Orbit

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Roger Hill, Editor

Last month, I greeted March with much enthusiasm, and it was wholly justified.

Part of it was that although METUL Night #2 was predicted to be cloudy, it didn't start off that way. As a result, three planets were seen: Earth (sorry Ed), Venus and several degrees further away, Mercury was seen in binoculars. When it got a bit darker, Mercury was seen without any aid whatsoever. Within the hour, though, it was cloudy, so we missed Uranus.

There were four of us that night: myself, Ed Mizzi, Mark Smith and a very good friend of mine that I've known since High School, Ron Zabel.

Ron has always had an interest in astronomy, and we've done some observing together, most notably for the Transit of Venus in 2012. He's been to a number of meetings, but in all those years, he's never been to the Hamilton Centre's observatory. He said he was very impressed (and so he should be!). Mark and Ed showed him the Orion Nebula and what could be seen through an 8" Dobsonian before the clouds rolled in. He stayed and chatted for a while afterwards, too. All in all, an enjoyable evening.

Sunday, March 4th was a lovely, clear, Sunday evening, and that afternoon I said on the Forum that I was thinking of heading out to the Observatory. Ed Mizzi said that he was going to do something in his own backyard, but three other people decided to join me. I'm sorry I can't remember their names, but they seemed to have some fun in the dark. I brought along my 300mm f/4 Asahi Pentax lens, and connected it to my Canon T1i, with a 6nm bandpass Hα filter clip-in filter. Both were put on top of the 16" scope with the intention of taking 30x2 minute exposures. It should be noted that not very much light gets through the filter, meaning that there only a few stars that are bright enough to use LiveView with to allow focussing. You see, the lens I was using is about 30 years old, and while it was nice and sharp for the day, it suffers from chromatic aberration. However, using an extremely narrow bandpass filter means that only a single colour comes through, and chromatic aberration is therefore not an issue. The lens, though, is very nice and sharp at single wavelengths, as long as you can image something bright enough to focus! Since I was going to try to image the Horsehead Nebula, there are a couple of stars that are bright enough in Hα that Live view can see them even through the filter: Sirius and Betelgeuse. Even then, achieving focus wasn't easy, because this old lens has a rather stiff focussing mechanism. It has a nasty habit of creeping backwards slightly, so you have to move a touch beyond where you want it, and hope that it creeps back just enough. When all was said and done, though, I was reasonably happy with an hour's worth of exposures.

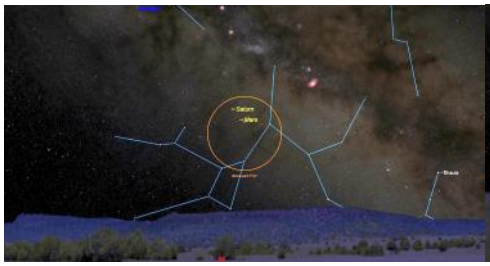
It turned out that 1 hour wasn't really sufficient, so I went back out on the 22nd, and spent another pleasant evening in the dark, this time getting 60x2 minute exposures. This resulted in a much nicer, smoother, image. When I was done, Martin Palenik (who was up there with Ed Mizzi, and their tale is told later in Orbit) said I should try imaging the Monkey's Head Nebula (NGC2174, an HII region in northern Orion) as it was a really intriguing area. I have to say, Martin knows what he's talking about, because the Jellyfish Nebula is in the same field of view using the 300mm lens. I took about 20 minutes of exposures before I'd had enough for the evening. What I took was sufficient to see that I'll need another couple of hours worth of images in that area. I may be running out of time, though, as Orion is rapidly heading toward the western horizon by the time it gets dark enough to image. There's always next year!

See you in the dark,

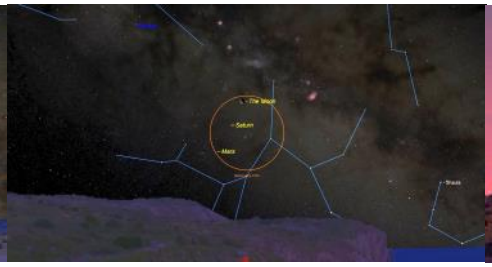
Roger

The front cover pictures this month come from Jeff Booth who has been climbing the steep learning curve with PixInsight, and used the Rosette Nebula in Monoceros to showcase his burgeoning talents. The ;lower picture shows what Chis Talpas can do from increasingly light-polluted Milton...doesn't seem to affect him, does it? And (as another Milton resident noted)...look at all those tiny galaxies! Head on over to the Forum to see them at their best!

What's up in the April Sky from Troy McCoy



Monday, April 2 - Mars meets Saturn in the southern sky between 3:30 a.m. and dawn on the morning of Monday, April 2, the orbital motion of Mars will bring it close to Saturn. With Mars about 1 degree below Saturn, the two planets will appear equally bright and fit in a binocular view (orange circle). Sagittarius will sit directly below the two planets.

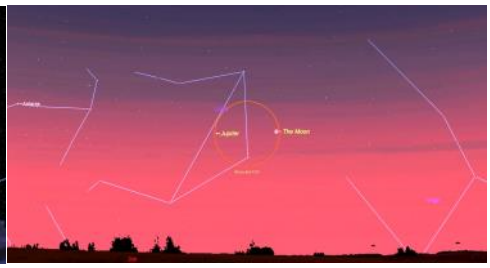


Saturday, April 7 pre-dawn – Mars, Saturn and the Moon Line up Mars will sit about 5 degrees to the lower left of the Moon, and Saturn roughly midway. The trio will appear low over the horizon after 3 a.m. local time. By dawn, they will be higher, and the moon will have shifted closer to Saturn. The trio will fit in a binocular view , and make a nice photograph.

