Event Horizon

Volume 22, Number 5
March 2015

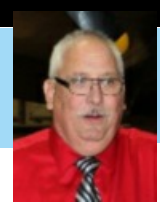
From The Editor

It's March, and, so, spring can't be all that far away. We should soon be able to do astronomy activities in some semblance of comfort!

I wish to thank everyone who contributed articles and images this month.

Enjoy this jam-packed edition of the E.H.!

Bob Christmas,
Editor



Chair's Report by Jim Wamsley

I think I am caught up in a repeating time loop. When I checked back on my Chair report from last year, I found I could almost just copy and paste the text from one to the other. My complaint that the winter had been the worst in memory, well again, this year's weather has been extreme, with lots of snow, and when not snowing the temp's too cold to contemplate the thoughts of getting outside and stand behind a frost covered telescope in -25 degrees and wind chills to -40. Last year I blamed the weather on the curse of certain club members purchasing new equipment, but that can't be the case this year. I guess it is just the fact that we live in Canada, and we are never happy. I know that soon the complaint will be that the heat is causing the scopes to dew over, and the mosquitos won't stop biting.

Again this year, the Hamilton Amateur Astronomers helped out at the Binbrook Conservation Area's annual Fishing Derby. Three club members showed up at 6:00 am. to help park cars. Matthew Mannering, Mario Carr, and myself, braved the cold and blowing snow to aid the Conservation Area, in having a successful event.

On the time loop ride still, at the Feb. general meeting the techno glitch we had with the multimedia projector failed to project "red" again. This machine performed flawlessly all year. I suppose it's a *(Continued on page 2)*

IN THIS ISSUE:

Chair's Report (continued)

Valentine thing. The presentations by Matthew and John went well anyway, with just a few jokes and quips on the failure. Be assured I will be speaking to the Spectator about this, and have it corrected by next meeting.

I had an opportunity to accompany John Gauvreau to the Ancaster Public Library this week. John gave his "Tour of the Universe" talk to about 13 very appreciative people. I brought along my meteorite collection as well, for a short show and tell after the talk. John also has scheduled talks at a Hamilton public school and another library in March, which I hope to tag along and offer any help I can.

March is going to be a busy month for the H.A.A. Starting March 5th we will be starting the Astro 101 course for the beginners in the club. There has been a great response to this course in the past and this year is no exception. Next, on March 7th 7:00 p.m. the Astro Photo Group will meet in the rec-room of my apartment building. This is an informal get-together. Don`t be afraid to attend because you feel you don`t know enough about the subject. We are all learning, and trying to share what we learn. Of course March 13th will bring the General meeting at the Spec. Our speaker this month will be John Gauvreau. John's talk is entitled, "New Horizons; Space Exploration Today". John always has very interesting talks, and I'm sure this one will be no exception. H.A.A. Council meets Monday March 16th. All council meetings are open to all. If you wish to attend, contact me for directions. Saturday March 28th brings the first of the club's public nights under the stars for this year. Club members will be setting up their scopes at the Grimsby Tourist Information Center just off the QEW Niagara at Casablanca Blvd. We always have a great time at this venue. There is a lot of traffic at the scopes, and the fact that there is a Tim`s and toilets on site is a bonus. Let's all hope this cold weather and snow will have broken by then.

I hope you all have a great month of March and are able to thaw out or dust off your telescopes as the case may be. I look forward to seeing you out there under a dark sky soon.

HAA Helps Hamilton

To support our community, we will be collecting non-perishable food items and cash for local food banks at our general meetings.

Please bring a non-perishable food item to the meeting or a donation of cash and help us help others.

If you would like to help or have any questions about this initiative, please contact Jim Wamsley at 905-627-4323.

Masthead Photo: *Conjunction of the crescent Moon, Venus and Mars, by Lise Bennett.*
Imaged on February 20, 2015 from Brantford, ON, using a Nikon D90, set at f/5.6 and ISO 640.
Two exposures of 1.6 seconds and 0.62 seconds fused together.

See more images of the Moon-Venus-Mars conjunction in The Sky This Month, next page, and on the Eye Candy page, Page 7.

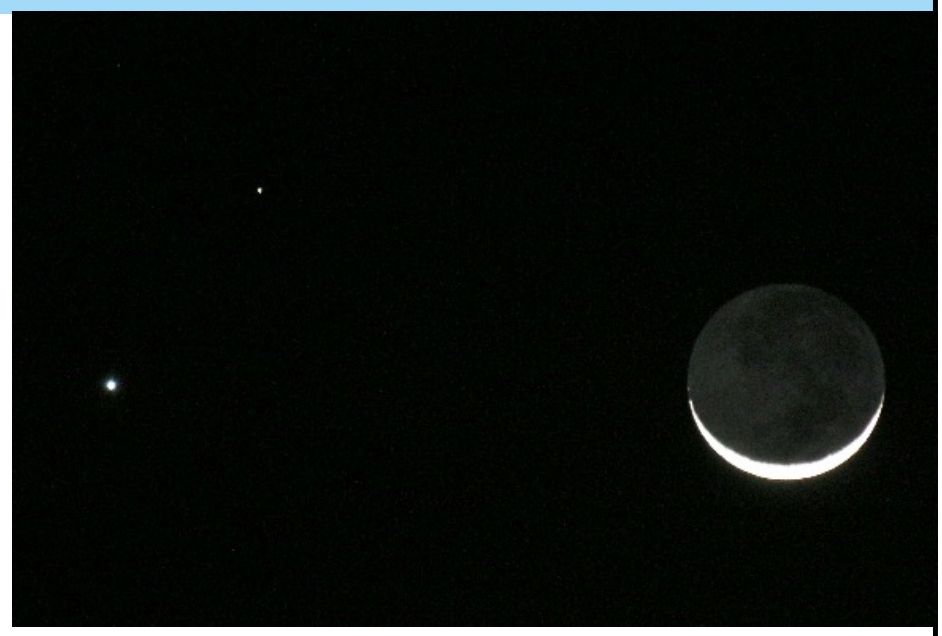
The Sky This Month for March 2015 by Matthew Mannering

This past month has been very challenging for us when it comes to the weather. The temperatures have continued to be ridiculous to say the least. Observing in these conditions is almost impossible for any length of time. Luckily spring comes to us officially on the 20th. Maybe the temperature will have risen to the freezing point!

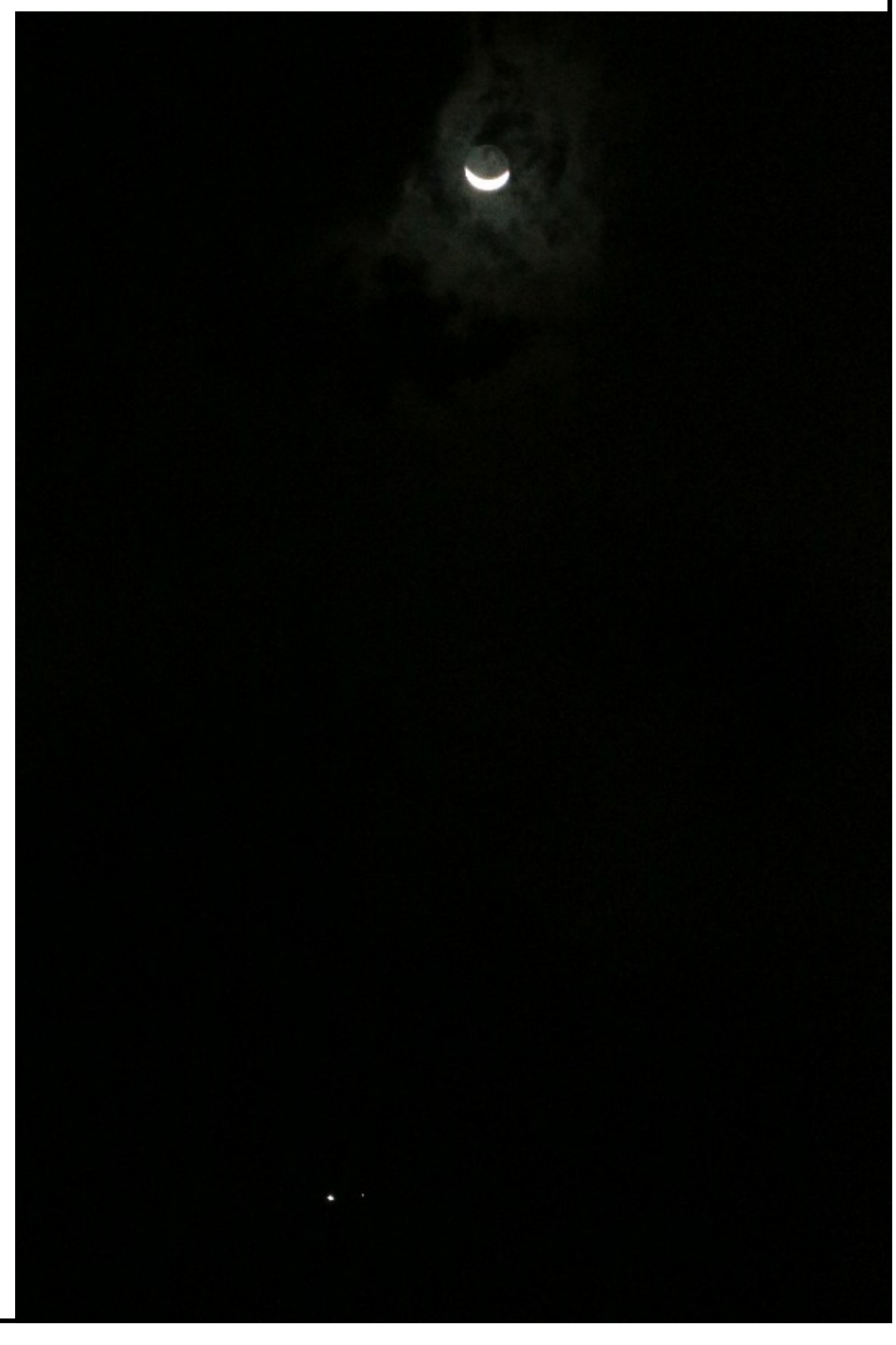
Even with the extreme temperatures a few of our club members managed to grab a few shots of the Moon, Venus and Mars conjunction on the 20th of February. You can see them posted on our blog. The next night there was a double pairing. Venus and Mars were only 0.25 degrees apart and the Moon and Uranus were 0.5 degrees apart. My wife and I took a number of photos of both events but didn't have to brave the cold as we spent that week on the south coast of the Yucatan peninsula.

