NOVA
NEWSLETTER OF THE VANCOUVER CENTRE RASC
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2015 International Astronomy Day @ SFU

by Suzanna Nagy

8,000 – that is how many people SFU estimates attended the joint International Astronomy Day and Science Rendezvous festivities on Saturday, May 9. If you were there, then you know what a great success it was.

RASC's contribution to the day included 19 tables of activities and displays. The Moon Phases with Oreo Cookies was so successful that I had to make a run to the nearest grocery store to buy more Oreos. One of our craft tables ran out of paper by the end of the event. The Solar System Toss to Pluto was a huge hit and Astronomy Bingo was enjoyed by both children and adults alike.

We hosted seven short lectures that were well attended with a good variety of topics, including "New Horizons and our First Visit to Pluto" by Scott McGillvray, "Are We Alone? The Search for Extra Terrestrial Life" by Stanley Greenspoon, "The Global Space Community" by Ken Lui, and Ed Hanlon's Northern Lights slideshow to name just a few.

The Chan family, winners of the Dobsonian door prize at Astronomy Day, with Suzanna Nagy

The weather was spectacular (the first time in 3 years we did not have rain on Astronomy Day) and RASC took full advantage with three solar telescopes set up beside the new Trottier Observatory for solar viewing.

A big thank you goes out to Vancouver Telescope and Pacific Telescope who donated an 8 inch Dobsonian as a door prize. The winner was the Chan family with children Carina and Colton from Burnaby, BC.

Canadian Telescope also donated solar viewing glasses, umbrellas, and binoculars which were given away throughout the day.

I can never thank our volunteers enough for all of their efforts. 40 RASC volunteers gave up their Saturday, many of whom were

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JULY 9 **SFU**
Vancouver Centre's Ian McLennan: What's New Out There... Science Centres and Planetarium Projects in the 21st Century. SWH10081 (see Meetup). SFU

NO MEETING IN AUGUST

SEPTEMBER 10 **SFU**
Speaker TBA. Watch Meetup for details.
SFU

Members' Gallery

Jupiter/Venus Conjunction over English Bay by Gordon Farrell

Jupiter and Venus in a close embrace in the evening sky as they set over the ships anchored off English Bay on June 30th.

Vice-President's Message

by Suzanna Nagy

The summer months are now upon us. We hope that you are enjoying the amazing hot weather and clear nights that we have been experiencing.

Your Vancouver Centre has been rather quiet for the past month in regards to evening public events. This is due to the fact that in the months of June and July, the days are too long and the evenings not dark enough to warrant a large planned public observing event.

Having said that though, there have been and will continue to be impromptu evening observing sessions held and we hope that you will continue to join us for those.

Our next pre-planned evening public event will be on Saturday, August 8 and the event will be two-fold. Firstly, we will enjoy the annual Perseid meteor shower

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About RASC

The RASC Vancouver Centre meets at 7:30 PM on the second Thursday of every month at SFU's Burnaby campus (see map on page 4). Guests are always welcome. In addition, the Centre has an observing site where star parties are regularly scheduled.

Membership is currently $78.00 per year ($45.00 for persons under 21 years of age; family memberships also available) and can be obtained online, at a meeting, or by writing to the Treasurer at the address below. Annual membership includes the invaluable Observer's Handbook, six issues of the RASC Journal, and, of course, access to all of the club events and projects.

For more information regarding the Centre and its activities, please contact our P.R. Director.

NOVA, the newsletter of the Vancouver Centre, RASC, is published on odd-numbered months. Opinions expressed herein are not necessarily those of the Vancouver Centre.

Material on any aspect of astronomy should be e-mailed to the editor or mailed to the address below.

Remember, you are always welcome to attend meetings of Council, held on the first Thursday of every month at 7:30pm in room P8445.2 of the Physics wing of the Shrum Science Centre at SFU. Please contact a council member for directions.

