NOVA
NEWSLETTER OF THE VANCOUVER CENTRE RASC
VOLUME 2014 ISSUE 3 MAY JUNE ASTRONOMY DAY 2014

Visiting Greenwich

by Alan Jones

In the fall of 2013, I travelled to the UK to visit family. We spent an afternoon at the Royal Observatory at Greenwich at the Prime Meridian. It houses a collection of observing instruments including a section of Hershel's 50-foot telescope, clocks, meridian telescopes and a collection of John Harrison's timepieces. Southern England is not mountainous so although the observatory is a on a 'rise' it is hardly what we would call elevation. It marks the Prime Meridian, which means it is 0° longitude. It is exactly on the opposite side of the world from the International Date Line. The short visit inspired me to learn a bit more and appreciate the truly amazing rapid progress in knowledge and precision over the last few hundred years.

Only three hundred years ago, maps of the world were inaccurate or non-existent and detailed star charts were rare. Mechanical time keeping was still developing and accurate time of the day was kept by large clocks that could be publicly viewed or heard ringing on the hour. Few people had watches and clocks of that vintage kept time within 5 minutes a day—close enough. Galileo had only in the previous hundred years shocked the world with his published observations of moons of Jupiter and the imperfect surface of our moon. It was in the 1600s that Columbus "proved" that the world was round! England was sending sailing ships to faraway lands for trade, imperial conquest and map making. Ship captains could determine their north and south position in the northern hemisphere

continued on page 4

NO MEETING IN MAY
See us at Astronomy Day at SFU on Saturday, May 10th

JUNE 12 **SFU**
Vancouver Centre's own Kenneth Lui will be speaking about the Chinese Space Programme. See Meetup for room details. SFU

JULY 10 **SFU**
Dr. Phil Stooke of UWO's Centre for Planetary Science and Exploration: A Cartographer's Guide to Mars Exploration. See Meetup for details. SFU

Astronomy Day Lectures at SFU

Saywell Atrium, Academic Quadrangle

12:00	Mark Eburne	**Astronomy for Non-Astronomers**
12:30	Ted Stroman	**Moon 101 and the Apollo Missions**
1:00	Howard Trottier	**Adventures in Astrophotography**
1:30	Scott McGillvray	**Tonight's Stars Were Brought to You by John Dobson**
2:00	Rohit Grover	**NEAR Projects re: Asteroids**
2:30	Leigh Cummings	**10 Mysteries of the Solar System**
3:00	Paul Stewart	**How to Hack Light Pollution**
3:30	Alan Jones	**Greenwich Observatory and the Prime Meridian**

Astronomy Day Activities

East Concourse, Academic Quadrangle

11:00am to 4:00pm

- Mobile Planetarium hosted by Canadian Telescopes
- Vancouver Telescope display
- Apollo Rockets and Mission display
- Jim Bernath and his hands-on science activities (6 tables of fun)
- Light pollution display
- Solar system and Our Planets display
- Solar telescope display
- 3 craft tables for the children including alien masks, spaceship portholes, and the Moon with Oreo cookies
- Astronomy Bingo

9:00pm until late (weather permitting)

- Star Party in honour of John Dobson, on the lawn near Strand Hall, east of the Academic Quadrangle (near the future site of the Trottier Observatory).

President's Message

by Mark Eburne

Welcome everyone to The Royal Astronomical Society of Canada's Astronomy Day 2014.

Each spring and fall, all across Canada and around the world, there are thousands of events being hosted that help promote astronomy to everyone who has the questions, the curiosity and the interest to explore the space above and everything in it. Whether you want to know what that bright star is in the night sky or what type of camera is best to take pictures of the Milky Way, you can find the answers here. Maybe you want to understand the speed of light or learn what you can see with a pair of binoculars. Or you simply want to feed the interest of your young son or daughter. All of the answers can be found here today at Astronomy Day.

"You don't have to know anything about astronomy to enjoy the wonders of the universe above."

continued on page 6

About RASC

The RASC Vancouver Centre meets at 7:30 PM on the second Thursday of every month at various locations in Metro Vancouver (see page 1 for meeting locations and page 4 for maps). Guests are always welcome. In addition, the Centre has an observing site where star parties are regularly scheduled.

Membership is currently $75.00 per year ($43.00 for persons under 21 years of age) and can be obtained by writing to the Treasurer at the address on page 5. 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.

2014 Vancouver Centre Officers

President	Mark Eburne president@rasc-vancouver.com	**Past President/Telescopes**	Howard Trottier telescopes@rasc-vancouver.com	**Merchandise**	Leigh Cummings merchandise@rasc-vancouver.com
Vice-President/Events	Suzanne Nagy vp@rasc-vancouver.com	**Dir. of Telescopes**	Kenneth Lui telescopes@rasc-vancouver.com	**Webmaster**	Rick Vandenberg webmaster@rasc-vancouver.com
Secretary/P. R./Observing	Scott McGillivary secretary@rasc-vancouver.com	**Membership**	Rohit Grover membership@rasc-vancouver.com	**NOVA Editor**	Gordon Farrell novaeditor@rasc-vancouver.com
Treasurer	Bruce Hutchison treasurer@rasc-vancouver.com	**LPA Chair**	Paul Stewart lpa@rasc-vancouver.com	**Speakers**	Barry Shanko speakers@rasc-vancouver.com
National Rep.	Doug Montgomery national@rasc-vancouver.com	**Education**	Bill Burnyeat education@rasc-vancouver.com	**At Large**	Terry McComas
Librarian	William Fearon library@rasc-vancouver.com	**AOMO**	Alan Jones aomo@rasc-vancouver.com	**Honourary President**	Dr. John Macdonald
				Trustees	Pomponia Martines J. Karl Miller