While in Mexico I was hoping to see the Large Magellenic cloud on the horizon to the south as well as many other southern Milky Way objects. Instead I was clouded out along the whole southern horizon for almost the whole week. One night we got up at 3am and went back to bed at about 5am. Luckily there was a break in the clouds for about 10 minutes at 3:50am. I was able to see Crux (the southern cross) for a few fleeting minutes. The pictures taken at the beach involved my wife acting as a wind screen as the wind was blowing at +20mph. Many of our pictures were ruined by camera shake no matter what we tried. The previous evening was so breezy and cold that we had on our winter sweaters and thin wool gloves! Oh well, it was still way warmer than here in the great white, extremely frozen north.

We did get to see the Omega Centauri globular several times, but had to be up well after midnight to get a good view of it. I saw it clearly on two nights and it is still impressive even in binoculars. At 30 arc minutes across, it's as big as a full moon! Anyone who has looked at northern globulars knows that they are usually just small fuzzy patches in binoculars, but Omega is a different beast altogether. *(Continued on page 4)*



February 20th – Venus, Mars and the Moon
(All moon & planet images by Matthew Mannering)



February 21st – Venus, Mars, Uranus (hidden by cloud) and the Moon

The Sky This Month (continued)

February 21st – Uranus and the Moon

So how do things look in March? Just like in February we have a few really nice groupings in the west after the sun sets. On March 4th at 7:30pm look for Uranus only 0.1 degrees below Venus with Mars closer to the horizon.

Next on March 11th at around 8:15pm look for Mars 0.3 degrees above Uranus. This is an hour later than you would expect as Daylight Saving Time has the clocks moving forward an hour on the 8th.

[Below: Chart of Venus-Uranus conjunction for March 4.]

[Next Page Top: Chart of Mars-Uranus conjunction for March 11.]

[Next Page Bottom: Chart of Moon-Mars conjunction for March 21.]

Venus and Uranus 1 degree apart with Mars below them, on March 4 at 7:30pm

(Continued on page 5)

The Sky This Month (continued)

Mars and Uranus 3 degrees apart on March 11 at 8:15pm

Moon and Mars 1 degree apart on March 21 at 8:20pm

(Continued on page 6)

The Sky This Month (continued)

The Moon:

Libration this month is as follows: The Northern limb will be most exposed on the 27th and the Southern limb on the 15th. The Eastern limb will be most exposed on the 25th and the Western limb on the 13th.

The Planets:

- ***Mercury*** is just visible about 5 degrees above the eastern horizon at 6:15am for the first week of the month. After that time it effectively disappears into the glare of the Sun.
- ***Venus*** remains low in the south west after sunset all through the month. Venus shows phases just like the Moon. By months end, Venus will only be 78% lit. Can you see this gibbous phase in your telescope?
- ***Mars*** continues to be low in the south west this month. The best time to see it is about a half hour after sunset.
- ***Jupiter*** is is still in its prime this month. Look between Leo and Cancer. It's the brightest object in that part of the sky!
- ***Saturn*** rises at 1:30am on the 1st and at 0:30am by months end.
- ***Uranus*** disappears into the evening twilight by mid-month.
- ***Neptune*** is on the far side of the Sun this month. It won't be visible until mid-April.

Other Events:

-March 4th:	Venus 0.1 degrees from Uranus.
-March 5th:	Full Moon.
-March 8th:	Daylight savings time. Move your clocks ahead one hour. Zodiacal light in the West after evening twilight for the next 2 weeks.
-March 11th:	Mars 0.3 degrees from Uranus.
-March 13th:	Last quarter Moon.
-March 20th:	The Vernal Equinox. It's officially spring! Maybe the temperature will get above freezing.
-March 21st:	Mars and the Moon only 1.0 degrees apart in the low in the west after sunset.
-March 27th:	First quarter Moon.

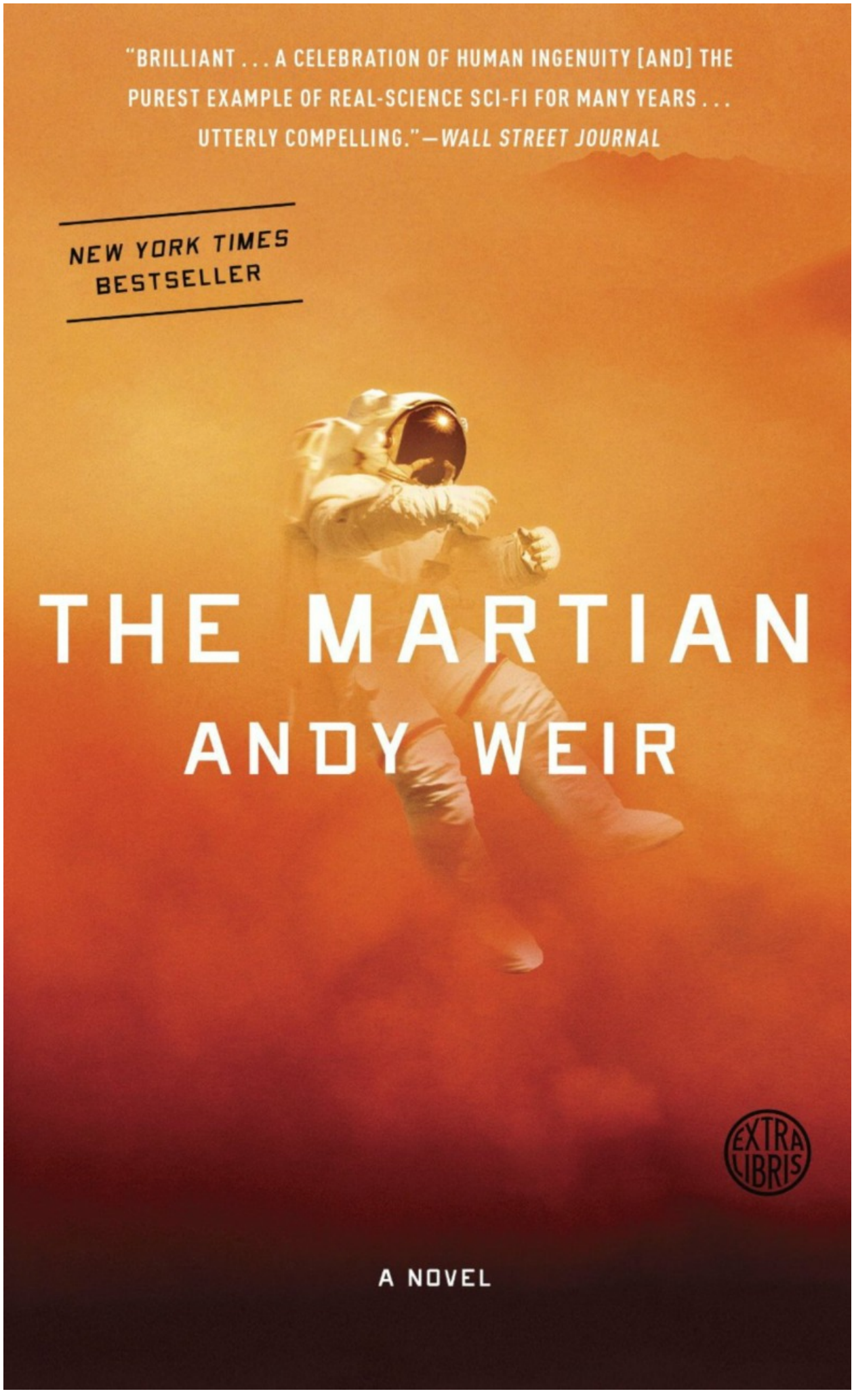
Eye Candy

Conjunction of the Moon, Venus and Mars, on February 20, 2015, by **John Gauvreau**
ISO 400, f/8 and 0.6 seconds exposure, tripod mounted.