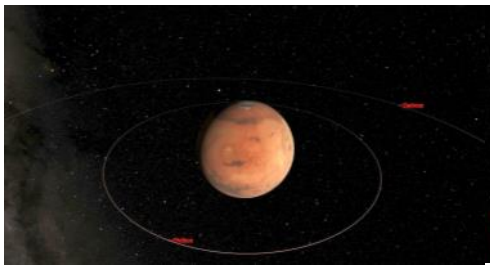
Tuesday, April 17 after sunset – Moon meets Venus Low in the western sky for about 90 minutes after sunset on Tuesday, April 17, the very young crescent moon will be visible sitting six degrees to the lower left of bright Venus. The pair will fit within the field of view of binoculars (orange circle) and make a lovely photo opportunity.

Wednesday, April 18 evening – Moon in the Hyades. The V-shaped face of the bull is formed by a large open star cluster known as the Hyades. The moon will enter the "V" at about 8:30 p.m. local time and reach the midway point by the time it sets around 10:30 p.m. local time. A few hours later, in some parts of the world, the moon occults Aldebaran.

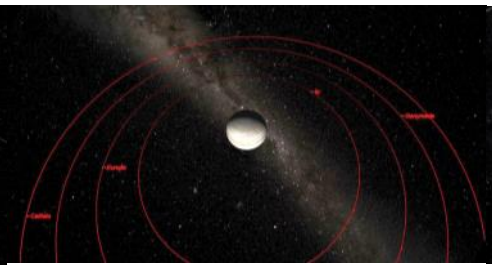
Monday, April 23 - Moon buzzes the Beehive. From late evening on Sunday to moonset on Monday morning, the moon will pass below the open star cluster in Cancer known as the Beehive, Praesepe, and Messier 44. The moon will be less than 2 degrees below the cluster as it sets around 2:30 a.m. Binoculars will show both the moon and the cluster.



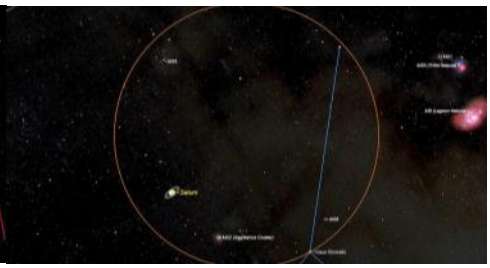
Monday, April 30 at 5:15am. Just before they set in the west on the morning of Monday, April 30, the full moon and Jupiter will be separated by only 6 degrees. The objects will appear together all night long, but will reach minimum separation of a binocular field apart (orange circle) near dawn.



Mars will spend April in the pre-dawn sky in Sagittarius. For the early days of the month, Mars will be close to Saturn, and the two planets will appear nearly equal in brightness. On April 2, Mars will pass only half a degree to the northeast of the globular star cluster Messier 22. On April 7, the last quarter moon will form a linear grouping with Mars and Saturn (see above). During April, Earth's orbital motion will continue to reduce our distance from the Red Planet. As a result, Mars will brighten from visual magnitude 0.27 to -0.38 and its apparent disk diameter will increase in size from 8.5 to 11 arc-seconds.



During April, very bright **Jupiter** (visual magnitude -2.4) will be in central Libra, slowly moving westward in a retrograde loop that will last until July. When the waning gibbous moon rises just before 11 p.m. local time on the evening of April 3, it will be positioned 4 degrees to the upper right of Jupiter. On April 30, one lunar orbit later, the nearly full moon will again pass Jupiter in almost the same position. Throughout the month, the planet will grow slightly brighter and larger in telescopes as Earth slowly draws closer to it ahead of next month's opposition.



Saturn will be easily observable in the pre-dawn sky during April, appearing as a yellowish, visual magnitude 0.5 object located above the Teapot asterism of Sagittarius and within 4 degrees of the Messier objects 22, 25, and 28. During the first week of the month, Mars will remain within a handful of degrees of Saturn, but the red planet's eastward orbital motion will steadily draw them apart. On April 7, the last quarter moon will form a linear grouping with Mars and Saturn. All three objects will appear within a binocular field of view. During April, Saturn will rise steadily earlier, becoming an evening object in May.

Monthly Sky watching information is provided by Chris Vaughn of Starry Night Education
Chris is a member of Toronto Centre - RASC
Follow Starry Night on Twitter @starrynightedu and Chris at @astrogoeguy

Measuring the Movement of Water on Earth By Teagan Wall

As far as we know, water is essential for every form of life. It's a simple molecule, and we know a lot about it. Water has two hydrogen atoms and one oxygen atom. It boils at 212° Fahrenheit (100° Celsius) and freezes at 32° Fahrenheit (0° Celsius). The Earth's surface is more than 70 percent covered in water.

On our planet, we find water at every stage: liquid, solid (ice), and gas (steam and vapor). Our bodies are mostly water. We use it to drink, bathe, clean, grow crops, make energy, and more. With everything it does, measuring where the water on Earth is, and how it moves, is no easy task.

The world's oceans, lakes, rivers and streams are water. However, there's also water frozen in the ice caps, glaciers, and icebergs. There's water held in the tiny spaces between rocks and soils deep underground. With so much water all over the planet—including some of it hidden where we can't see—NASA scientists have to get creative to study it all. One way that NASA will measure where all that water is and how it moves, is by launching a set of spacecraft this spring called GRACE-FO.