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Trustees Pomponia Martines
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Library

The centre has a large library of books, magazines and old NOVAs for your enjoyment. Please take advantage of this club service and visit often to check out the new purchases. Suggestions for future library acquisitions are appreciated.

On the Internet

http://rasc-vancouver.com or
http://www.rasc.ca/vancouver
http://astronomy.meetup.com/131/
http://www.facebook.com/RASC.Van

@RASCVancouver

Mailing Address

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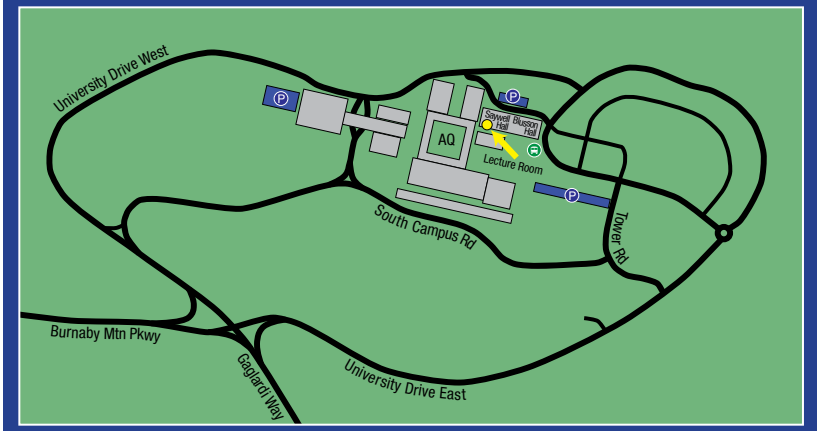
Map to Meeting Site



SFU

Our May, June and July meetings are in room SWH 10081 of Saywell Hall, indicated by the arrow on the map.

Pay parking is available at several locations around campus (indicated as "P" on the map).

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at the joint Metro Parks/ RASC event at Aldergrove Regional Park. Check out our page at Meetup for more details.

Secondly, the August 8 event will be held in conjunction with our sister astronomy club—the Astronomical Association of Jamaica. The Jamaica club will also be observing on the evening of August 8, and afterwards our two clubs will share details and photos. Your Vancouver Centre was paired with the Astronomical Association of Jamaica in February of this year through the Astronomy Without Borders Pairing Program. To date, our communications have been restricted to email and Skype but with this first-ever joint observing event, we hope to solidify this pairing.

If you haven't already, please join the Vancouver Centre Meetup group for email notifications of all of our events at www.meetup.com/astronomy-131. ✸

Clear skies,
Suzanna Nagy
Vice President

cartoon by Dan Collier

Antares: Red Heart of the Scorpion

by Bill Burnyeat

Thomas Hardy tells us each tree has a voice in addition to a look, sings to the woodland rambler a tune, creaking or wishing or trembling mournfully under pelting rains, furious or dry breezes. Trees communicate their floral happenstance, now happy and well drained, or fretful, overwatered, then desiccated, undercut or endangered by season and circumstance.

Antares (centre-right) with bright globular M4 above it and smaller NGC 6144 between them and to the left

Image by Rudy (rudynix)

Stars engage sky watchers with similar narratives. Each summer as Orion and the Bull of winter decline westward, with dirges of regret, the Scorpion joyfully arises to the hum of dragonflies. Up he comes, claws first, his long tail dragging a row of gems along the southern horizon. His upward voyage from the unapproachable horizon, mimics emergence from hidden underground chambers where real bugs, reptiles and crawling things are born and creep from filthy nests and eggshell hovels into the bright air above.

The Scorpion sniffs the summer air, and to celebrate, the bright star Antares shows off. It twinkles and seems to be turning in the sky, attempting to throw off colours to the sound of a violin's "e" string, a high-pitched announcement that the buzzing, humming and droning sessions of summer are at hand. The chatter can be taken in by sitting at any woodlot pool or ditch. Remain quiet and listen. These sounds are the orchestration of Scorpio. For this is the music of the spheres, the tones and exhalations of the galaxy and all its constellated inhabitants. This rustle points to the elation of summer; a constellation-led parade of bright lights will enter, as the somber tones of the winter sky flee away.