Conjunction of the Moon, Venus and Mars, on February 20, 2015, by **Everett Cairns**

Book Review — The Martian by David Tym

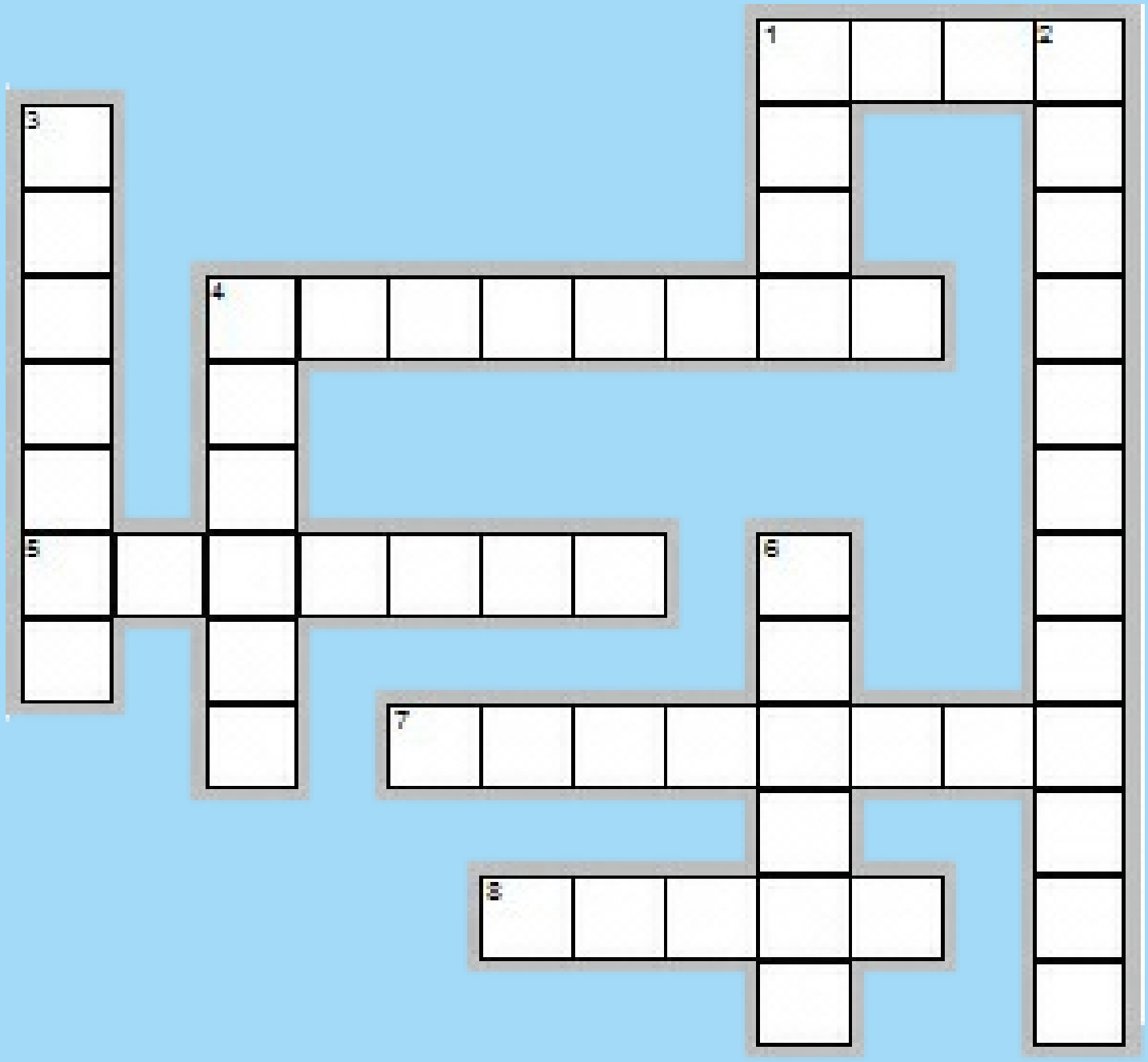
The Martian by Andy Weir is a novel set in the near future where manned missions to Mars are a reality. This is a castaway story focusing on a NASA astronaut, Mark Watney, who is left stranded on the surface of Mars during an emergency evacuation. With nothing but the mission supplies on hand and an unwavering will to live, Watney must not only figure out how to survive on Mars but get back to Earth.



The Martian explores a one man struggle against incredible odds and as each problem presents itself to Watney, Weir writes their solution with scientifically plausible outcomes that lend credibility to the story. As a self-professed science geek, Weir takes the time to get the science right. Well read on the latest space research, Weir's commitment to accuracy went so far as to calculate orbital paths involved in the story.

The Martian is sure to please the geek at heart but is approachable as an exciting page-turner for the casual reader. The Martian is difficult to put down and while it's set to be released in movie format for November 2015, Weir's novel is worth checking out. It provides a credible glimpse into a possible future of manned missions to Mars and the strength of human spirit and resilience.

Astronomy Crossword by Mario Carr



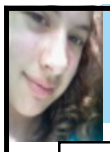
Across

1. On March 21 this object is close to Mars in the evening sky.
4. The full moon on March 5 will be ? of the year.
5. On March 20 Spring finally arrives with this event at 6:45 p.m.
7. For the next two weeks after March 8, you could see this type of light.
8. On March 22 the Moon is close to this planet in the evening sky.

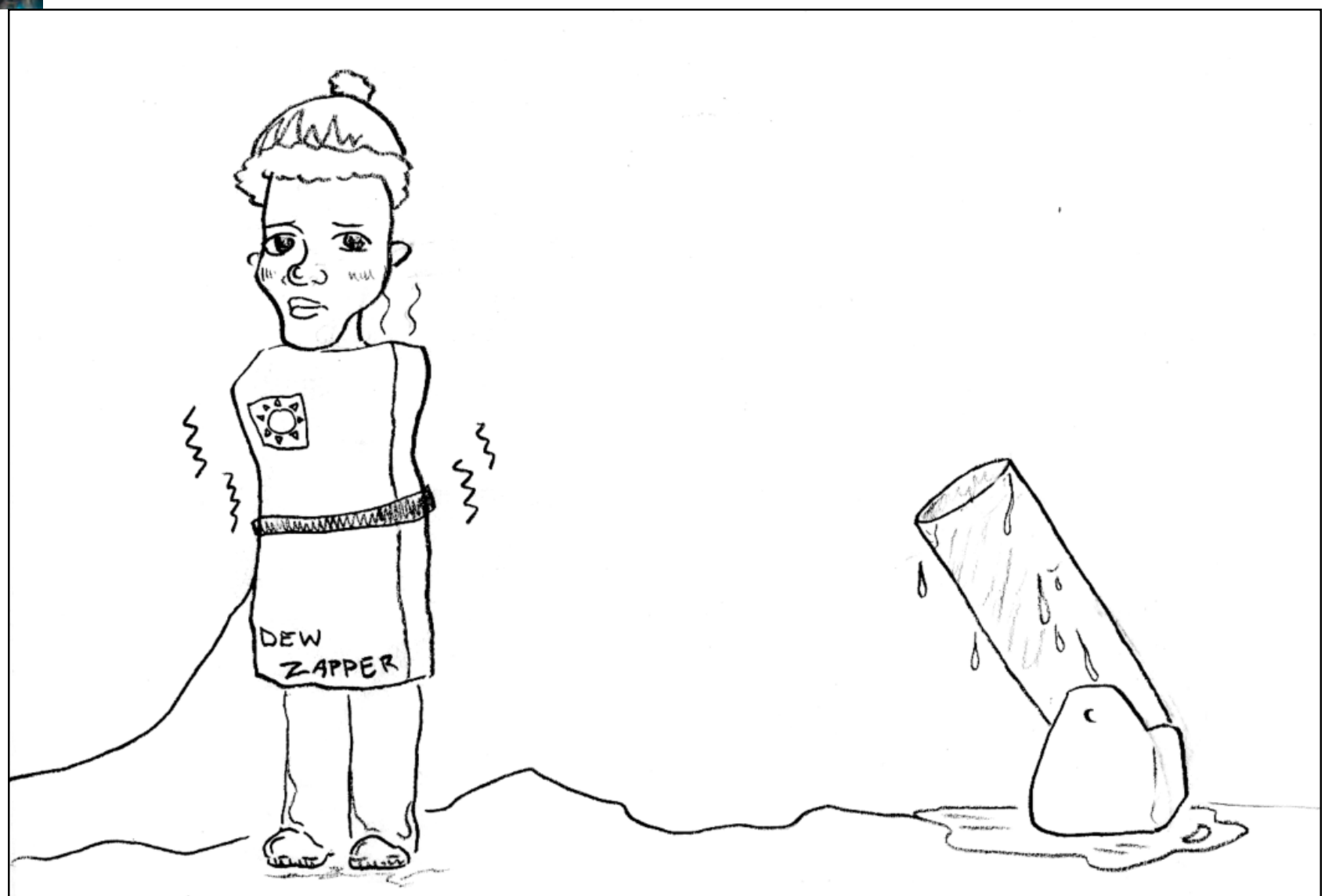
Down

1. On March 10 & 11 this planet and Uranus are close in the evening sky.
2. If you're in this place on March 20, you could see a partial solar eclipse during sunrise.
3. On March 29 the Moon is below this planet in the evening sky.
4. On March 12 the Moon is close to this planet in the morning sky.
6. This planet and Venus are extremely close on March 4. It's also an excellent opportunity to see the planet with binoculars.

Answers can be found on page 21. (No peeking!)



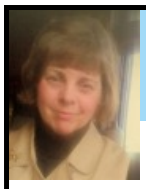
Cartoon Corner by Alexandra Tekatch



February 2015

First Experience At Seeing the Large Megellanic Cloud by Tom Kelly

Since I am now down under in a beautiful lakeside town called Topau surrounded by volcanoes and a fairly dark sky and clear I thought I would finally get to see the Magellanic Clouds. So off I went to the shoreline with the best southern exposure armed with my Celestron binoculars. My first surprise was to see Orion clear and sharp but of course upside down. The southern milky way was directly overhead and I could pick out Triangulum Australe and the Southern Cross but couldn't find the Magellanic Clouds since I was looking for these great big bright nebulae like you see in the photos. After using the search function of the night sky for deep space objects it directed me to look right where I thought it should be and then it became clear that what I was looking at was a very large dark grey irregular shaped cloud that didn't move and had a very bright object that looked like a star cluster at the top. Now I know why Magellan called it a cloud because that is just what it looked like, a dark dusty cloud obscuring the background stars. This cloud was huge and also visible to the unaided eye and about the diameter of 20 full moons. Since I now knew what to look for, I could also find the Small Magellanic Cloud. I was amazed to see how seemingly close they were to Orion since I could see both in the same sky. I hope to visit an Observatory in Sydney Australia before I leave for home.
Clear skies to you all.