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

RASC Vancouver Centre
PO Box 19115
2302 West 4th Ave.
Vancouver, B.C.
V6K 4R8

A Brief History of the RASC Vancouver Centre

by William C. Fearon

The Royal Astronomical Society of Canada was born as the Toronto Astronomy and Physics Society in 1868. Later, when the Canadian Government in 1890 decided to build a national observatory for research, a new centre was formed in Ottawa. With other centres to follow in the next decade, it was decided that with the new century that reorganization was needed. The Canadian Astronomical Society was formed.

In 1902, the National Council of the Canadian Astronomical Society petitioned King Edward VIII for Royal recognition and in 1903 the petition was granted and became the Royal Astronomical Society of Canada.

In 1914, a new centre formed in Victoria, BC when the Canadian government decided to build the new Dominion Astronomical Observatory north of Victoria. Victoria centre's membership by 1930 would eventually include members who call Vancouver home.

In 1930, members in Vancouver (and the Lower Mainland) decided that they would like to create their own centre. The National council in Toronto granted this, and in November, 1931, the Vancouver Centre of the Royal Astronomical Society of Canada was formed.

The first Centre President was Dr. Gordon Shrum (of SFU and UBC) and the first meeting was held in the old Astronomy and Physics building at the University of British Columbia. Monthly meetings were held there until 1968. Activities of the centre included public star parties, articles for newspapers and magazines as well as visits to the national observatories of Canada and the US.

In 1968, after the completion of the H. R. MacMillan Planetarium, the decision was made to move the Vancouver Centre to the planetarium, our home until 2011. During our time there, we held star parties and volunteered at the planetarium (with the occasional free planetarium show thrown in). In 1979, the Gordon Southam Observatory was added to the Planetarium and opened with Vancouver Centre providing the astronomical volunteers to aid its operation.

The past years have seen the Vancouver centre hold its meeting around Metro Vancouver (sorry, not south of the Fraser river-yet), but this September (2014) we will permanently be based at the Simon Fraser University's new observatory.

So, as you can see, we are still an active centre and will continue into the future. ✸

continued from page 1

by measuring the angle of the North Star or anywhere by measuring the Sun's angle at noon. But finding their position east and west was by dead reckoning. They would keep track of their heading and progress through the water and guess about effect of current and weather. The inaccuracy of this method led to disasters. An admiral lost his life and his fleet when they misjudged position and ran aground off the west coast of England on the way home.

What has this got to do with astronomy? One of the motivations that inspired England to support astronomical observations was to find better ways to navigate at sea. The Royal Observatory at Greenwich was in charge of informing ships in the harbour of official time at noon. At noon each day, a sphere was lowered from a tower that could be seen by ships at nearby anchor. A warning was giving by raising the sphere halfway at 10 minutes to the hour. The observatory kept official time and was located at the prime meridian and so it was used to map the stars as they passed the zenith or straight overhead. Most of the observing instruments used at Greenwich are designed

continued on page 5

continued from page 4

to accurately measure angle (azimuth) along the north-south axis of the meridian. The instruments appear in a way to be astronomer's sky equivalents to land surveyors' tools to measure accurate angles. The astronomers observed and recorded with precision the time and the angle of the stars passing the zenith in order to prepare accurate star charts.

The Scilly naval disaster of 1707 mentioned above resulted in parliament passing the Longitude Act of 1714. The act established a Board of Longitude to reward a prize of 20,000 pounds (equivalent to millions in today's currency) to anyone that could solve the problem of longitude for ships at sea. It had to be a practical solution that anyone could use and be accurate to a half a degree (30 miles at the equator). Imagine what they would think of our GPS systems that we just take for granted!

The problem of longitude was eventually solved in two ways: one by inventing a device that could keep accurate time on a rolling ship; and secondly by developing accurate tables and star charts of the Moon's apparent path through the sky.

John Harrison was a carpenter fascinated by clocks. He tackled the problem of building an accurate timepiece for a ship and refined his solution over forty years. At 81 years old, Harrison was awarded most of the prize. Captain James Cook took one of the copied test time pieces on his second world voyage and he remarked in his log book on utility and accuracy of the watch many times. Some of the charts made by Cook on that journey were still in use in the mid-20th century. Harrison's desire for perfection worked against him in a way because astronomers had enough time to develop a competing method. The early Moon observation method required advanced skill in mathematics and at least 3 hours of work to calculate the position based on Moon observations and having a reference book of tables along. The Moon had to be observable against the stars and that was undependable or even unavailable during at least half the month.

The Greenwich observatory museum exhibits the tools used by the royal astronomers along with the first four time pieces created by John Harrison—an amateur watchmaker—to solve the longitude problem. It is an amazing display and it makes one marvel at how recently this discovery took place. James Cook sailed off the coast of B.C. and mapped the coast on his last voyage. Today we can measure time accurately to seconds in millions of years and we wear watches or carry GPS devices that we just take for granted.