Antares is the most reddish of all the bright stars. The star sits low in the south from latitudes of Canadian summers yet its bright glow, like a small coal or ember from the

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Membership has its Privileges!

New members, did you know? The Vancouver Centre has several telescopes available for loan free of charge! We have telescopes ranging from 60mm to 10" in diameter. For more information see the Director of Telescopes after the members meeting. The loaner period is for one month, to be returned after the next meeting. Telescopes are not allowed to circulate outside of these meetings. You can now reserve two different telescopes per year and use what is left at the end of the meeting anytime.

Your greatest opportunity as a member of the RASC is to take advantage of the company of other enthusiasts to increase your knowledge, enjoyment and skill in astronomy.

The best thing you can do to gain the most from your membership is to get active! Take in the club meetings; engage other members with questions; come out to observing sessions (also known as "star parties"), and, by all means, volunteer to take part in our many public events.

For the usual observing sites and times, visit our website at http://rasc-vancouver.com/observing-sites/ or contact the Observing Chair at observing@rasc-vancouver.com.

Upcoming Events

August
8 – Perseid Meteor Shower Watch at Aldergrove Lake
8 - 16 – Mt. Kobau Star Party
15 – Starry Night at Deas Island Regional Park

September
Sept. 11 - 19 – Merritt Star Quest

December
10 – AGM

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there all day—some arriving as early as 9:00 am to start setting up and stayed until 6:00 pm for take-down. I wish to acknowledge their efforts by naming each here:

Staff at Vancouver Telescope

Staff at Canadian Telescope

UBC Astronomy Club and Ronan Kerr

Planetary Society and Ken Lui/ Catherine Lui

Karl Miller, Gordon Farrell, Doug Montgomery and their solar telescopes

Howard Trottier for opening up the Trottier Observatory for tours

Ted Stroman for his Moon and Apollo Mission display

Jim Bernath and his hands-on science displays

Adrian Mitescu, Phil Lobo, Pomponia Martinez and Bob Parry for helping Jim Bernath at his six display tables

Mark Eburne and his Light Pollution display

Stanley Greenspoon and Sarang Brahme at Craft Table #1

Benjamin Joseph and his son Mark as well as Jennifer Kirkey at Craft Table #2

Judy Zhou, Anca Datcu-Romano and Irena Datcu-Romano at the Moon Phases/Oreo Cookie activity

Scott McGillvray at Astronomy Bingo

Eimi Anazawi and Samer Aabedi at the Solar System Toss

Alan Jones who coordinated all seven lectures

As well as Muguette McDonald, James Smith, Kyle Daly, William Fearon, Ron Jerome, Michael Levy, Terry McComas, Jeremy Van Den Driesen and Leigh Cummings.

I don't think that I missed anyone but in the event I did, please accept my heartfelt thanks.

And finally, a very special thank you to Simon Fraser University and its amazing staff for allowing RASC Vancouver to hold International Astronomy Day in the Academic Quadrangle and all fees waived. A special relationship has developed between RASC Vancouver and SFU and with the opening of the Trottier Observatory, we are looking forward to many more years of astronomy-related activities at SFU.

From my lips to God's ears—here's hoping for many clear-weather night skies. ✸

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fire, caught and lifted by the wind, coming to rest in the Milky Way by some unaccountable way has come to rest in the middle of the air. The constellation seems to refer to the Scorpion Men, in the mythical world of the ancient near east.