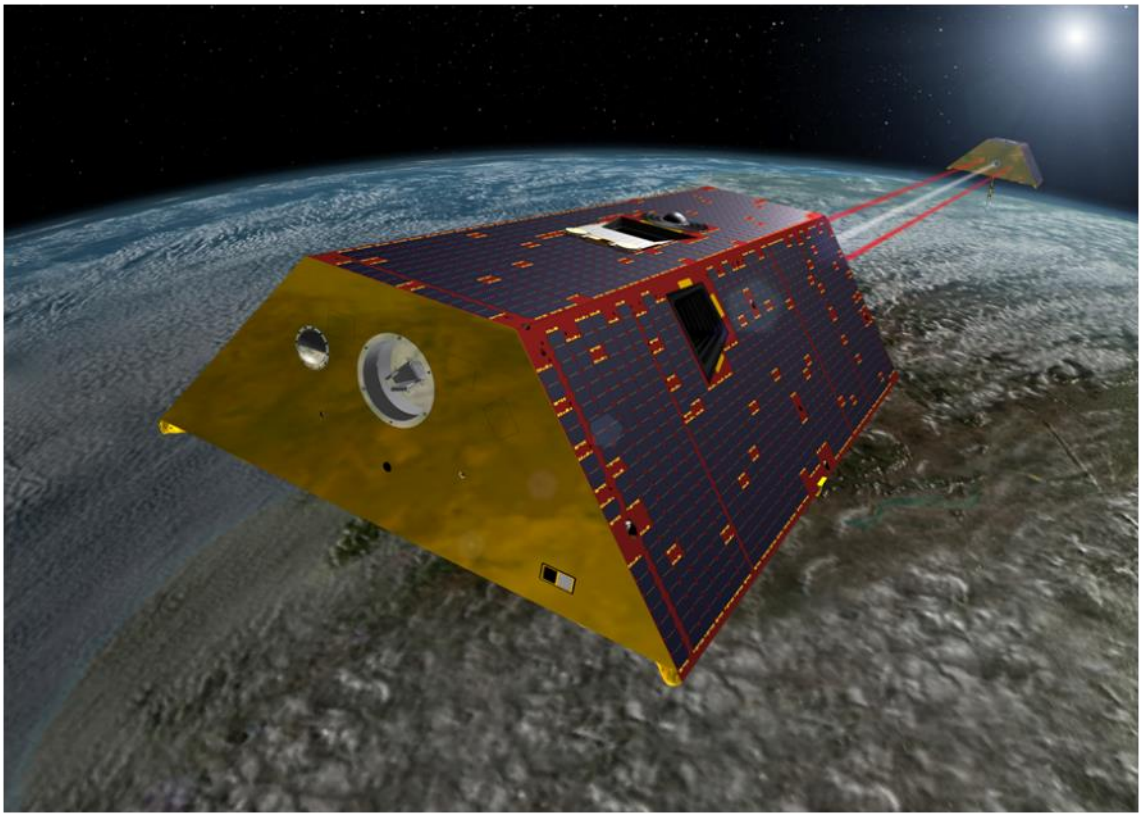
GRACE-FO stands for the "Gravity Recovery and Climate Experiment Follow-on." "Follow-on" means it's the second satellite mission like this—a follow-up to the original GRACE mission. GRACE-FO will use two satellites. One satellite will be about 137 miles (220 km) behind the other as they orbit the Earth. As the satellites move, the gravity of the Earth will pull on them.

Gravity isn't the same everywhere on Earth. Areas with more mass—like big mountains—have a stronger gravitational pull than areas with less mass. When the GRACE-FO satellites fly towards an area with stronger gravitational pull, the first satellite will be pulled a little faster. When the second GRACE-FO satellite reaches the stronger gravity area, it will be pulled faster, and catch up.

Scientists combine this distance between the two satellites with lots of other information to create a map of Earth's gravity field each month. The changes in that map will tell them how land and water move on our planet. For example, a melting glacier will have less water, and so less mass, as it melts. Less mass means less gravitational pull, so the GRACE-FO satellites will have less distance between them. That data can be used to help scientists figure out if the glacier is melting.

GRACE-FO will also be able to look at how Earth's overall weather changes from year to year. For example, the satellite can monitor certain regions to help us figure out how severe a drought is. These satellites will help us keep track of one of the most important things to all life on this planet: water.

You can learn more about our planet's most important molecule here: https://spaceplace.nasa.gov/water



Picture, Right: An artist's rendering of the twin GRACE-FO spacecraft in orbit around Earth. Credit: NASA

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Heavy M.E.T.U.L. Night #3: FRIDAY April 20, 2018—Your host: Roger Hill

With the Sun setting later and later, I thought we'd try for a Friday evening, allowing people to stay later if they wish. I'll open the gates at 7:30pm, and we can convene at around 8. I'll have hand-outs for the evenings viewing.

This night has a 5 day old Moon in the sky, with Orion sinking in the west. Venus will be visible early on, with The Realm of the Galaxies coming once it gets dark.

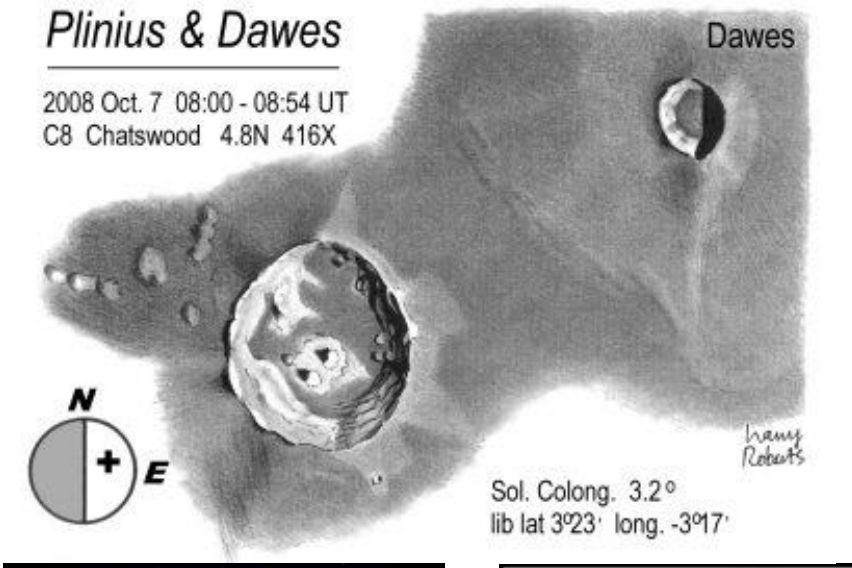
The ETU folks can look for three of the 12 constellations they need: Ursa Major, Leo and Bootes, for instance.