A fascinating book: *Longitude*, Dava Sobel, 1996; tells the story of John Harrison and his relationship with the royal astronomers. I think you will enjoy reading it. It's won literary prizes and been translated in many languages. Dava gave a lecture at UVic in Oct 2009, the 400-year anniversary of Galileo. ✸

Membership has its Privileges!

New members, did you know? The Vancouver Centre has 8 telescopes available for loan free of charge! We have telescopes ranging from 60mm to 10" 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

May
10 – International Astronomy Day at SFU

June
25 - 30 – RASC GA in Victoria

July
19 – Solar Observing at Campbell Valley
July 26 - Aug. 3 – Mt. Kobau Star Party

August
23 - 31 – Merritt Star Quest

December
11 – AGM

continued from page 3

You may notice here that I didn't call it the night sky. Typically one thinks of astronomy as a night-time activity and for the most part this is true but there are so many things to see in the daytime as well. For starters, the sun, moon, some of the planets and even stars—under the right conditions—can be found during the day. So don't limit your interest to the night sky, any time is a good time of astronomy. As for the "You don't have to know anything about astronomy" statement, you just need curiosity on your side and the knowledge will quickly follow. Test your curiosity out today and ask a question or two.

Having said that, in today's world of fast computers, faster internet, tiny mobile phones and portable tablets, we can find ourselves exploring the universe while we eat our lunch or take a ride on the bus. We have never had so much information to view and read at our fingertips. We are able to see detailed pictures of the exploration of Mars by small rovers as it happens and tweet a question to the captain of the International Space Station via Twitter at the same time. You can follow the progress of the Kepler mission as it finds new worlds and keep up with particle physics developments with the click of a mouse. Today's astronomy takes us from the deepest part of the Pacific Ocean to the furthest reaches of space itself, live and in colour, 24/7. There are so many ways to be involved in the science of astronomy—from the armchair explorer to the "all night" observer or to the dedicated professional astronomers uncovering and proving the latest discoveries in the world of astronomy. Astronomy is one of the most shared sciences we have.

Today's events are hosted by the RASC Vancouver Centre. The Vancouver Centre hosts public talks every month at various locations around Vancouver as well as several outdoor observing events where you are able to see the gems of the night sky through telescopes, binoculars and the camera lens. Be sure to check out the RASC website to find the next event. As a club, we offer many ways for interested people to get involved with astronomy at every level. Make sure you check out the membership booth and explore the possibilities.

The RASC Vancouver Centre and its members would like to thank Vancouver Telescope and Canadian Telescopes, plus the members of the UBC Astronomy Club and SFU Starry Nights for their assistance in bringing you today's activities. I would like to personally thank the members of RASC's council and the valuable volunteers who have worked hard to make the event come together.

I looks forward to seeing you all during the day's events and at the star party outside with lots of telescopes—weather permitting of course.

So have fun and ask questions. Exploration missions leaving all the time—get on board. ✸

Mark Eburne
President, RASC, Vancouver Centre

From the Sidewalk 2014

by Leigh Cummings

During Astronomy Week, you may hear of John Dobson quite a bit. He passed away this last January 15th at the age of 98. Some say his greatest achievement was the creation of the "Dobsonian Telescope." He never patented his design on purpose, as a gift to people of all financial backgrounds to have a chance to experience amateur astronomy with a telescope of their own making. Myself, I think his greatest achievement was what he did with his "invention." He took his homemade telescopes to street corners in the city of Los Angeles for the sole purpose of letting the passerby citizens of the city view the wonders of the night sky. He was the first "Sidewalk Astronomer."

Watching a video of John Dobson working his magic on a Los Angeles street corner was what inspired me, several years ago, to try Sidewalk Astronomy as well. I do not own a Dobsonian-mount telescope, however that did not stop me from taking my EQ3 and 6" Mak to the ValleyFair Mall in Maple Ridge and set up for a night of star gazing with the passing-by public. It was such a wonderful experience that I was hooked and have been doing it ever since.

This last winter has been pretty dismal for viewing. The clear nights always seemed to be on a weeknight when I had to be up early the next morning for work. My days of party-all-night and work the next day are long gone. My boss has this strange expectation that I won't sleep at my desk, or worse, in a company vehicle. So I had to be patient and wait for what turned out to be rare weekend clear nights.

One such evening was Friday, February 28th. Driving home from work, I observed that the sunset was leaving behind a dark blue sky that promised some stability for the upcoming evening. I could not pass up the chance, so when I got home I started packing up my Mak and HEQ5 with the idea of doing a little Sidewalk Astronomy at my local Save-On-Foods in ValleyFair Mall. I have set up my equipment there lots of times and was sure that I would likely be welcome.

I arrived by 7:30 and, after requesting permission from management, I began to set up. I finished by 8 and the lineup started forming. As the building is oriented facing south, I am not able to see Polaris to obtain an accurate polar alignment. I guess at north using the parking lot curb as a guide. I was off a little as the telescope drifted to the north slightly all night. I had to correct it every 10 minutes or so. Not bad, considering.