The Scorpion Man motif got me thinking about the horizon which the Scorpion is said to guard. Could the sign have been more near the desert ground in the far off times of the ancient world? To settle the matter, I set the latitude adjustment of the planetarium at the British Columbia Institute of Technology to 35 degrees north. Next, I turned the precession control, slowly for it feeds a rather old and crotchety cable, and in seconds the star field—to the tune of a whirl of unseen fittings—was moved back 5000 years. The stars themselves don't move relative to one another. Instead they all move against the grid of solstices, equinoxes and other circles that describe position on the Celestial Sphere. This is what is meant by the precession of the equinoxes.

When the stars came to a halt, I inspected the new sky. To my surprise the scorpion was higher and not lower in the sky than today. Orion, on the opposite side, is depressed in position. A little exploring reveals that five millennia ago the Southern Cross, beneath Scorpio, would have risen enough to have been seen perched on the horizon from southern Ontario.

One item, not usually explored for its seemingly obvious nature, is how we come to see a bright star. Antares

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Astronomy Taboo

by Scott McGillivray

There are certain questions you just shouldn't ask. I learned this as an 8-year-old at a Thanksgiving dinner when I asked my extended family which religion is correct. 10 years later came the most important day of my life (according to my parents), the day my first voter's package arrived. "*Everyone has to vote, it's the most important thing you can do!*" Voting isn't easy, especially when you're 18. We're under a constant barrage of reasons not to vote for each candidate. Should I just not vote then? I couldn't let my parents down, so 18-year-old me decided to seek advice from some veteran voters. Again, Thanksgiving dinner... "*Who should I vote for? Who are you voting for?*"

I've always considered astronomy a safe haven from these passionately debated questions. There are all sorts of wonderful theories and nothing is out of the question until proven otherwise by science. In this information age, we can check Wikipedia or our favourite stargazing app for fast facts. Astronomers still have our grey areas, like what telescope is best, but we aren't dividing families over Dobsonians versus refractors or astro-photography versus a night at the eyepiece. There is, however, that one question that you just shouldn't ask or the star party will come to a grinding halt – is Pluto a planet?

Pluto's history began in 1930. Everyone thought the solar system was a big vacuum with 8 large spheres orbiting the sun and a few hundred rocky bits somewhere between Mars and Jupiter. But the movement of Neptune wasn't quite right. Astronomers from a century ago theorized a "Planet X" was responsible for subtle irregularities in Neptune's orbit. Clyde Tombaugh, a young astronomer fresh from university, was tasked with finding this 9th planet. Tombaugh had the monotonous job of scanning thousands of pairs of sky images, looking through millions of stars for that one tiny dot that had moved. Somehow, after a full year of searching, he found Pluto, an object extremely small and moving so slowly it must have been outside the orbit of Neptune. Pluto was thought to be approximately earth sized, much larger than Mercury, however not large enough to be Planet X. The attention of the astronomy community focused beyond Neptune as many astrophysicists believed there could be tens, hundreds, or even thousands of very distant planets yet to be discovered.

Over time, advances in astronomical methods and technology constantly change our perception of the cosmos. In 1978, Californian astronomers using more powerful telescopes discovered Pluto had a moon (Charon) which was not much smaller than the planet itself. This meant the actual planet was significantly smaller than originally measured and much smaller than Mercury and the largest asteroid, Ceres. As better telescopes were built and more bodies discovered, the astronomy world realized the solar system beyond Neptune was teeming with tiny objects orbiting the Sun.

The straw that broke the camel's back was Eris. In 2005, Michael Brown discovered an object much larger than Pluto, Ceres, and Mercury. It had an elliptical trans-Neptunian orbit 44 degrees inclined from most of the solar system and its aphelion (furthest point) was a whopping 97 AU, almost exactly twice the aphelion of Pluto. Was Eris another planet? Surely there would be many more of these planet-sized objects lingering in the furthest depths of the solar system. Anyone's kid could name the 9 planets but nobody could say what a planet actually was. The onus was on the International Astronomical Union.

