoxy glue which takes three days to cure but is more than strong enough to handle the job. The whole thing was completed in a morning with the exception of waiting for the glue to cure.



The unassembled and assembled flex-cell and mirror

So did it do any good? You bet! The Cassini division in Saturn's rings looks clean and sharply defined as well as plenty of cloud belts and pole darkening clearly visible. Jupiter also shows more detail, the Great Red Spot can now be found and there is detail within the bands.

And what did I learn? If I had intended to make only one telescope it would probably have been easier to purchase a "Mirror Kit" from the USA which includes the mirror blank and tool, grit, pitch and polishing agent. This would have saved a lot of running around trying to find materials and may have been cheaper than buying in bulk. Talking to people also helps. There are some really talented telescope makers around and the ones I have dealt with have been more than happy to offer advice and help as required. Also money saved on telescope construction can be spent on purchasing good quality eyepieces as these make a huge improvement in the image. And finally, with a little effort anyone can build a telescope that will give you fantastic views of many astronomical objects for a fraction of the cost of purchasing one.

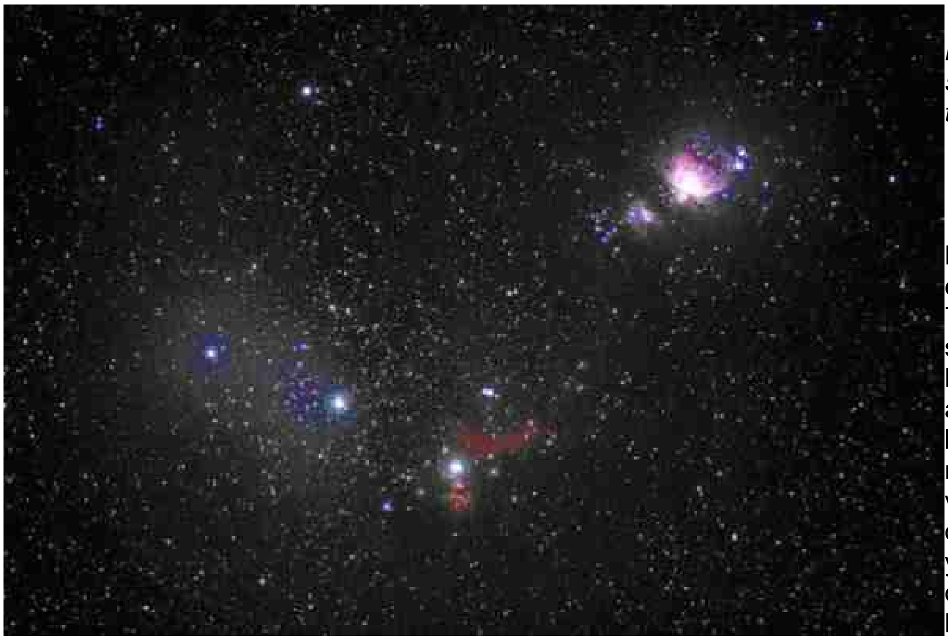
Constellation up Close: ORION

For me the appearance of the constellation of Orion in our evening sky heralds the start of summer. This constellation is large, bright and easily recognisable. It also holds some bright deep sky objects that are available to even the smallest telescope or binoculars.

The familiar pot asterism was the first introduction I had as a child to learning my way around the night sky. I remember at a very young age my father pointing out the three bright stars of Orion's belt and being shown how they formed the base of the pot with the stars that form Orion's sword making up the pot's handle. It was only later when I had read a few books and learned that the pot was only an asterism that formed part of the larger constellation of Orion.

While the sword of Orion, or the pot's handle, appears to be made up of three stars the middle one is in fact a bright nebula. This was number 42 in Charles Messiers 1781 catalogue and is also referred to as the "Great Orion nebulae" in some literature. It is a great sight in even the smallest telescope; even in light polluted sky's it seems to spread a pair of wings or arms outwards from a brighter central region. From a dark sky these areas form delicate tendrils of gas that spread out like wisps of smoke. This nebula is a stellar nursery where new stars and probably planets are forming. The illumination for this nebula comes from the young stars recently formed within.

Closer study of the central region will show a tight cluster of four bright stars within. This grouping is called the "trapezium". If seeing allows and you are using a telescope try to crank up the magnification on this target. When seeing allows, using around 200 x magnifications on the 10inch scope, I can clearly see six stars hovering within the misty depths.