I put Jupiter into view and right away the lineup of shoppers wanted to have a look. I never got the telescope off of Jupiter all night. The seeing was not bad for the west coast and Jupiter is bright enough to see even with the parking lot lights. Many of the people who stopped to look were surprised that anything could be viewed with the light pollution in our town. I assured them that the planets and Moon were bright enough to be found even under those conditions. The ValleyFair Mall had recently changed all their lighting and to be fair they did install full cut off lights. The lighting choice is an improvement in regards to the light shining upwards. The lighting is full spectrum LED which I am sure is significantly cheaper on electricity. From an astronomer's perspective, however, the light is impossible to filter out. Even with that caveat, I consider this a step in the right direction. It was heartening that people were aware of the problem but it saddened me a bit that so many just seemed to accept it as an inevitable price to pay for civilization.

The public was able to make out at least two bands on Jupiter, with some people telling me they made out a third. I have to confess that I did not, however I did get to watch the moons orbit around Jupiter as one moved from one side of the planet to the other. The night started out with two moons on

continued on page 8

continued from page 7
each side and by 9:30 there was three on one side and one on the other. The wind came in gusts and added a little vibration to the scope but, for the most part, the building shielded me from the worst.

I had a steady stream of people from 8 to about 10 and then a trickle until I decided I was cold enough and started packing up at 10:30. I wouldn't have lasted that long if not for the warmth my new RASC BC observing jacket afforded me. Overall, I estimate that between 60 to 70 people of all age groups looked through my telescope in 2-1/2 hours. Not bad for an impromptu evening.

The next time the weather gave me a chance to hit the sidewalk was Saturday April 12. Although the day started out cloudy, the Clear Sky Clock website indicated that it was supposed to clear by evening. I dropped by the Save-On-Foods store at the ValleyFair Mall and met the new store manager, Cal Siemens, and asked if he wouldn't mind me setting up in front of the store again. He was very enthusiastic with his only regret that he was not working that night. I assured him I would be doing this again and hopefully he could have some time at the eyepiece. He also informed me that his store is the busiest store in the Lower Mainland. No wonder I always have lots of people looking through my telescope when I set up there.

Before going out to mow my "hayfield," I emailed some of our Maple Ridge members to see if anyone could join me on short notice for another evening of sidewalk astronomy. After disposing of enough grass to feed a herd of goats, I received a phone call from Rick Vandenberg. He told me he would love to join me that evening and I was happy to have his company. It is always more fun when you have fellow enthusiasts to share the experience with.

After supper, I loaded the Mini and headed over to the store. I arrived by 8pm and had the telescope all set up and running by 8:30. I set up a table for people to set their grocery bags on as well as allowing me to set out some books and pamphlets about RASC. I also hung my "Sidewalk Astronomy" sign on the side of the table. Although the sky was still fairly light, I had no problem finding Jupiter. The lineup to view started growing before I even had the target acquired. As usual, Jupiter was not a disappointment. There was also a bright Moon and Mars was just peeking out above the Mall.

It seemed like a blink of the eye and Rick came walking up with his 80mm short tube refractor and an Alt Az mount. I couldn't believe a half hour had already passed. Rick set up and put his telescope onto the Moon. He aimed for the terminator to give the public the best possible view of the craters and mountains highlighted by the rising lunar sunrise. I heard lots of ooohs and aaahs coming from his direction. It always amazes me how many people have commented that our Sidewalk Astronomy events have given them their first chance to view our nearest solar system neighbours through a telescope.

The nice thing about setting up in front of the store is that we get a fair number of families passing by. I even had one mother ask me how long we would be there as she wanted to bring the rest of her family by to have a look. Rick and I both answered that we would stay until the store closed at midnight. Sure enough, she came back with the rest of her family later that evening. They each took several turns at viewing Jupiter and the Moon.

We also had several people that own telescopes ask us for tips on how to use them. Rick and I took pleasure in giving them whatever help we could. I also gave them a RASC brochure with our website address so they can check us out further in their pursuit of learning.

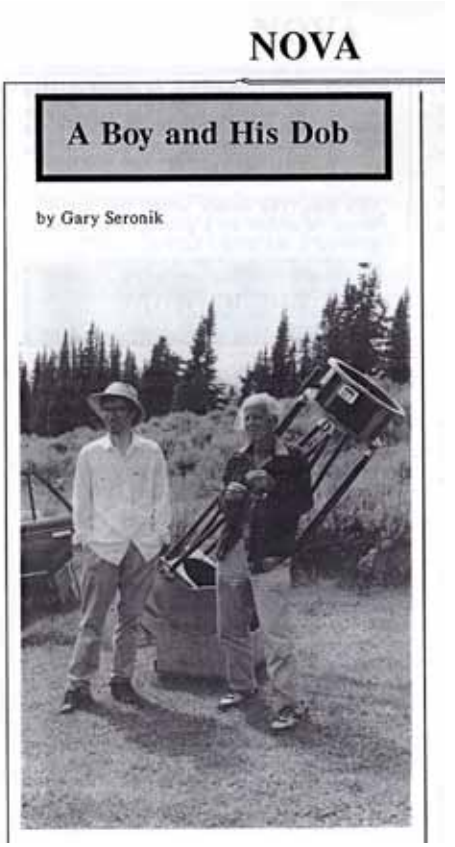
We can never be sure how people will react when they look through our telescopes for the first time. Some people take a quick glance as if to please us where as others are genuinely intrigued by the opportunity. For example, a group of three

teenagers came out of the store, so I called out to them and asked if they would like to see Jupiter through a telescope. They approached cautiously not sure what to make of me while I explained who we were and that it would cost them nothing to have a look. One of the young ladies turned to the young lad and gestured for him to go ahead and take a look, knowing that he wanted to. He obliged her and his enthusiasm at what he was seeing intrigued the two girls, who each took a turn to have a look. After a discussion of what they had seen, they soon realized that they had had different experiences at the eyepiece. One girl hadn't seemed to see much, so I encouraged her to have another, longer, more patient look through the eyepiece. Soon she was getting excited as she started to make out the bands of Jupiter and realized the other little star-like objects were the Jovian moons. Hopefully the experience will help to revitalize their natural curiosity and they will seek out more knowledge of the Universe.