The IAU was established in 1919 with a mission to protect the integrity of astronomical science. Composed of nearly 11,000 astronomy researchers at the PhD level with national representatives from 73 countries, the IAU holds a general assembly every 3 years. Among their responsibilities is defining the rules for designating and naming celestial bodies and their features. In August of 2006, The IAU gathered in Prague for their regular general assembly with the high profile task of defining a planet.

The first draft for planetary definition did not exclude any current planets, but added Ceres and Eris. However IAU voters feared modern telescopes would discover

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is so far away that its apparent size is less than 0.05 arc secs. Imagine Antares to be the size of a ping pong ball. Then, its rough distance, to maintain the size/distance scale is no less than 150 kilometres. Can you see a ping pong ball at this distance? The star is too small to be seen. Yet it is seen. Bright objects like street lights or lights on towers can commonly be seen at night although the object producing the radiation is very small. Looking eight to 10 kilometres across the inlet where I live I can see traffic lights changing from Green to Red. By day, looking at the same scene, they are not visible. The size of the light, as I recall from memory, is about a third the diameter of an apartment building window. Of course, the traffic light is much smaller, so what is going on?

It is not the object itself, but, what we might call its "light signature" that is seen. The star is too small to be viewed and, if they were not luminous, the sky would be empty of objects except Sun and Moon. It was Galileo who first noted that the stars can seem exaggerated in size. He said the star had an "adventious ray" or a kind of topping like a hat which gave a bigger account of itself than the real case. This was a bundle of light that exaggerated the star's size making nonsense out of supposed estimates of the stars bulk. This cap, much bigger than the star, is called the Airy disk. Named for George Biddell Airy (1801-1892), an English astronomer and mathematician, the Airy disk can be seen in a telescope as a series of rings that surround a star image. It is a pattern of light and its size is a function of the aperture viewing it and not keyed to the size of the object emitting light.

That the star is really smaller than it appears to the eye can be measured with another of the Galileo-inspired experiments. Select a bright star near enough to the ground to be near some telephone lines. Move back and forth watching the star and the telephone line and keeping one eye closed (to prevent a parallax).

You should be able to find a point where the star disappears entirely behind the apparently thinner wire. This works for stars or for far-off light bulbs. The greater size of the disk is cause by the interference of light constructively, and negatively. It forms a series of circles with dark areas between the bright rings and is dependent on the size of the imager, the wavelength of light and not at all on the distance of the light source. So, Antares is too small to be viewed even though its true size is larger than the size of the Earth's orbit about the Sun.

The Airy disk misled early astronomers into concluding it was the real bulk of the star that is viewed with the unaided eye. Lists were made, by early Arabic scholars, of the sizes of stars based on apparent magnitude. The first magnitude star's apparent size is 5 arc seconds and a sixth magnitude star about 1 arc second. These measurements were made before the telescope, and, of course, if these sizes were correct, any small telescope might see a bright star as a good sized globe complete with sunspots if there are any to be seen. This debate, in which Galileo took the side of the small star supporter, was no idle speculation. At stake was the position of the Earth. Since we do not see a periodic motion in stars, no annual parallax, the stars must be very far away. But if the star subtended five arc seconds at the Earth, and its distance is remote, the star would have to be ridiculously large. This was used by those supporting the Earth-centred solar system to argue that the Earth was not moving about the Sun. The trick with the wire and the star's "adventious ray" made it more plausible that the stars are very far away.

Of course, another completely different tactic also seems to imply that we can't see Antares. That is a measure of the star's colour. It turns out that the bright red star should not be seen at all.

Consider a star. It radiates a mixture of all the wavelengths of light about it but the dominant wavelength is proportional to the star's temperature. Blue stars are hotter and red stars cooler (not the other way around). A star's luminosity, or its contribution of light emitted, is proportional to $R^2\ T^4$ where R is the star's radius and T is its temperature (in Kelvin degrees). Take note of the "T" and how it is raised to the fourth power. A number multiplied by itself four times gets big fast. For example, $5^4 = 625$. This means stars with greater temperatures have a larger luminosity than cooler stars. Based on this, we get a sky that we expect, mainly bright blue stars that seem the majority of the naked-eye stars.