Lights on the Moon: Moon Express by Denise White

While surfing the net, I stumbled upon an event called Ideacity; a "think tank" conference that acts like an "incubator for inspiration" for privileged ticket holders. Each June, for the last sixteen years, a mélange of elite scholars, from avant-garde literary giants and artistic talents, to visionary scientists and innovative entrepreneurs, convene in Toronto to partake in what is reputed to be 'Canada's Premier Meeting of the Minds'. Over the course of three days, the smartest people talk about their biggest ideas in a dynamic open forum. Ideacity alumni have included Romeo Dallaire, Margaret Atwood, and Michael Ignatieff. The entry fee to this sparkling affair is just a mere $3,000 plus HST (that's only if one registers before March 31, 2015, otherwise it will cost $5,000 plus HST at the door). I am sure the entry fee is a little too steep for most of us; however, 'Everyman' dreamers need not to despair since Ideacity lectures are uploaded onto the computer. It was from one of these videoed presentations I learned of **Moon Express Inc.**, a company led by Dr. Robert D. Richards, a former assistant to Carl Sagan.

Richards is a Canadian-born space entrepreneur and CEO of Moon Express Inc., a privately funded U.S. company headquartered in Moffett Field, California with propulsion development and testing facilities in Huntsville, Alabama. Frustrated by the slow progress of the space flight industry, Richards and his co-founders, Mr. Naveen K. Jain and Dr. Barney Pell, formed a lunar transportation and data services company in 2010 with the ambition to explore new channels for commercial space activities beyond Earth. Four years later, Dr. Andrew Aldrin, the son of Buzz Aldrin, left his executive position with United Launch Alliance-Boeing to become MoonEx's president; he felt this creative company's space industry vision corresponded better with his own ideas of space exploration. Moon Express, says Richards, is "… blazing a trail to the moon to unlock its mysteries and resources for the benefit of life on Earth and our future in space." MoonEx's prime directive is to build robotic rovers to mine moon material. They also plan to mount, by 2018, two telescopes; one radio and one optical on the 5 kilometers (3.1 miles) high Malapert crater located on the moon's far side.

MoonExpress Inc. secured a 10 million dollar commercial lunar contract from NASA (National Aeronautics Space Administration), a U.S. government space agency that began in 1958. Richards and his partners have forged strong ties with NASA working with this American space agency as both a collaborator and a customer. Besides the partnership with NASA, this lunar transportation company has taken on the challenge of being a competitor in the 30 million dollar Google Lunar X Prize. Google is sponsoring an international competition for innovators to go back to the moon with the hopes of expanding the world's economic sphere outward. Robert K. Weiss, vice-chairman and president of Google Lunar X Prize says a "whole new economy around low-cost access to the Moon" is worth investigating. Moon Express is feverishly working on their spacecraft design to meet the December 31, 2016 competition deadline.

No one has been back to the moon since 1972; only twelve human beings, in the last forty-three years, have walked on the moon's surface (Neil Armstrong, Buzz Aldrin, Pete Conrad, Alan Bean, Alan Shepard, Edgar Mitchell, David Scott, James Irwin, John Young, Charles Duke, Eugene Cernan and Harrison Schmitt). Unified Space Vision Institute representative, Dr. Buzz Aldrin says space exploration has been "purely a governmental adventure" with the "private sector being on the sidelines and building only what the government has largely paid for" but now he feels this is changing with the private sector pursuing the commercial development of orbital passenger travel (e.g.,Virgin Galactic). The former moon walker expects the private sector will be responsible for the next US landing on the moon. This space endeavour, he says, will "build on the accomplishments of Apollo with a new paradigm of commercial lunar activity that will unlock the moon's resources..." . Both Dr. Buzz Aldrin and Moon Express Inc. believe the private sector will advance ways to access the moon faster and more cheaply.

(Continued on page 12)

Lights on the Moon: Moon Express (continued)

Our moon's formation history sheds light on the private sector's excitement for moon exploration. The widely accepted "Giant Impact" theory suggests that the newly formed infant Earth had chunks of it blasted into space after an enormous Mars-sized planet body crashed into it 4.5 billion years ago. Richards and others like him, surmise, "What happened to Earth, happened to the moon." These two celestial bodies have nearly the same oxygen isotope ratios. If the Earth and the Moon were "formed from the same pool of raw material" as some scientists suspect it was, then this means the resources we use on Earth are likely on the moon too.

The Moon has been "an aggregator of accessible asteroid resources" for billions of years. Asteroids have bombarded the moon's untouched surface for eons, and as a result, precious Earth-like mineral elements have accumulated in immense quantities. In the last fifteen years, orbital probes have returned an enormous amount of information about our Moon's geology. This data has enabled scientists to map out the Moon's geology with great accuracy. Sampled moon materials brought back from Apollo missions have yielded rich geological information. Valuable mineral elements such as platinum, silver, gold, iron, nickel, aluminum, gems, uranium, titanium, thorium, silicon, potassium, calcium, oxygen, and hydrogen all exist in the moon rocks. A vast unspoiled geological resource is sitting on the moon; a "gold mine" that is fueling the moon rush.

Although the moon is rich in geological material, there is something even more precious on the moon --- water. The recent discovery of large quantities of water on the moon, particularly at the poles and in the moon craters now makes lunar space exploration even more economically viable. According to Richards, water on the moon is a game changer for space exploration; since it is the "oil of the solar system." Water is composed of hydrogen and oxygen and that is exactly what is required to make rocket fuel. The Canadian space entrepreneur believes it will no longer be necessary to take fuel to the moon --- space vehicles will have the capacity to re-fuel themselves by using the resources on the moon and this will result in big savings for the space industry.

New technologies have made moon resource exploration a promising project for the private sector, and businesses are more willing to risk their investments to make this new world economy a reality. Moon Express Inc. has designed their MX-1 lunar lander so it can execute a legion of tasks out in Earth's orbit and in deep space. This programmed robotic spacecraft will carry out such exercises as satellite servicing, space tugging and lunar sample returning. Richards claims, "The MX-1 is the 'iPhone of space'; a platform capable of supporting many apps…" including our company's "… core plan of exploring the Moon for resources of benefit to humanity."

A typical satellite weighs up to 5,000 kilograms; this extra bulk takes up the rocket's entire payload fairing and that makes launch costs expensive. Moon Express's MX-1 lunar lander is a lighter spacecraft; it weighs only 600 kilograms (1,320 lbs.) and is about the "size of a large coffee table." The MX-1 robotic lander's compact design makes it a cheaper secondary payload to "hitchhike" a rocket ride. However, Andrew Aldrin says, some business-contractual issues still have to be worked out before Moon Express Inc. can depend on any ride share plan.

Another key technological development involves the propulsion of the MX-1 robotic spacecraft. Moon Express Inc. intends to use multiple fuels to propel its spacecraft; this is a very unconventional choice in the space industry.

"The main engine for the MX-1 is a bipropellant liquid fuel rocket designed to use high concentration hydrogen peroxide as a monopropellant, assisted by injections of kerosene when breaking out of Earth orbit. The engine will use hydrogen peroxide alone for most maneuvers, with kerosene only being used to enter the Earth-Moon transfer orbit." The designers of MX-1 hope

(Continued on page 13)

Lights on the Moon: Moon Express (continued)

to manufacture extra rocket fuel on the moon's landing site using lunar water --- "this is what is sometimes known in the English civil service as a courageous decision."

Moon rocks and lunar water are not the only factors motivating Moon Express to travel to the Moon; this company wants to push space exploration for humanitarian reasons too. Man, asserts Dr. Richards, should not solely be dependent on one single planet. "It is true that in geological sequences of history, not much happens to a planet but every once in a while something does" says the space entrepreneur. Asteroids have smashed into earth before (e.g., extinction of the dinosaurs), and there is a good chance it can happen again." Richards says if we are to survive, "we must become a space bearing civilization and learn to become a multi-world species --- all of life on earth may depend on this ability. And if we understand how other worlds work through space exploration, then we will better understand our own planet."

The moon, once thought to be a dead, dry ball of rock, is firing up the imagination of the private sector and its sparking up a "Moon rush" that harkens back to the Alaskan gold rush days. The "eighth continent" of the world offers a new commercial avenue to develop with its mineral rich rocks, and its "lunar" water. Moon Express, by merging the best practices of traditional aerospace knowledge with the innovative entrepreneurial spirit of the space industry, expects to be the first private company to land on the moon to mine its resources. Through their advanced forms of space mining exploration, private lunar companies will contribute scientific knowledge that can both enrich and secure humanity's future in becoming a multi-world species. If Richards and the Moon Express team realize their dream, the next generation just might see the glow of man-made lights beaming from the moon.