Little kids pose their own challenge at the eyepiece. They need no encouragement to have a look, however, sometimes it takes patience to train them to look straight into the eyepiece at the right distance to properly be able to see. A multistep footstool can be very helpful to set them at the best height for looking directly into the eyepiece. I usually use a low-power eyepiece with a long eye relief for the beginner. Still, sometimes it takes awhile before the target is acquired. Kids are not the only ones though that sometimes have difficulty learning about observing. One lady insisted over and over that she could see nothing but black. Finally I asked her to let me have a look. I also could only see black. Whoops! My mistake. The mount was not tracking dead on and Jupiter had drifted out of view. As the mount was more accurately aligned then I usually get (without a view of Polaris), I had gotten lazy at checking my target. It was still not perfect and needed a nudge now and again to stay on target.

Rick and I both tried observing Mars at one point, however, the planet was still too low in the eastern sky for the seeing to be good enough to observe much detail of the Martian surface. I had also targeted the Moon at the request of a young couple. I had to step down my aperture as the Moon was blindingly bright. The view of the mountains so close up amazed them both. I love it when people get a thrill out of something as simple as a close up look at the Moon. It is a deeply human experience.

Rick and I were both caught off guard when the store doors started to close and we realized it was midnight. In all, I think we had close to 60 people look through our telescope. We also had quite a few of the store staff come out on their breaks and have a peek at our targets. The time had just flown by. Rick told me he had a great time, so I am hoping I have hooked another astronomer on the fun of Sidewalk Astronomy. ✸



John Dobson (right) and Lance Olkovick at Mt. Kobau in 1993

The Planets of our Solar System

by Bob Parry

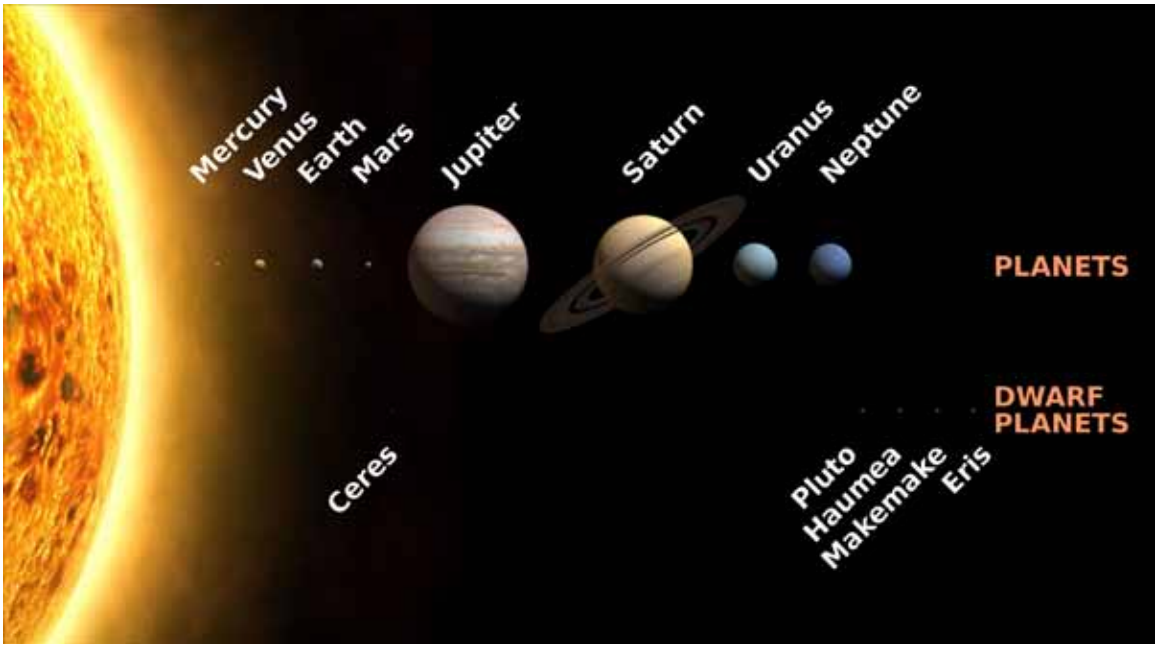


Image credit: IAU, Wikimedia Commons

Since 2006, when the IAU (International Astronomical Union), defined what a planet was, no discussion of the planets can begin without defining what is a planet. The IAU's definition reduced the number of planets that I grew up with from nine to eight. However they added dwarf or minor planets to the group so we went from nine planets to twelve? Huh!

Image credit: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

Mercury

So how did that come about? Well the IAU decided we needed a definition of what was a planet. The definition they came up with was:

(1) The object is in orbit around the Sun.