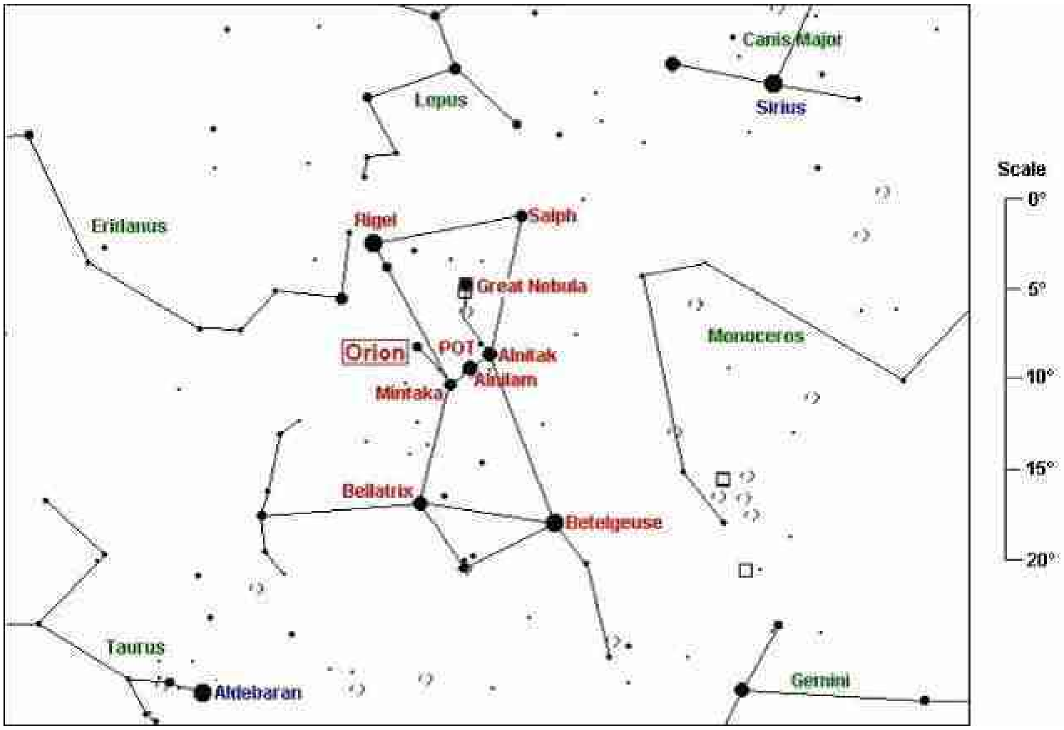


This fantastic wide field photograph by Hamilton Astronomer Dave Brock, shows the "Pot" asterism as well as the nebulae discussed in this article.

But don't think you need a telescope to enjoy this object. Through a pair of 7x50 binoculars the nebulae clearly shows its structure. These objects are best enjoyed if the binoculars are held as steadily as possible. I find that leaning them against a post or similar rigid support helps greatly when viewing at low to mid altitudes. For objects higher up in the sky try lying on your back looking up. Rest your elbows on your stomach for support. This beats craning your neck up which is something I find I can not do for long, just make sure you use a ground sheet or similar to protect yourself from the dew.

Another bright nebula for telescope owners to enjoy is NGC2024 also known as the flame nebula. This nebula is aptly named as the dark regions within the brighter nebulae give it the appearance of a flickering candle flame. This nebula shows a lot of detail to a six inch scope from a dark sky site. It is a worthy target from Tauranga but will lose some of it's impact due to light pollution. This nebula is close to the bright star Alnitak (zeta Orionis) which is the easternmost star of Orion's belt. If you are fortunate enough to have access to a large telescope you will be able to hunt this area for the elusive "Horse Head Nebula" This is located on the other side of Alnitak from the flame nebula. I have only observed this through an eighteen inch scope using a Hydrogen Beta filter; it is worth mentioning as it is such a famous object.

Orion is home to several very bright stars including Rigel and Betelgeuse. Rigel is the brightest star in the constellation and is located 773 light years from us (as measured by NASA's Hipparcos satellite). This is a supergiant star with approximately 17 times the mass of our sun. It is also a double star with Rigel B having a magnitude of 6.7. Good seeing and medium to high magnification is required to separate the companion from Rigel's glare. Also associated with Rigel is the reflection nebula IC2118 also known as the "Witch head" nebula. I have seen photographs of this object but have not observed it myself yet.



Betelgeuse is a Red Giant located some 427 light years from earth and is the second brightest star in Orion. It has been given the designation of Alpha Orionis but due to its variability Rigel is brighter more often than not. It has a bright orange colour to the eye and is very conspicuous in the summer sky. This star was the first to have the diameter of its disk directly measured. This was done by a technique known as interferometry and was conducted by Michelson and Pease using the 100 inch Mount Wilson telescope in 1919. They measured the disk as being a massive 240 million miles in diameter.

Due to the large number of bright stars within its border Orion is a very conspicuous constellation. It holds targets for both the novice and more experienced observers alike. With the nights being mild and warm at the moment, take advantage and spend some time looking up. If you're new to star gazing Orion is a great place to start!

A word form the editor

Well 2007 was a very good year for Astronomy, highlights for me were Comet McNaught in January and a very eerie total eclipse of the moon in August. I have also enjoyed writing about them for the Tauranga Astronomical Society Newsletter. If you feel you would like to contribute an article, image, poem or anything else for the newsletter please feel free to email it to me at andrew32walker@yahoo.com

I look forward to any contributions you may wish to make.

Regards

Andrew Walker

BACK PAGE

The Tauranga Astronomical Society holds a monthly meeting on the fourth Wednesday of each month at the Otumoetai Soccer Club rooms, Fergusson Park, Tilby Dr, Matua. The meeting begins at 7.30pm and all are welcome.

New comers are invited to attend two meetings free of charge, however, after this a charge of $5.00 per meeting will apply if membership of the society is not taken up.

Current membership fees are below and may be paid to the treasurer on any club night.

Full Time Student $15

Ordinary Membership $20

Family $30

Meetings consist of a presentation of roughly one hour either by a society member or an invited guest on an astronomical subject. After light refreshments this is followed by viewing through one of the society's telescopes, weather permitting, or the screening of an astronomical DVD.

The Tauranga Astronomical Society Newsletter is published quarterly each January, April, July and October. The editor welcomes contributions from members provided they are on an Astronomy related subject and are original. Articles for the newsletter may be submitted electronically by email too: andrew32walker@yahoo.com

T.R.O.G (Tauranga Roving Observers Group)

TROG is a list of persons interested in observing from a dark sky site. We have been currently meeting approximately once a month at the editor's home in rural Te Puke. Another location previously used is Bell Road Papamoa and other sites are welcomed.

If interested in observing contact either Ursula Macfarlane 5767283 or Andrew Walker 5738550. The group is informal and no previous experience is required. Just bring along a telescope or binoculars if you have them, any star charts you might need and your enthusiasm.

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