Sources:

http://www.ideacityonline.com/ideacity-2014/

http://robertdrichards.com/id4.html

http://en.wikipedia.org/wiki/Moon_Express

https://www.youtube.com/watch?v=cbsnXWLYQ6w

http://lunar.xprize.org/teams/moon-express

https://www.facebook.com/MoonExpress

http://www.sciencedaily.com/releases/2014/06/140605141503.htm

http://science.nasa.gov/science-news/science-at-nasa/2009/24sep_moonwater/

http://www.nytimes.com/2009/11/14/science/14moon.html?_r=0)

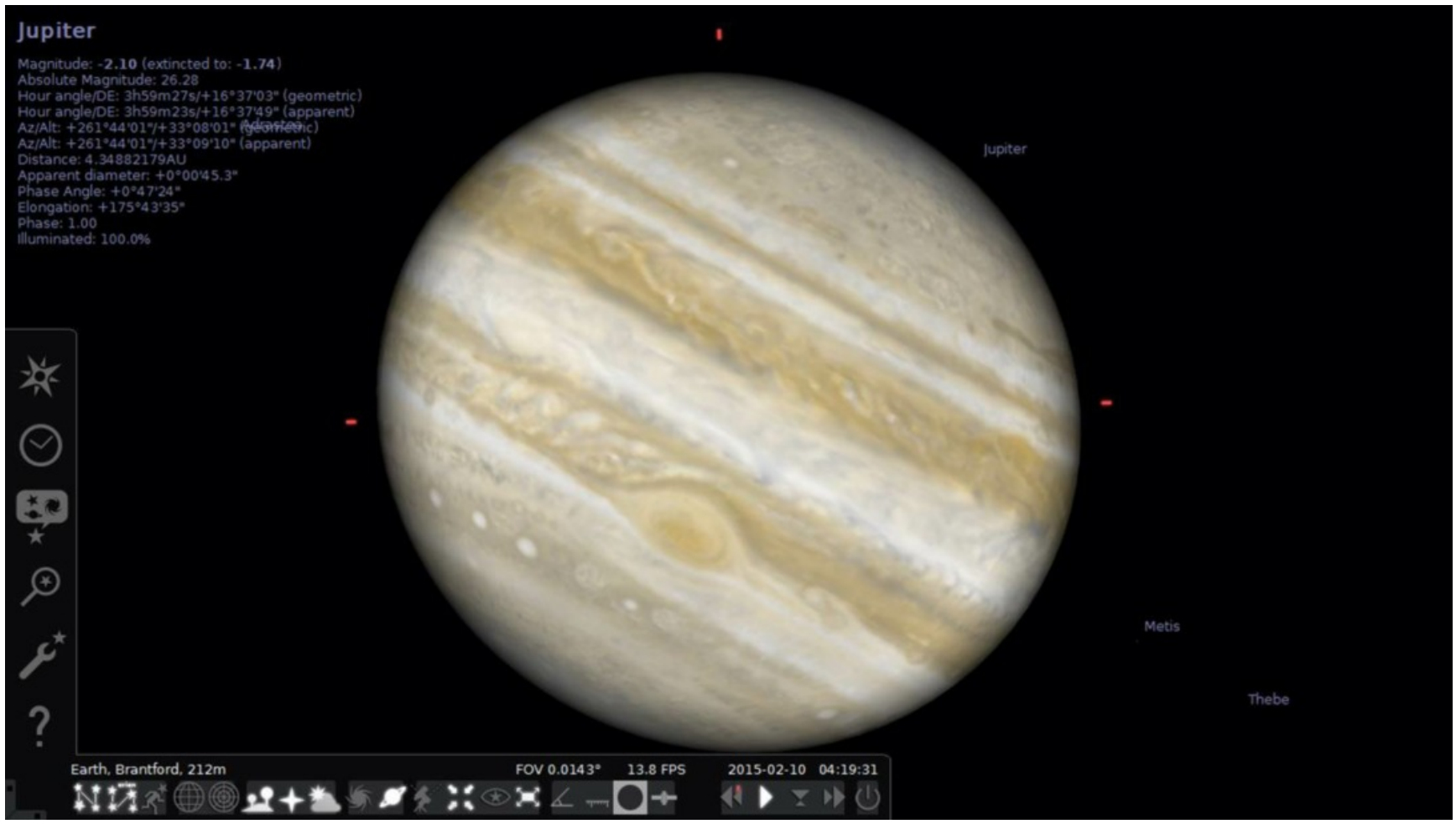
http://www.gizmag.com/moon-express-mx-1-lunar-lander/30050/

http://en.wikipedia.org/wiki/Payload_fairing

Quirks of Stellarium by Matthew Mannering

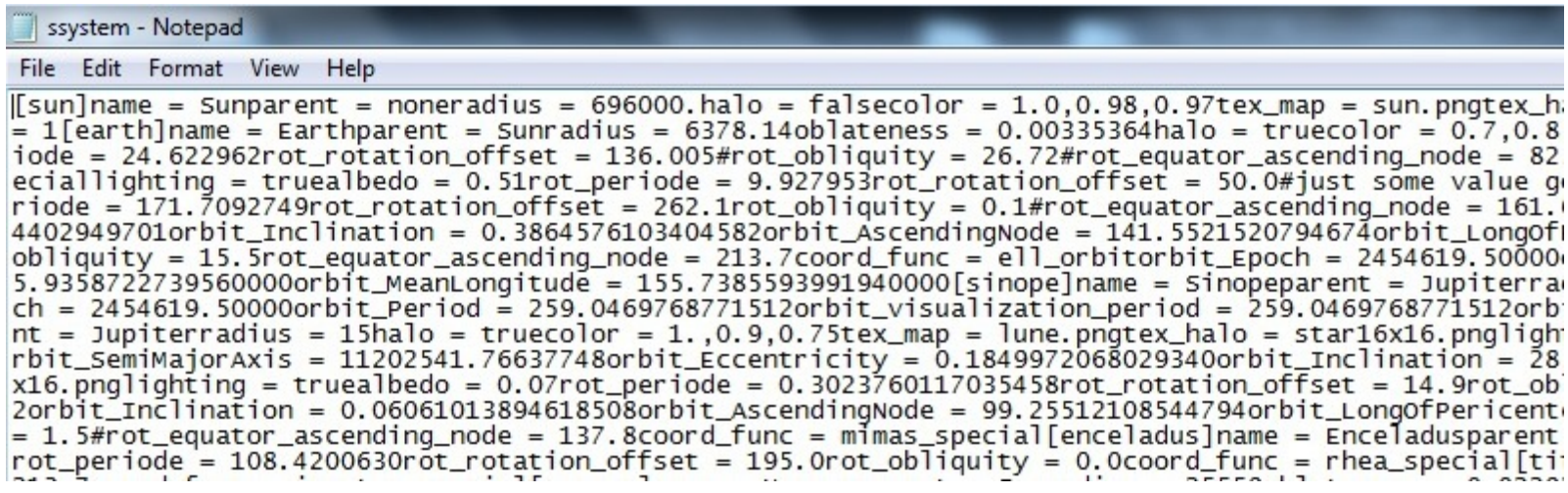
Stellarium is a great free planetarium program for windows. It does however have a few problems or quirks that you should be aware of.

First of all the Great Red Spot calculation gets out of whack after 6 months or so. Once that happens, the GRS will appear to be centered on the disk at the wrong times as seen from Earth. This is what Stellarium looks like when you zoom in on Jupiter.



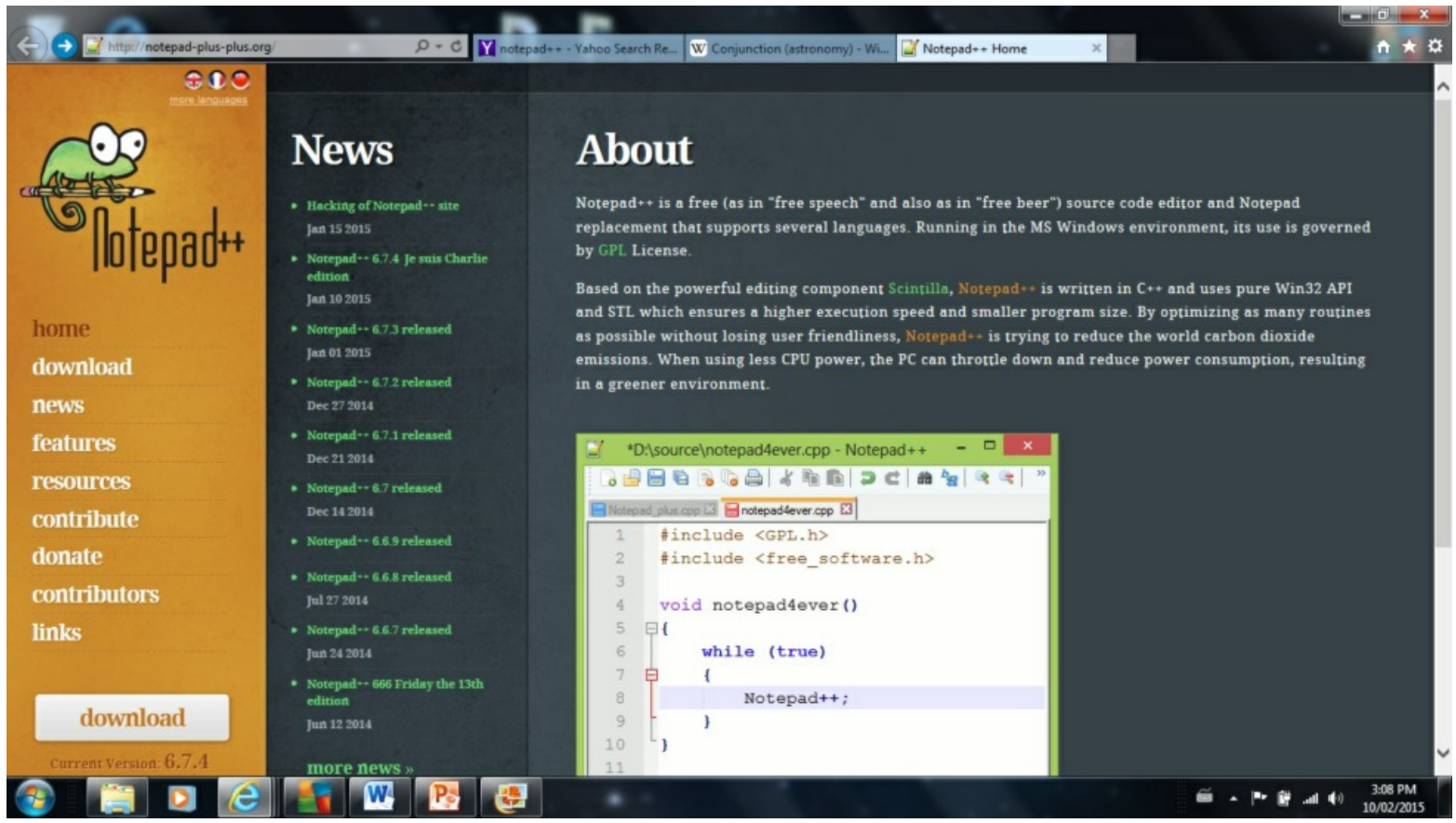
You can fix this problem manually as follows. The file that needs updating is called **'ssystem.ini'**. Note that there are several copies of this file in different locations on your disk and only one of them will actually affect the functioning of the program. Use the Windows Explorer file system to find all of the versions on your C: drive. I had to change a copy and see if Stellarium ran differently. If it doesn't then you have the wrong version of the file. Change a version in a different location and restart Stellarium. The version that worked for me was located in **C:\Users\User\AppData\Roaming\Stellarium\data**. You could change this file using Notepad on your PC but the format will look like this below. As you can see, this isn't a very user friendly way of modifying the contents.