So, why is not the sky the exclusive domain of blue stars like Vega

and Altair? Look at the "R" in the luminance term. The red star can be seen if its radius is jumbo. Each red star visible to the unaided eye is a giant, since dwarves of a reddish caste would fall below naked-eye visibility if more than a couple of dozen light years away. Antares is a star of a vast hulk—the Earth's orbit about the Sun could be contained within this giant. Scheat, the upper west side star in the great square of Pegasus, Aldebaran, Pollux and a few others stand out. My favourite is Kochab the brightest star in the pail of the small dipper. This star is plainly dark orangey-red and its circumpolar locale means it can be inspected every clear night of the year from Canadian skies. If you meet someone who is sceptical that stars are coloured, show them Kochab in binoculars to straighten them out.

The stars change. Over great periods, stars develop cooler outer atmospheres as they swell in size. How do we know stars change? Obviously the time scales are too large for anyone to have inspected this. We know stars change because we can see them. Consider a star that you are watching. Your eye is receiving light from that star. The radiation in the star was released and now a photon of light enters your eye. The star had that light, now it's gone so the star has changed by the loss of the photon. Of course the photon is rather a light load for the star to lose. Yet, consider this. Your eye can be seen as perched on a sphere with the star in the centre. The surface area of a sphere is equal to $4 \pi r^2$. If the radius is 100 light years (the distance to a handy star) then the globe, on which your eye sits and watches, has an area of 125,600 square light years. Over that whole area the star is wastefully sending out its light. You could be standing at any spot on this sphere and see the same thing (ignoring interstellar absorption). This globe is pretty large; full-scale reproductions of the solar system, if glued on the ball, could accommodate about 600 million copies on its surface. So, the star is losing a fair amount of light and it must have some consequences to it down the road.

Fortunately, the Airy disk gives the star's light added punch and so a small contribution goes father due to the nature of light. It brings us back to the original point. We should not be able to see the stars at all. A sort of series of miracles arranges for them to be on display.

Antares's neighbourhood contains many more miracles in light. Here are a few.

M4 is one of the easier objects to find, located, as it is, just over one degree west of Antares. The globular sits in a breathtaking field of bright stars, clouds of faint stars and the ruby-like blaze of Antares. The globular itself is bright and, as, one of the nearest such objects, it reveals myriads of stars in small telescopes. A curious star chain is set within the object and draws the attention of observers although it is not seen on photos. M4 is a fine example of a globular cluster, one of the most ancient objects that we can see. On average, each globular is about double the age of our solar system and most of the stars seen are more luminous than the Sun. M4 appears as a tiny dot in binoculars but its true nature can be seen in a 150 mm telescope.

M80 is a small but grand globular cluster often observed since it is easily found just north and west of Antares. In small scopes, M80 is a round ball of light set amid huge numbers of Milky Way stars that inhabit this area of sky.

Larger scopes find some evidence of mottling and many outlying stars associated with the cluster. In 1860, one of the stars in M80 brightened to seventh magnitude in an event called a "nova." In the small telescopes of the time, where the star drowned out the cluster, it was thought by some that the cluster had turned into a star! It's a charming but false interpretation of the observation. It was suggested that two stars had collided and the outburst was the result. This seems likely when a globular is observed. The stars seem so close that one can imagine such a mishap. Modern estimates claim that such events would be rare, about once every one million years, and only in the densest region of the globular. The theory of star collisions causing novae received its death blow in 1901. In that year, a bright nova appeared in Perseus. The star faded and then sprang up in brightness only to fade once more and return several times. Was the colliding star backing off and having another run at the helpless first star, as in some crazy cosmic demolition derby?

To round off the field about Antares, take note of NGC 6144, just north of the star. This is a faint globular, even closer to Antares than M4, but much smaller and fainter.