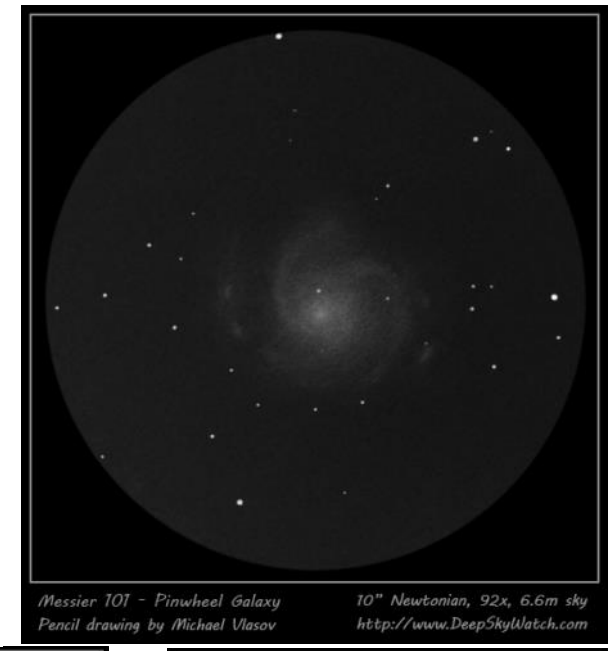
The Leo Trio should be good, as well as M51 - the Whirlpool in Canes Venatici. Some of the deep sky objects in Ursa Major, like the Owl Nebula could be visible, although the Moon may interfere early on.

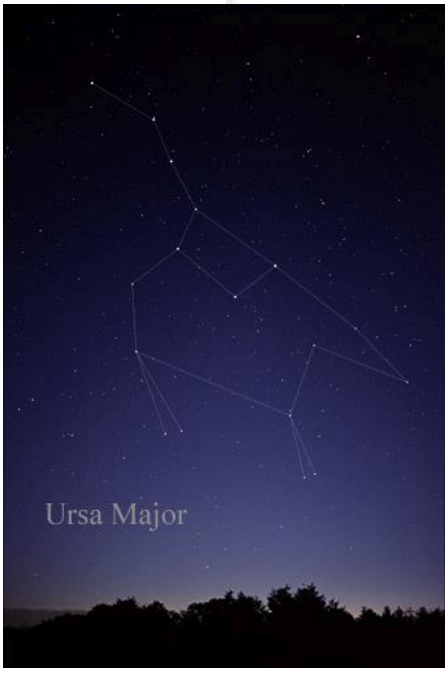
As always, everyone is welcome.

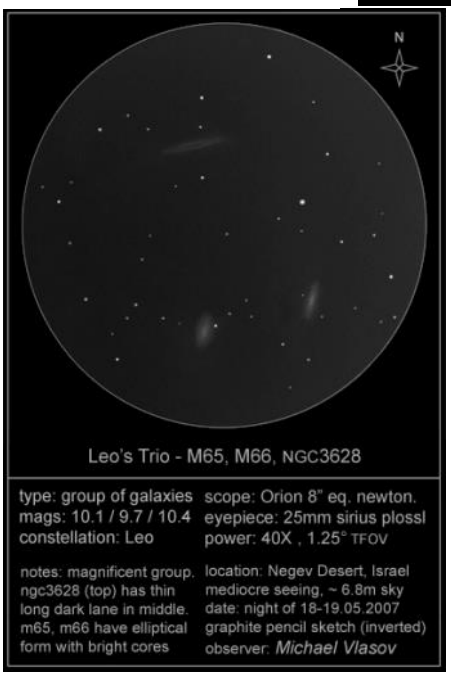
If you bring your own telescope, park on the north side of the parking lot (to your left as you drive in). Dress warmly, bring a clip-board, a couple of pencils, and one of those Canadian Tire headlamp flashlights that has a red LED setting.

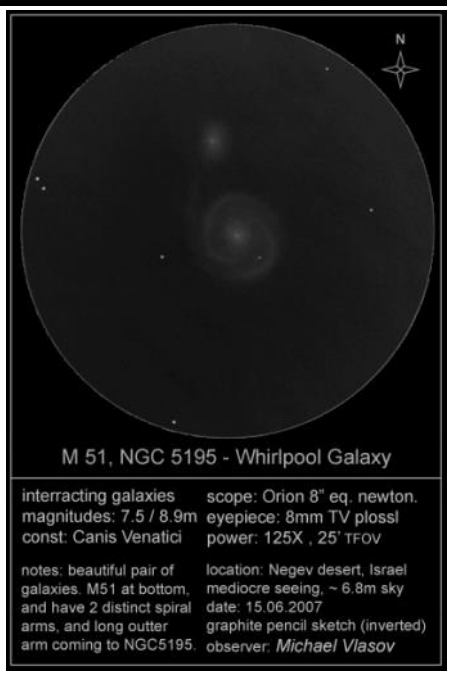
See you in the dark!











The C14 is back! **By Ed Mizzi**

Thanks to the determined work of member Martin Palenik, our Celestron Edge 14" telescope is back up and running.

Martin worked on the scope's Celestron CGE Pro mount for several weeks as it had incurred circuit board issues. He was very excited when he finally completed that work and was ready to remount everything at the observatory. He had to order a new main motor board but he saved the club hundreds of dollars since we did not have to send the whole mount to Celestron in the U.S.A.

So Martin, Dilip Mahto and I met at the observatory on March 22, to help get the heavy mount and OTA back onto the pier. Once we got the OTA and mount affixed, we connected a Telrad, finder scope and guider scope. And then we spent several hours getting the scope talking to the hand controller and computer. Martin was the brains of the operation and we were the brawn (and gofors) and it worked out wonderfully.

Of course, with a clear sky above us, it was tough not spending time using such a beautiful piece of equipment, so we pointed it at the Moon and several other objects. With an aperture of 355mm (14"), a focal length of 3910mm (154") and a focal ratio of f/11 it is a fine instrument with which to view the night sky.

The feeling we had was similar to getting a new toy for Christmas and what a toy!!!

Club members, **after proper training**, are now welcome to use this new and improved addition to our observatory. But don't forget that we also still have the 16" scope available, as well as 2 - 10" Dobsonian scopes and 3 loaner 8" Dobsonian telescopes.