(Continued on page 15)



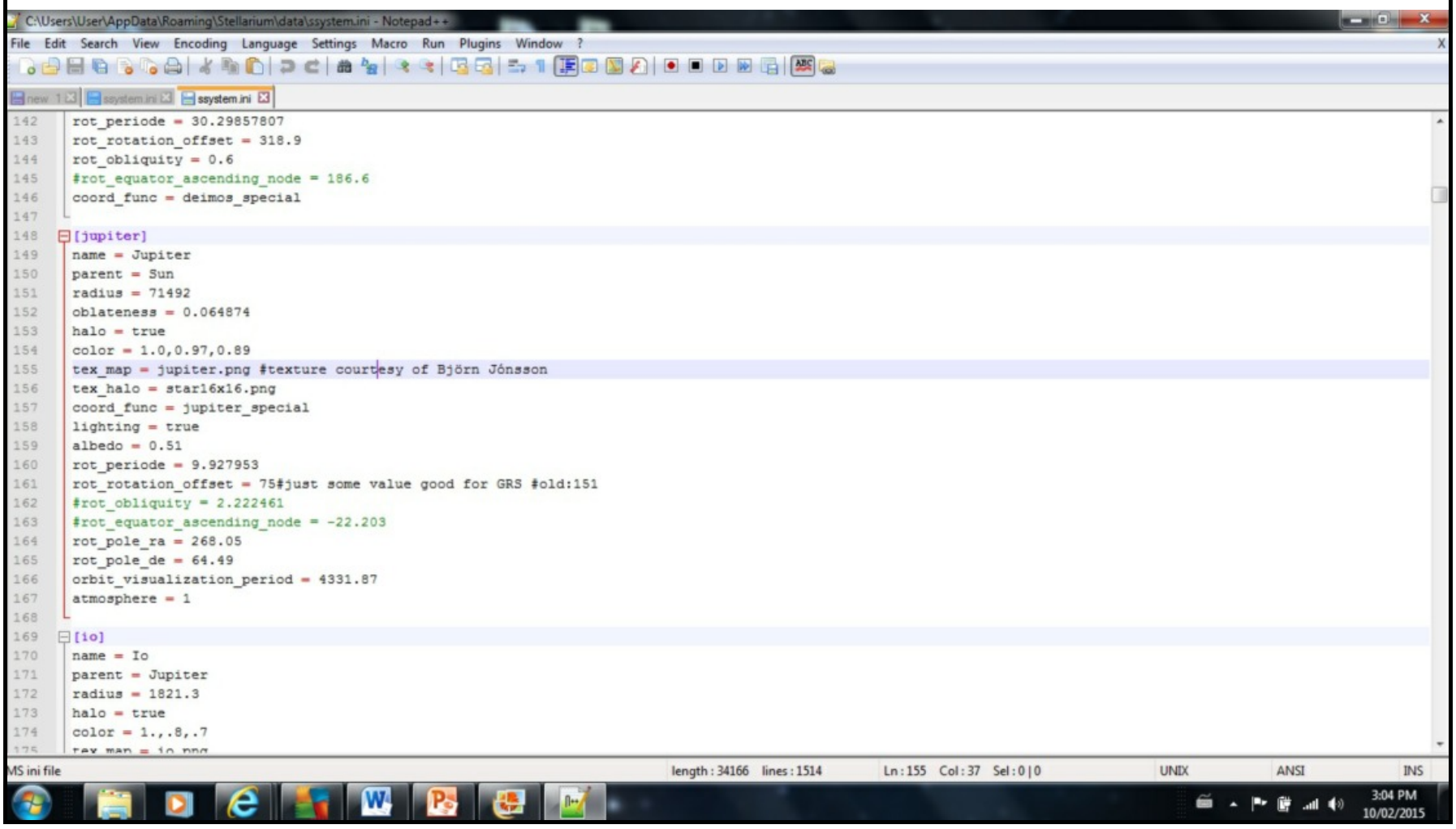
Quirks of Stellarium (continued)

Instead, I would recommend downloading **Notepad++** from notepad-plus-plus.org. This program will format the 'ssystem.ini' file in a much more friendly way.



Once you have installed Notepad++, you can open the 'ssystem.ini' file and scan down to the section marked Jupiter as shown below.

(Continued on page 16)

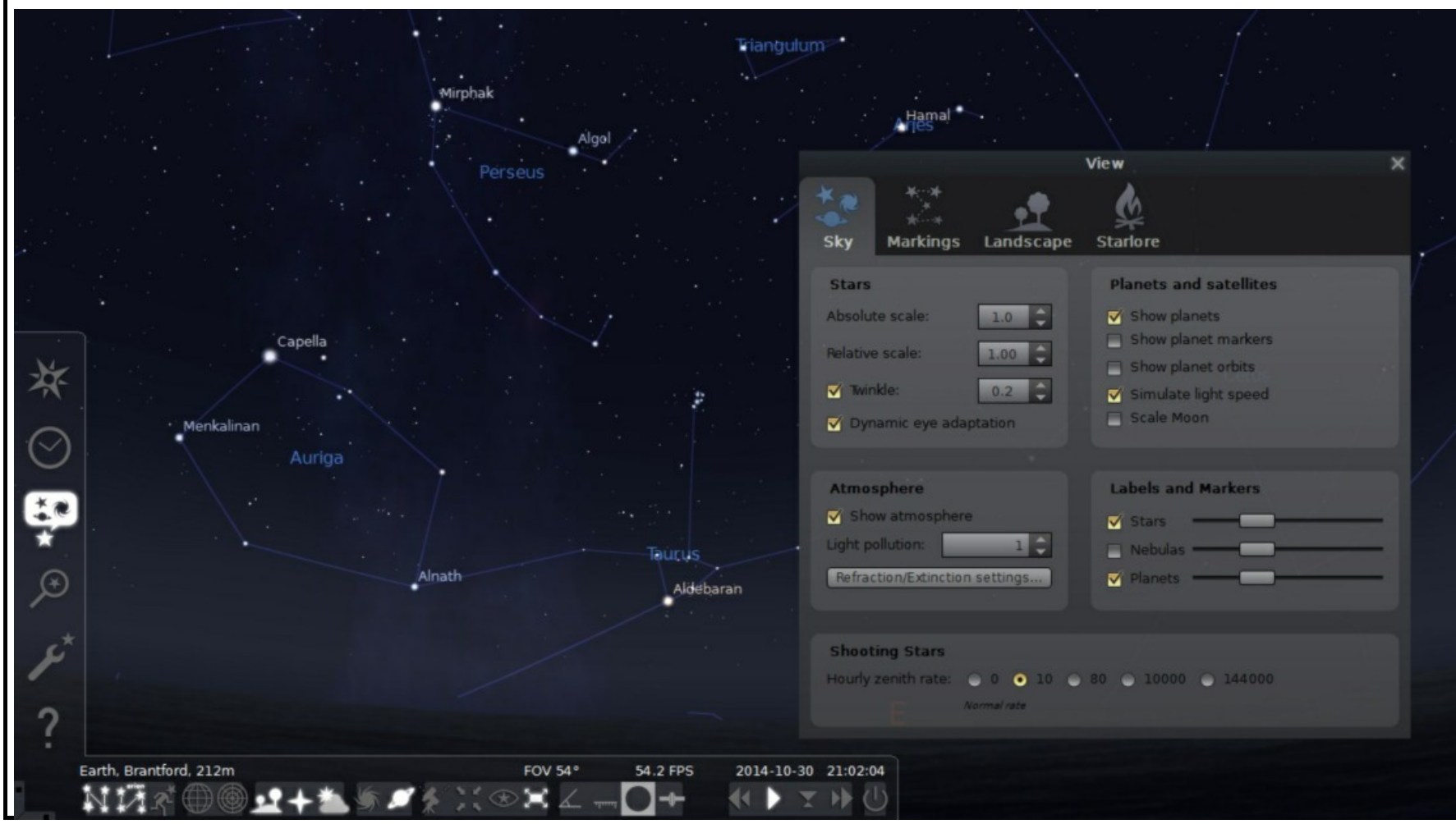


Quirks of Stellarium (continued)