(2) The object has sufficient mass to assume hydrostatic equilibrium (a nearly round shape).

(3) The object has "cleared the neighbourhood" around its orbit.

That last one was a bit controversial as if you apply this rule strictly Neptune could be argued to not be a planet as Pluto's orbit crosses inside Neptune's for part of its orbit around the Sun.

So because there were other objects that orbited the Sun—that is they are not a moon of a planet such as our moon—we

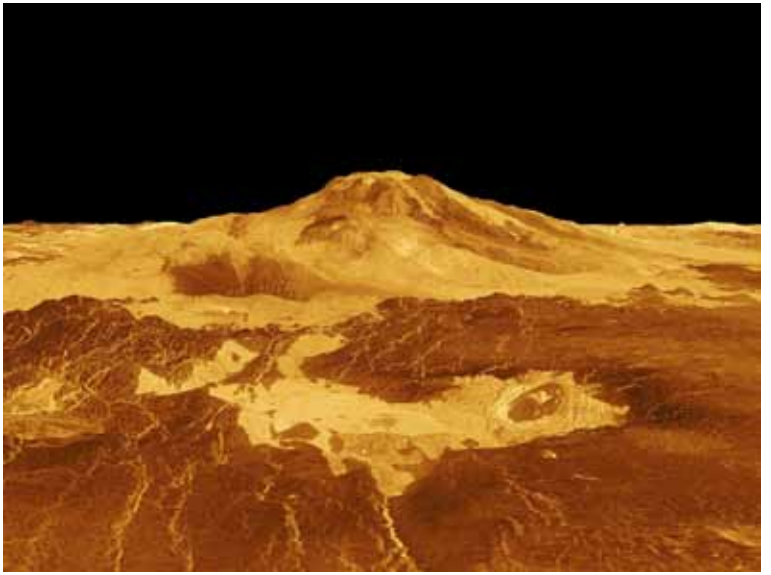


Image credit: NASA/JPL

Computer-generated view of Venus from NASA radar images

ended up with twelve, if you count the number on the picture above.

So let's talk about the planets in our solar system, but leave those recently discovered planets around other stars to another discussion.

So we will start from the closest to the sun and work our way out. First up is Mercury. As stated, it is closest to the Sun and has a "year" 88 Earth days long. It rotates rather slowly and makes one rotation in about 56 Earth days. However, because it goes around the Sun so quickly, its solar day is actually two Mercury years long, or 176 Earth days. This means that when the Sun is up, the surface of Mercury gets very hot—up to 430° C. However, the backside of Mercury drops to a very cold –160° C with areas near the poles in deep craters falling as low as –180° C.

If you look at recent pictures of Mercury it looks remarkably like our Moon.

Next we will go to Venus. Venus has been called Earth's twin as it is rocky and very nearly the same size as Earth. There are however some very major differences. A day on Venus, like on Mercury, is longer than its year. A day on Venus is 243 Earth days long, however its year is 225 days. The biggest difference is temperature. Venus is 450° C pretty much everywhere. Earth has an average temperature of about 10° C. The reason for this difference is the very dense atmosphere of mostly carbon dioxide. The pressure at the surface of Venus is 92 times that of Earth. The CO_2 has caused a runaway greenhouse effect that has resulted in the extreme temperatures. The atmosphere is the reason why at night it does not get cold like it does on Mercury. The atmosphere transfers the heat all around the planet. We cannot see the surface of Venus because of thick clouds, but orbiting spacecraft have mapped the surface by radar. Venus is the hottest planet in the solar system with lots of volcanos. So Venus is more like an angry

continued on page 12

Image credit: J. Bell (Cornell U), M. Wolff (SSI) et al., STScI, NASA

Mars

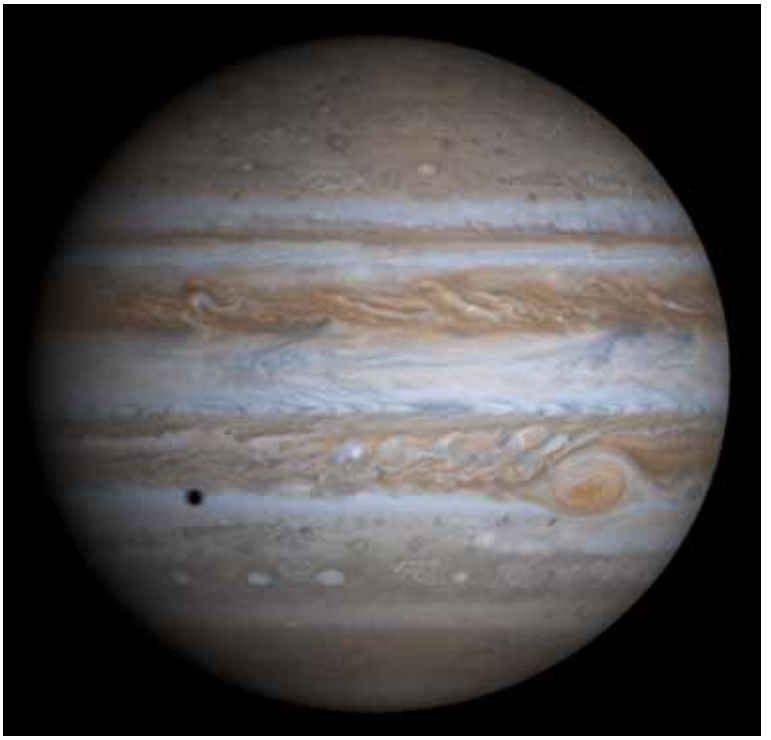


Image credit: NASA/JPL/University of Arizona

Jupiter

continued from page 11

neighbour than a twin.