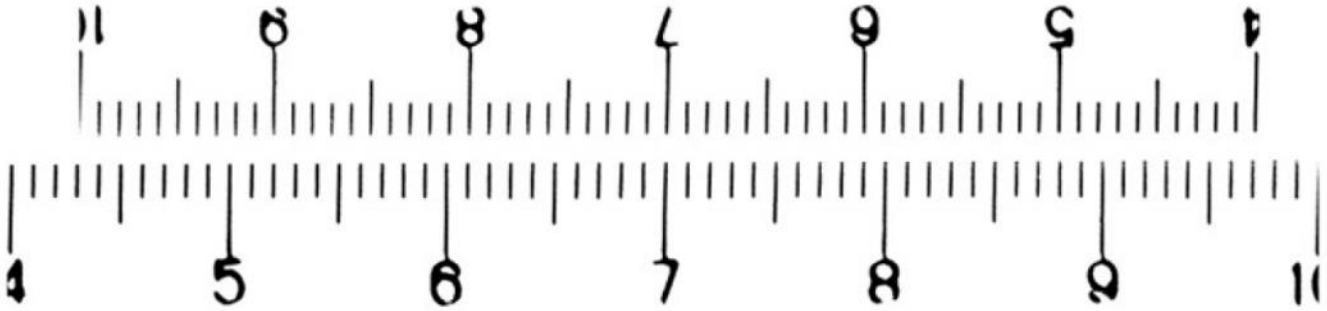
See you at the observatory. And kudos to Martin.

Two Focusing Aids for Astrophotography with Camera Lenses

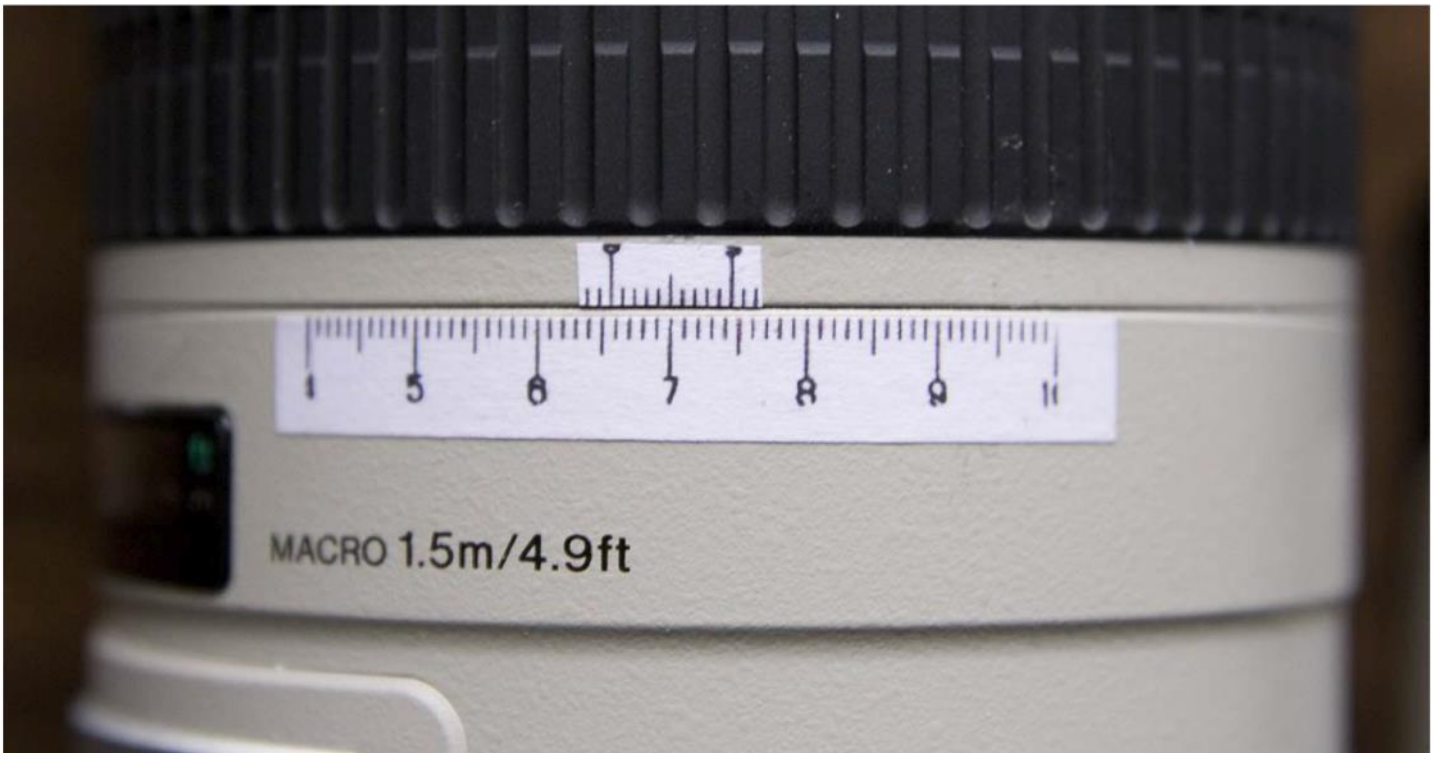
December 19, 2007 W. John McDonald, Victoria Centre

For anyone contemplating doing wide field astrophotography using camera lenses, focusing can be a challenge. It is also quite important to get a more precise focus in astrophotography than is usually needed in terrestrial imaging but most modern camera lenses are not well suited to manual focusing. The focus rings have too little movement to provide a precise setting and the scales are usually too coarse to allow repositioning the lens once a good setting has been found. Alan Dyer has highlighted the importance of precise focus and given some suggestions for achieving it on page 87 of the November 2007 Sky and Telescope magazine. The methods and devices below are some additional ideas for focusing of camera lenses.