Next, change the **rot_rotation_offset** parameter. You can try 75 as an initial value. Save the file and restart Stellarium. Zoom in on Jupiter at a known time when the GRS should be centered on the face. You can find this information online or in magazines such as Sky and Telescope. If it isn't centered, close Stellarium and change the parameter again by guessing at another value and start Stellarium again. Notice the change in location of the GRS and continue to adjust the parameter until it looks right. If the GRS is close to being centered, only make small changes to the value.

```
150  parent = Sun
151  radius = 71492
152  oblateness = 0.064874
153  halo = true
154  color = 1.0,0.97,0.89
155  tex_map = jupiter.png #texture courtesy of Björn Jónsson
156  tex_halo = star16x16.png
157  coord_func = jupiter_special
158  lighting = true
159  albedo = 0.51
160  rot_periode = 9.927953
161  rot_rotation_offset = 75#just some value good for GRS #old:151
162  #rot_obliquity = 2.222461
```

Another quirk of Stellarium is that it assumes when observing the moons of a planet in our solar system that you are right there. So things like moon shadow transits will appear to happen at totally different times than when you would observe them here on Earth. This is because the light from those events (using Jupiter as an example) takes about 40 minutes to reach the Earth. Planets that are even further away such as Saturn, Uranus or Neptune create an even longer lag time. Call up the Sky settings menu and put a check mark in the Simulate light speed box. Once you do this, the program will account for the amount of time light takes to get from the planet to Earth and now the transits will occur at the correct times.



NASA's Space Place

The heavyweight champion of the Cosmos

By Dr. Ethan Siegel

As crazy as it once seemed, we once assumed that the Earth was the largest thing in all the universe. 2,500 years ago, the Greek philosopher Anaxagoras was ridiculed for suggesting that the Sun might be even larger than the Peloponnesus peninsula, about 16% of modern-day Greece. Today, we know that planets are dwarfed by stars, which themselves are bound together by the billions or even trillions into galaxies.

But gravitationally bound structures extend far beyond galaxies, which themselves can bind together into massive clusters across the cosmos. While dark energy may be driving most galaxy clusters apart from one another, preventing our local group from falling into the Virgo Cluster, for example, on occasion, huge galaxy clusters can merge, forming the largest gravitationally bound structures in the universe.

Take the "El Gordo" galaxy cluster, catalogued as ACT-CL J0102-4915. It's the largest known galaxy cluster in the distant universe. A galaxy like the Milky Way might contain a few hundred billion stars and up to just over a trillion (10^{12}) solar masses worth of matter, the El Gordo cluster has an estimated mass of 3×10^{15} solar masses, or 3,000 times as much as our own galaxy! The way we've figured this out is fascinating. By seeing how the shapes of background galaxies are distorted into more elliptical-than-average shapes along a particular set of axes, we can reconstruct how much mass is present in the cluster: a phenomenon known as weak gravitational lensing.

That reconstruction is shown in blue, but doesn't match up with where the X-rays are, which are shown in pink! This is because, when galaxy clusters collide, the neutral gas inside heats up to emit X-rays, but the individual galaxies (mostly) and dark matter (completely) pass through one another, resulting in a displacement of the cluster's mass from its center. This has been observed before in objects like the Bullet Cluster, but El Gordo is much younger and farther away. At 10 billion light-years distant, the light reaching us now was emitted more than 7 billion years ago, when the universe was less than half its present age.

It's a good thing, too, because about 6 billion years ago, the universe began accelerating, meaning that El Gordo just might be the largest cosmic heavyweight of all. There's still more universe left to explore, but for right now, this is the heavyweight champion of the distant universe!

Learn more about "El Gordo" here: http://www.nasa.gov/press/2014/april/nasa-hubble-team-finds-monster-el-gordo-galaxy-cluster-bigger-than-thought/

El Gordo is certainly huge, but what about really tiny galaxies? Kids can learn about satellite galaxies at NASA's Space Place http://spaceplace.nasa.gov/satellite-galaxies/.

(Continued on page 18)

NASA's Space Place (continued)

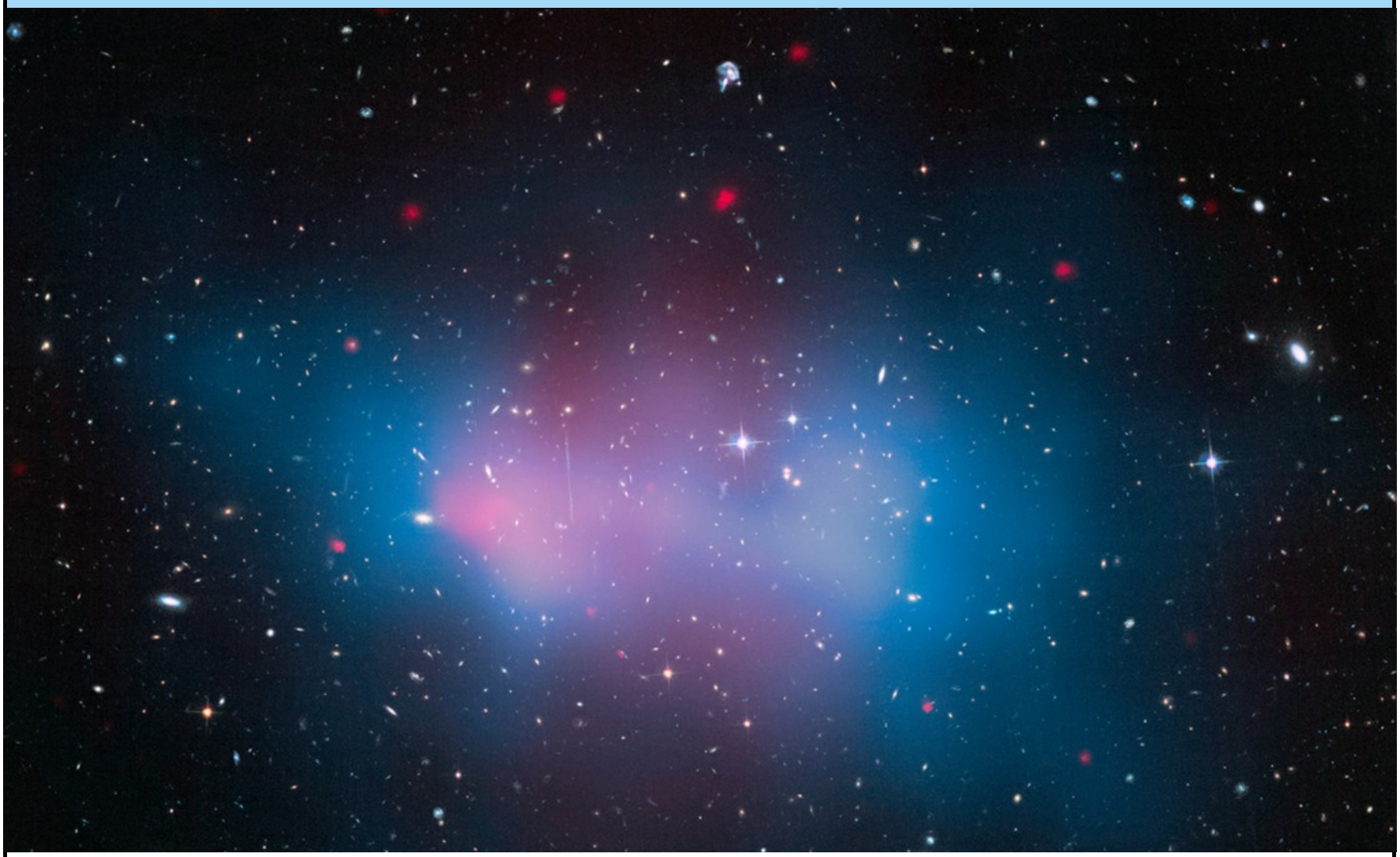


Image credit: NASA, ESA, J. Jee (UC Davis), J. Hughes (Rutgers U.), F. Menanteau (Rutgers U. and UIUC), C. Sifon (Leiden Observatory), R. Mandelbum (Carnegie Mellon U.), L. Barrientos (Universidad Catolica de Chile), and K. Ng (UC Davis). X-rays are shown in pink from Chandra; the overall matter density is shown in blue, from lensing derived from the Hubble space telescope. 10 billion light-years distant, El Gordo is the most massive galaxy cluster ever found.

Treasurer's Report by Steve Germann

Treasurer's report for February 2015 (Unaudited)

Opening balance:	$8,426.70
Revenue:	$366.00
Expenses:	$700.00
Closing Balance:	$8,092.70

Revenue included $56 from 50/50, $105 from calendar sales, and $205 from memberships.
Expenses consisted of $200 BASEF prize and $500 BASEF Bronze Sponsorship

Total calendar sales as of now are $2815. Net income approximately $700. Cost of printing was $2118.75. There are a few calendars remaining. Thank you for your support of the Calendar Project.