We will skip past our own planet—lots of people are writing about Earth—and head out to Mars. Like Mercury and Venus, Mars has been know for as long as humans have gazed at the sky. However, because it's much farther from the Sun—farther than Earth—it is visible for much longer than the other two we have talked about. It is very red to the unaided eye and this has made the human mind dream, fantasize, write fabulous stories about, and finally (recently) explore. Mars is thought to have once been much warmer with oceans, rivers and lakes. That, if it was ever the case, was a very long time ago. Mars now is more like a frozen desert. There is only ice on the surface and that is concentrated at the poles. Landers on Mars and orbiting telescopes have found ice below the surface and there is speculation the simple forms of life may be able to live below the surface of Mars.

A day on Mars is remarkably close to a day on earth at 24 hours 37 minutes. One would not have trouble getting used to a day on Mars. A Martian year is 687 earth days long, nearly twice that of home.

Mars also has huge canyons that would make the Grand Canyon look like a little ditch. Because the gravity is so low on Mars, you would weigh less than half what you weigh on Earth. A volcano on Mars has grown to be the biggest know volcano in the solar system. It seems to be a dead volcano, like most of the surface of Mars.

There are currently several rovers on the planet. The largest telescope ever sent to another world orbiting Mars, HiRISE (High Resolution Imaging Science Experiment), has taken hundreds of photographs of the Martian surface and has even photographed a lander parachuting to the surface. There is so much happening at Mars it is difficult to keep up with. Try Googling Mars and see how many hits you get.

Next we will move on to the giant of planet—Jupiter. Jupiter is the largest of all the planets, so large that it is more massive than all the other planets combined. It is 317 times more massive than Earth. Jupiter could almost be classed as its own solar system with 62 know moons. The four largest are easily seem from Earth through modest telescopes and binoculars. Those beautiful little points of light are part of what got Galileo into so much trouble. When the Church said that everything revolved around the Earth, it was uncomfortable to them to have some say that something was revolving around, orbiting, something other than the Earth.

Jupiter's largest moon, Gany-

mede, is larger than Mercury but is not as heavy as Mercury. Of the other moons that you can see, only Io is smaller that our Moon. Europa and Calisito are both larger than the Moon. Recently, data gathered by the spacecraft Galileo has been analyzed and scientist now believe that oceans of water may exist below the surface of Ganymede and Europa with the possibility of life that could be more advanced than thought possible on Mars.

The planet Jupiter itself is a very dynamic and interesting place. There is a storm in Jupiter's atmosphere that it larger than the Earth and has been visible as long as humans have had the ability to see the surface of Jupiter. The clouds of Jupiter are easily visible in telescopes and are very interesting to watch.

A day on Jupiter is very short, just 9 hours and 55 minutes long. During the winter, if Jupiter is visible, it is possible to see an entire rotation of Jupiter in one Earth night through your telescope!

Jupiter is an amazing sight in a telescope and if you get a chance to see it you will not be disappointed.

We will now head out to the last of the planets known since ancient times and the most distant planet that can be see without telescopic aid, and that is Saturn. Saturn is one of—if not the most—impressive sights you can see through a telescope. Saturn's rings set the view and they are magnificent. I have had first-time viewers think I am fooling them as they thought only the Hubble Space Telescope could see such a thing, but no you can see the rings in rather modest sized telescopes.

Saturn has almost as many moons as Jupiter with 53 officially recognized moons, the largest of which is also bigger than Mercury and has an atmosphere. Titan is the only moon with anything more that a trace of an atmosphere, but Titan makes up for all the others with a thick, dense atmosphere mostly of nitrogen. The pressure of the atmosphere is about 1.5 Earth atmospheres. Titan is one of the most interesting places in the solar system and is the only other body other than Earth to have liquids on it surface. However, because Titan is so cold, −170° C, it is not water. The liquids that may actually rain out of the sky on Titan are made of methane. Methane is mostly what natural gas on Earth is made from. There are rocks on the surface of Titan are made out of ice! Titan is a fascinating place as are other moons around Saturn. The moon Enceladus has geysers venting water vapour into space which has produced one of the rings of Saturn. This ring is very faint and visible only in big telescopes. These geysers have made scientists believe there must be a large lake of water below the surface of Enceladus. This is remarkable because Enceladus is so small it should