Aid One – the Vernier Scale:



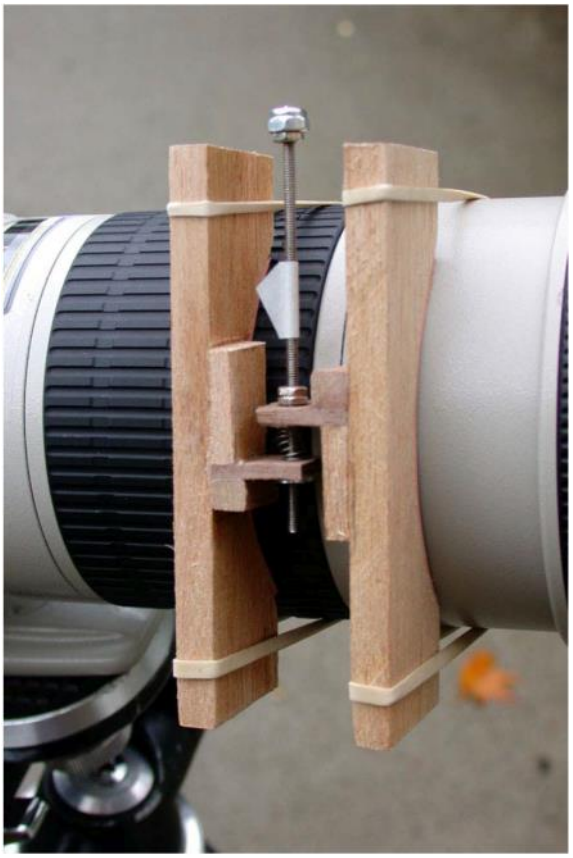
The first useful aid is a simple Vernier Scale as shown below. This is really two scales one of which is 10% shorter than the other. By attaching one to the lens body and the other to the focusing ring, it is possible to estimate the focus position to 1/10th of the smallest division of the longer scale. To do this you simply look at where the left index mark on the left of the short scale falls on the longer scale. Suppose it lies between 6.5 and 6.6 as shown in the image below. Then you look for which of the short division marks lines up with those of the longer scale. Suppose it is the 5th one. Then the scale reading is 6.55. A magnifier can be used if needed and of course, a red flashlight is required in the dark.



If you wish to try this, just print an appropriate sized version of the first figure for your needs and cut each scale out. You just need a length of the short one that covers two of the large index marks but it is convenient to have a longer section of the larger scale. I have attached the scales to my lens using paper glue. For weather resistance, the scales can be covered with clear tape.

Aid 2 – Micro Focuser

The second tool is a micro focuser made from some bits of wood and a 4-40 screw as shown below. The picture is fairly self explanatory. Two plates are connected via the screw such that they can be moved relative to each other with the screw. I have a bit of reflecting tape on the screw as a tab to facilitate counting turns. One of the plates is held on the lens body and the other is attached to the focusing ring using elastic bands.



I use this tool to check for the precise focus position by taking a series of images of a bright star while keeping track of the number of turns of the screw I have made from the starting position. Once I know that number for the best focus position, I use half turns around that spot. The focuser can be repositioned very accurately so it is easy to make repeated checks and be sure of the best focus point. Then I take the Vernier reading for the most precise focus point and use that to reset the focus quickly if it is disturbed for any reason. Unless there is a significant change in temperature it is not usually necessary to recheck the focus using the Micro Focuser during a session or even when setting up on a different night. Checking the Vernier to make sure nothing has changed is usually sufficient. In the case of the 300 mm L series Canon lens I have, I have to use the micro focuser each night because the lens has a slip clutch on the focus ring and the relative position of the two scales will shift if the ring goes past either end of the focus travel.

Using the Focus Aids

The following is a set of steps gives precise focus quickly and fairly painlessly.

1) With the lens on auto focus, focus on a bright star or the moon. If possible, set the cameras to use a single autofocus point in the center of the screen. The target must be located on top of this focus point for the autofocus to work. For ease in achieving this, it helps to switch on the autofocus led light manually if you can and use it to aim at the target. 1)

2) Read and record the Vernier scale position.

3) Attach the micro focuser and then, and only then, switch to manual focus.

4) Check the Vernier reading and reset the focus ring if necessary using the micro focuser to get the same reading as found in step 2.

5) Do a series of images of a bright star with different micro focus settings. Be careful to avoid overexposure of the star. Try 1/60 second exposure at ISO 400 to start and adjust to get a visible but not to bright image.

6) Pick the best focused image from the series and reset the micro focuser to reproduce that setting.

7) Record the Vernier reading that gave the best focus and the ambient temperature for future reference. If you inadvertently move the focus ring by mistake and need to reset the focus position the Vernier reading will usually suffice.

Footnote: On many cameras, it is possible to select the focus point you want to use instead of having them all active. Often it is also possible to turn the indicator led on manually and have it stay on for a brief period while you centre the target.

Computer searches telescope data for evidence of distant planets by Larry Hardesty

Machine-learning system uses physics principles to augment data from NASA crowdsourcing project.—MIT News Office, March 29, 2018