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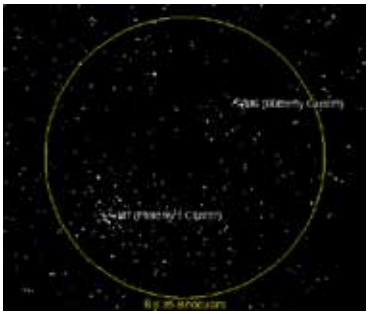
It's suitable for viewing with a 10-inch scope.

M7, or Ptolemy's cluster, is a naked-eye object and is mentioned



M6 (top right) and M7 (lower left)

by the ancient Greek philosopher Aristotle, making it one of the earliest recorded objects. This open cluster in the Scorpion is an irregular patch of grey within the Milky Way's rich star clouds. A 60 mm telescope shows about 25 stars in a shape like a coat hanger. Open clusters are sometimes called galactic clusters since they are strongly oriented along the middle section of the galaxy. Larger telescopes show many of the M7 stars to be pale blue, but one charming red star seeks attention within. This is a common feature of the open clusters, M103 in Cassiopeia is another example, and the show-off star is an old giant that stands out against the more youthful majority.

M6 is the first object in the list of Charles Messier that is an open star cluster. It's a rich and magnificent object, sometimes called the butterfly cluster on account of a fan-like shape. It is visible to the unaided eye as a tiny patch of light above the form of the Scorpion. In a small telescope, M6 is similar, but half as big as M7, and resolves into a tight patch of faint stars. About 20 are seen without any effort and the cluster can be viewed as full of stars even in binoculars.

The large size and ease with which M6 can be seen is illustrated by its inclusion, along with M7, in star catalogues well before the telescope. In the Middle Ages, the two clusters appear as the "cloudy ones which

M7 (sketch by Ronald Piacenti Jr.)

follow the sting" a reference to the tail of Scorpio. To the unaided eye, M6 appears alternatively as a star or a very faint glow and both clusters may be viewed to advantage even in opera glasses. Enjoy. ✸

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more Eris-like bodies and the planet population would explode like it did in the 1800s when an influx of asteroid discoveries were getting planetary status. After a final vote by the IAU, Pluto would not make the cut and the list would be trimmed to 8. A number of new categories were added and the IAU would now refer to Pluto as a dwarf planet, minor planet, plutoid, and plutino.

Under today's IAU "definition of a planet" approved at that 2006 assembly, an object is a planet if

1) It orbits the Sun.

2) It is massive enough to form a round shape under its own gravity.

3) It has "cleared its neighbourhood," meaning it is gravitationally dominant and no other objects of significant size are in or near its orbit.

This IAU definition stands today, but not without heavy criticism. Many astronomers on each side point out the lack of clear boundaries and ambiguity in these rules. In recent years, as Near Earth Asteroid discoveries have boomed, one might say the Earth has not cleared its neighbourhood, therefore Earth is not a planet. Most astronomers will agree that the official definition of a planet is a crummy one and doesn't serve its purpose.

I have heard two fantastic definitions in last week, each categorizing Pluto differently.

1) If an ancient culture saw a "wandering star", it's a planet.

2) If a lot of people say it's a planet, it's a planet.

Where do I stand on Pluto? I answered that question on TV a couple weeks ago and I regret doing so; I'm dealing with the fallout from friends, family, and coworkers. If you really must know how I feel about Pluto, ask me at the next star party or astro cookies. Just wait until the end when people are packing up to leave. ✸

Smoky Skies

The recent wildfires near Pemberton have had quite an impact on skies around the Lower Mainland, turning the skies butterscotch, the air acrid, and having quite an impact on the appearance of the Moon and Sun. The Moon has turned a blood red without the need for an eclipse and sunspots have been easy to see, even at midday. Here's hoping the clear skies return soon!

Images above courtesy of Leigh Cummings (Moon) and Mairi Welman (Sun).

CanadianTelescopes.Com

Canada's Telescope Store

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