continued on page 14

Image credit: NASA/JPL/DLR

Jupiter's Moon's (left to right) Io, Europa, Ganymede and Callisto

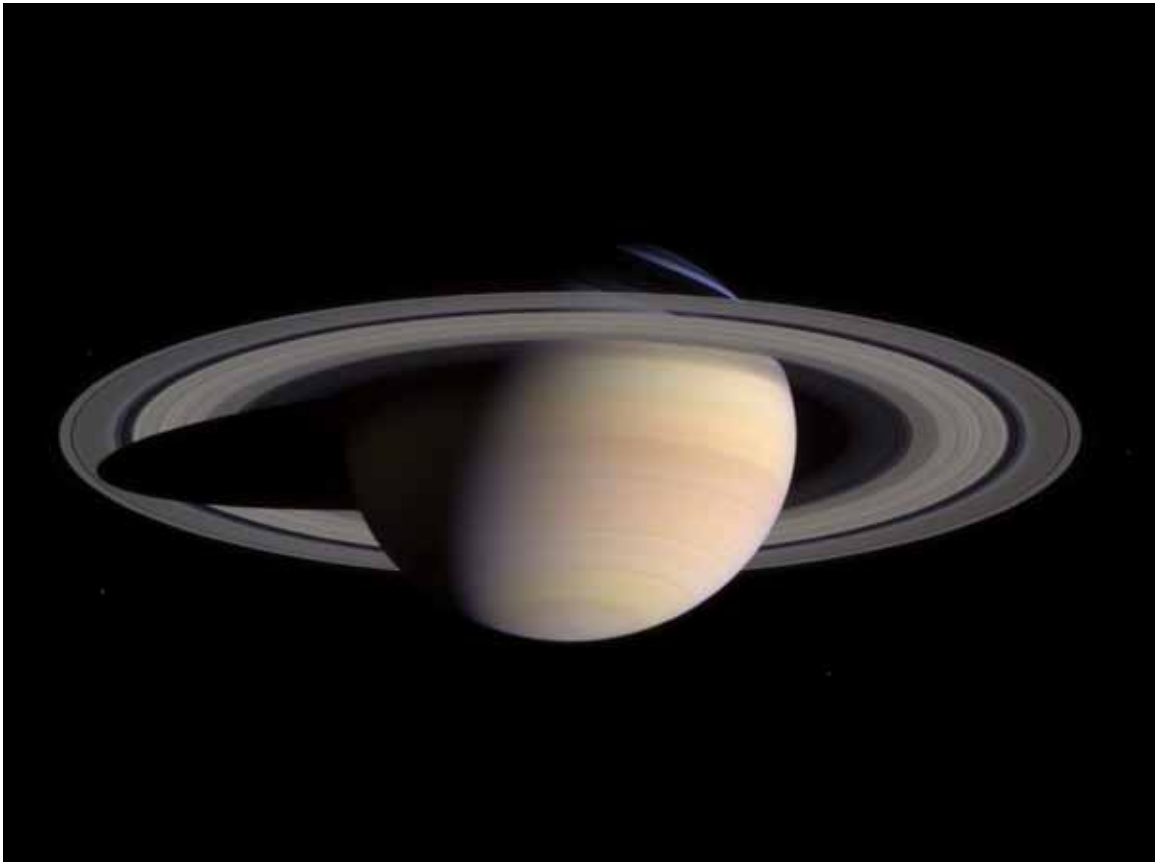


Image credit: NASA/JPL/Space Science Institute

Saturn

continued from page 13

have frozen solid eons ago. The theory is that tidal forces from Saturn cause the little moon to flex and this provides enough heat to keep the interior of the moon warm enough to provide a lake about the size of Lake Superior beneath the surface of this very interesting moon.

The story of Saturn is of course its system of rings. These rings, while looking so huge from Earth, are very very thin and sparse. The spacecraft Cassini, now exploring the Saturn system, actually passed right through the rings when it first arrived at Saturn without damage. The rings are made primarily of water ice with some few tiny bits of rocky material thrown in for good measure. Scientists do not really know how or why these beautiful structures were formed and even if they are a permanent feature. There are gaps in the rings that are visible from Earth. These gaps seem to have shepherding moons that orbit in the gap. These have been observed by the Cassini spacecraft.

If you get a chance to observe Saturn, do not pass it up. It will be worth the time to look. I am going to end our tour of planets at Saturn as it is the last of the classical planets that can be observed without optical aid. Please look up these and all the other wonderful objects in the solar system. The 'net is a great source, as are the NASA sites, so have fun and explore even from your armchair. ✸

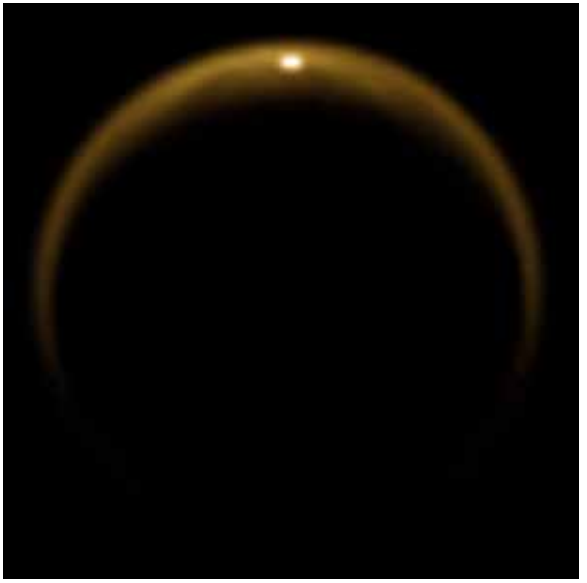


Image credit: NASA/JPL/University of Arizona/DLR

Image credit: NASA/JPL/Space Science Institute

Sunlight glinting off one of Titan's methane lakes (left) and water geysers on Enceladus (right)