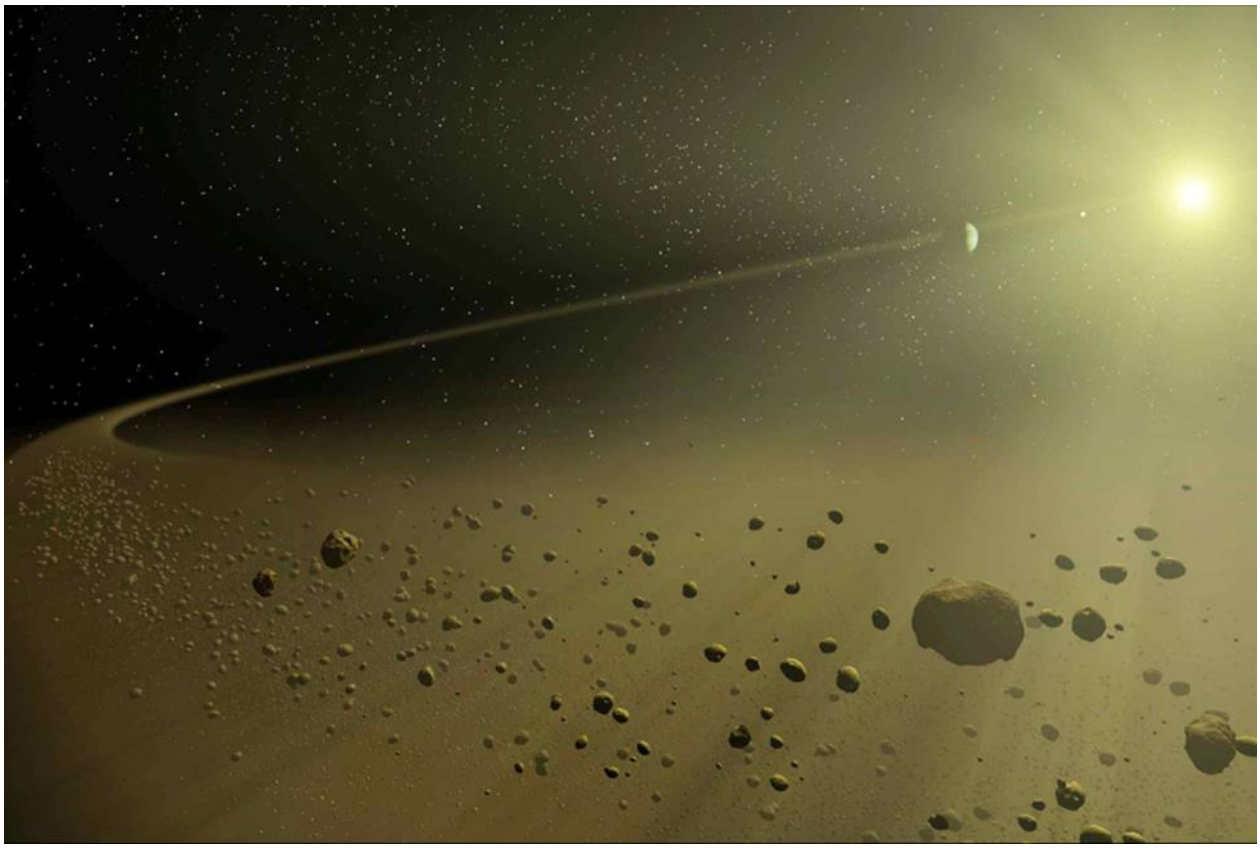
As part of an effort to identify distant planets hospitable to life, NASA has established a crowdsourcing project in which volunteers search telescopic images for evidence of debris disks around stars, which are good indicators of exoplanets. Using the results of that project, researchers at MIT have now trained a machine-learning system to search for debris disks itself. The scale of the search demands automation: There are nearly 750 million possible light sources in the data accumulated through NASA's Wide-Field Infrared Survey Explorer (WISE) mission alone.

In tests, the machine-learning system agreed with human identifications of debris disks 97 percent of the time. The researchers also trained their system to rate debris disks according to their likelihood of containing detectable exoplanets. In a paper describing the new work in the journal *Astronomy and Computing*, the MIT researchers report that their system identified 367 previously unexamined celestial objects as particularly promising candidates for further study.

The work represents an unusual approach to machine learning, which has been championed by one of the paper's coauthors, Victor Pankratius, a principal research scientist at MIT's Haystack Observatory. Typically, a machine-learning system will comb through a wealth of training data, looking for consistent correlations between features of the data and some label applied by a human analyst — in this case, stars circled by debris disks.

But Pankratius argues that in the sciences, machine-learning systems would be more useful if they explicitly incorporated a little bit of scientific understanding, to help guide their searches for correlations or identify deviations from the norm that could be of scientific interest.

"The main vision is to go beyond what A.I. is focusing on today," Pankratius says. "Today, we're collecting data, and we're trying to find features in the data. You end up with billions and billions of features. So what are you doing with them? What you want to know as a scientist is not that the computer tells you that certain pixels are certain features. You want to know 'Oh, this is a physically relevant thing, and here are the physics parameters of the thing.'"



A young sun-like star encircled by its planet-forming disk of gas and dust.

Image: NASA/JPL-Caltech

Classroom conception

The new paper grew out of an MIT seminar that Pankratius co-taught with Sara Seager, the Class of 1941 Professor of Earth, Atmospheric, and Planetary Sciences, who is well-known for her exoplanet research. The seminar, Astroinformatics for Exoplanets, introduced students to data science techniques that could be useful for interpreting the flood of data generated by new astronomical instruments. After mastering the techniques, the students were asked to apply them to outstanding astronomical questions.

For her final project, Tam Nguyen, a graduate student in aeronautics and astronautics, chose the problem of training a machine-learning system to identify debris disks, and the new paper is an outgrowth of that work. Nguyen is first author on the paper, and she's joined by Seager, Pankratius, and Laura Eckman, an undergraduate majoring in electrical engineering and computer science. From the NASA crowdsourcing project, the researchers had the celestial coordinates of the light sources that human volunteers had identified as featuring debris disks. The disks are recognizable as ellipses of light with slightly brighter ellipses at their centers. The researchers also used the raw astronomical data generated by the WISE mission.

To prepare the data for the machine-learning system, Nguyen carved it up into small chunks, then used standard signal-processing techniques to filter out artifacts caused by the imaging instruments or by ambient light. Next, she identified those chunks with light sources at their centers, and used existing image-segmentation algorithms to remove any additional sources of light. These types of procedures are typical in any computer-vision machine-learning project.

Coded intuitions

But Nguyen used basic principles of physics to prune the data further. For one thing, she looked at the variation in the intensity of the light emitted by the light sources across four different frequency bands. She also used standard metrics to evaluate the position, symmetry, and scale of the light sources, establishing thresholds for inclusion in her data set.

In addition to the tagged debris disks from NASA's crowdsourcing project, the researchers also had a short list of stars that astronomers had identified as probably hosting exoplanets. From that information, their system also inferred characteristics of debris disks that were correlated with the presence of exoplanets, to select the 367 candidates for further study.