William J. McCallion Planetarium

McMASTER UNIVERSITY, HAMILTON, ONTARIO

- **Public shows every Wednesday (7:00pm)**
- **Public transit available directly to McMaster campus**
- **Tickets $7 per person; private group bookings $150**
- **Different shows every week**
- **Upcoming shows include:**

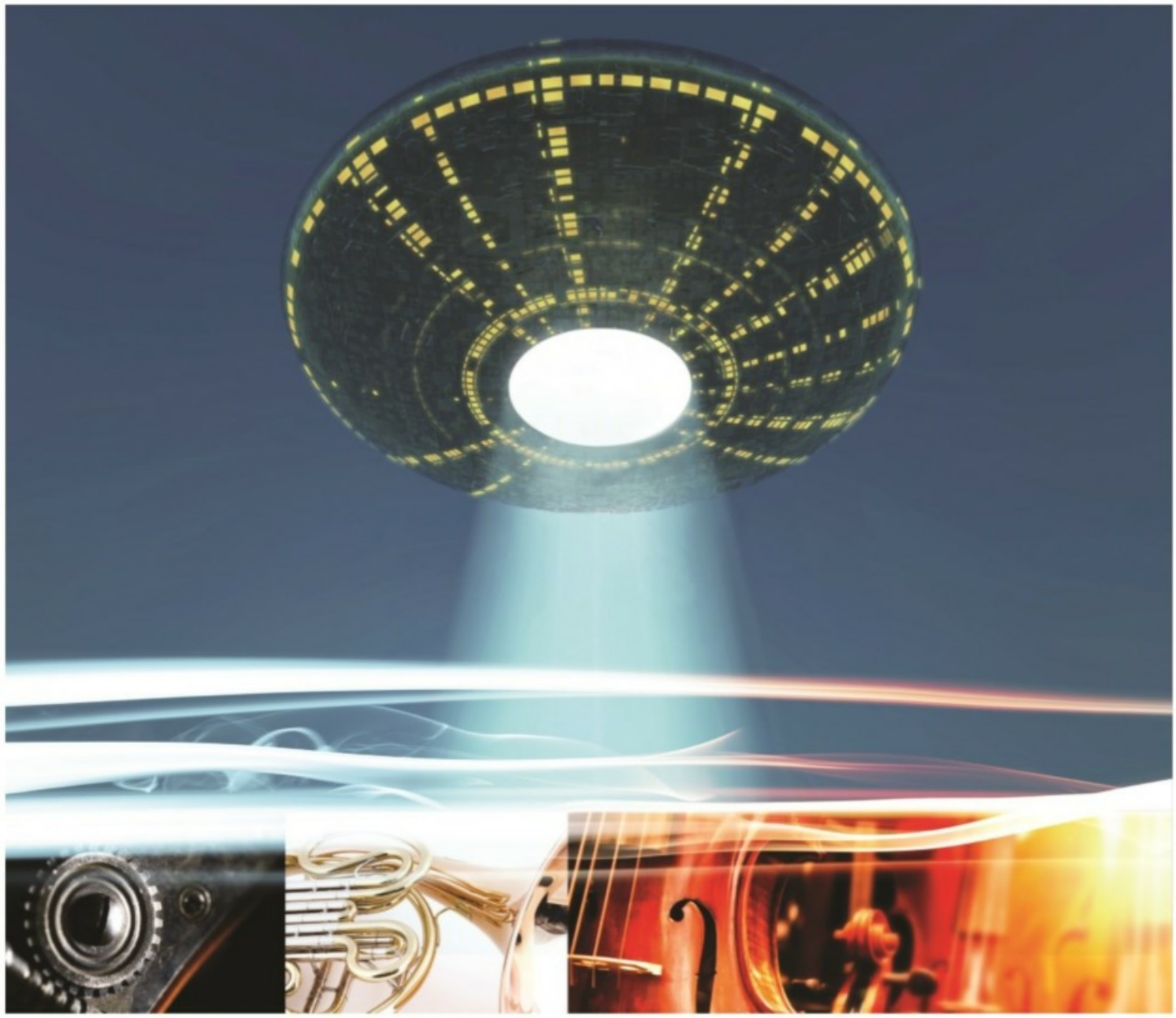
  - **Mar 4: Introductory Astronomy for Kids (1st Wed of every month)**
  - **Mar 11: Ancient Astronomy**
  - **Mar 18: Themed Astronomy for Kids Show – Explosions!**
  - **Mar 25: Cosmic Footprints**

For more details, visit

www.physics.mcmaster.ca/planetarium

HPO Hamilton Philharmonic Orchestra

14-15



Sci-Fi Spectacular

Mar 21, 2015, 7:30pm
Hamilton Place

David Martin
Conductor

Larry Larson
Trumpet

Go where no show has gone before. An out of this world musical adventure featuring music from your favourite sci-fi hits including *Star Trek, Twilight Zone, E.T., Planet of the Apes,* and *Close Encounters.* Live long and prosper. Costumes welcome!

Visit us online today at hpo.org for tickets or call the HPO Box Office at 905.526.7756

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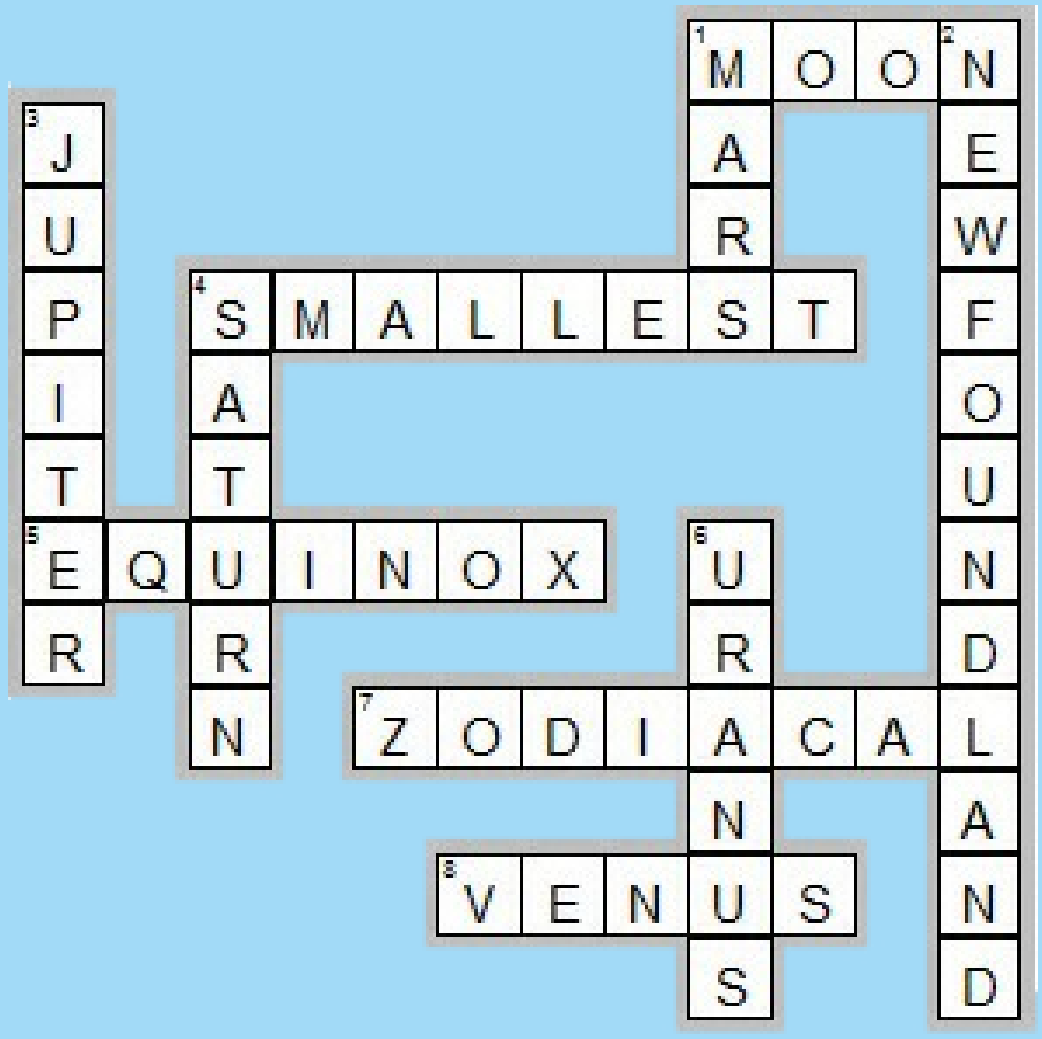
Answers to Astronomy Crossword on Page 9



UPCOMING EVENTS

March 7, 2015 - 7:30 pm — *Astrophotograghy Group Meeting*. Contact H.A.A. Chair for location.

March 13, 2015 - 7:30 pm — *General Meeting* at the Hamilton Spectator Auditorium. Our main speaker will be John Gauvreau. John is a longtime member of the H.A.A., and is our Education Director. He was an astronomy instructor at Mohawk College for 20 years, and has spoken at a wide variety of venues. John's talk will be entitled "New Horizons; Space Exploration Today".

March 28, 2015 - 7:30 pm - 11:00 pm — *Public Stargazing Night* at the Niagara Gateway Tourism Centre, Grimsby, ON.

April 10, 2015 - 7:30 pm — *General Meeting* at the Hamilton Spectator Auditorium.

2014-2015 Council

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Second Chair	Joe McArdle
Treasurer	Steve Germann
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