"Given the scalability challenges with big data, leveraging crowdsourcing and citizen science to develop training data sets for machine-learning classifiers for astronomical observations and associated objects is an innovative way to address challenges not only in astronomy but also several different data-intensive science areas," says Dan Crichton, who leads the Center for Data Science and Technology at NASA's Jet Propulsion Laboratory. "The use of the computer-aided discovery pipeline described to automate the extraction, classification, and validation process is going to be helpful for systematizing how these capabilities can be brought together. The paper does a nice job of discussing the effectiveness of this approach as applied to debris disk candidates. The lessons learned are going to be important for generalizing the techniques to other astronomy and different discipline applications."

"The Disk Detective science team has been working on its own machine-learning project, and now that this paper is out, we're going to have to get together and compare notes," says Marc Kuchner, a senior astrophysicist at NASA's Goddard Space Flight Center and leader of the crowdsourcing disk-detection project known as Disk Detective. "I'm really glad that Nguyen is looking into this because I really think that this kind of machine-human cooperation is going to be crucial for analyzing the big data sets of the future."

The Zodiacal light is sunlight reflecting off dust grains that circle the sun in the inner solar system. These grains are thought to be left over from the process that created our Earth and the other planets of our solar system 4.5 billion years ago.

So, when you're looking at the Zodiacal Light (seen here in the dawn sky outside of San Pedro de Atacama, Chile, on March 14, 2016), you're seeing the remains of the Sun's debris disk.

March 2018 Monthly Meeting by Roger Hill

The meeting was cancelled due to the incoming inclement weather.

Which means I have a couple of empty pages that are normally filled by Ed Mizzi. Boy, you don't know what you've got 'til it's gone…so, time for some poetry:

Lowell's Mars by Stuart Atkinson

His observatory silent around him,
Wood panels glowing in the starlight,
All assistants sent home long ago,
Lowell, alone beneath the open dome
Stared at Mars and frowned.

In the eyepiece of the 24", viewed through
Syrupy Arizonan summer air
The planet was barely round – a misshapen pumpkin,
Mottled and bruised, too ugly to be used
As a lantern on Hallowe'en; just a creamy
Orange orb with a splash of blue-white at its pole.

But now and then, perhaps once in every hundred heartbeats
Barsoom would snap sharply into view
And reveal the secret only he knew:
Its copper coin face was scratched with a cross-hatch
Of black and grey; criss-crossed with lines,
Most of them single, as if drawn with a quill,
Others double like railroad tracks.

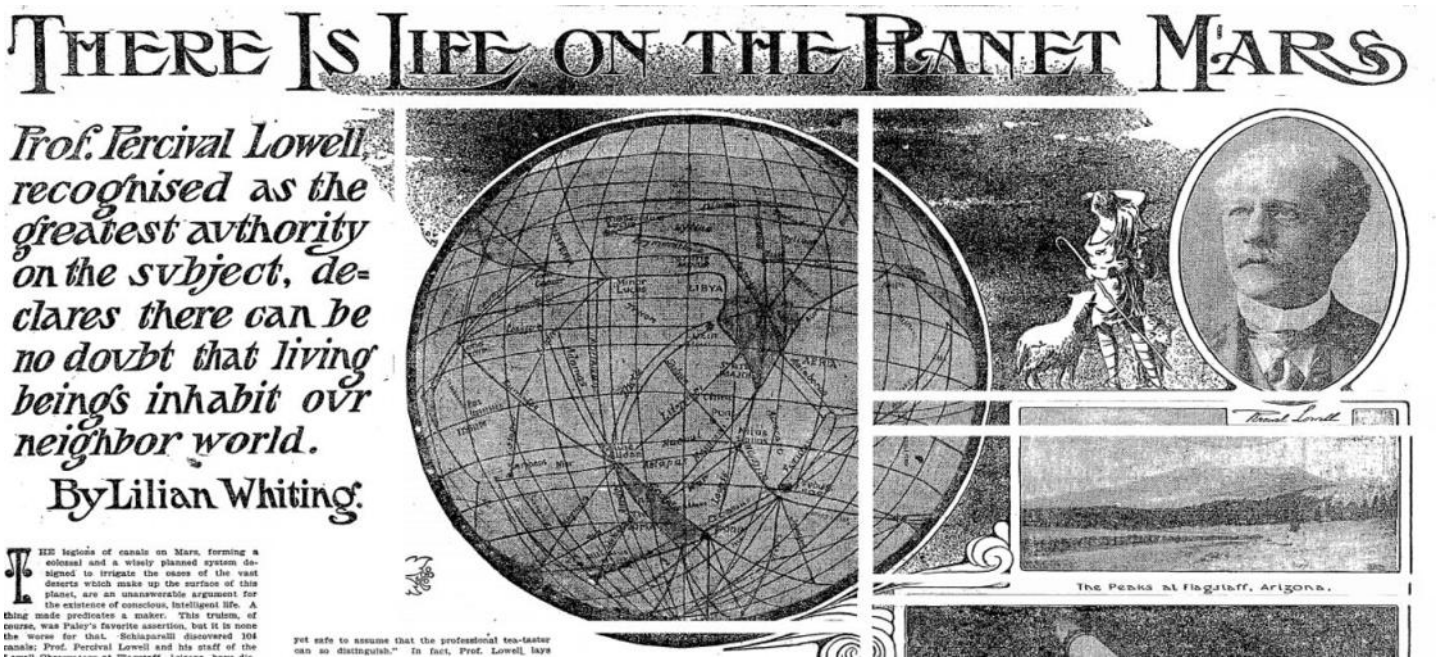
Here and there, where groups of lines met,
Dark spots stood out starkly against the sepia-hued face of Mars.
Oceans? Lakes? Oases? he wondered –

Lowell's knowing grins turned to groans every time the turbulence
Of the air set the image in the eyepiece trembling again,
Reducing Mars to a spasming orange stain, all traces
Of the lines erased.

Schiaparelli had seen them too, and had even given them a name –
Canali, meaning simply "lines",
But the Arizonan knew the truth: they really were canals,
Channels excavated from a dying planet's crust,
Running arrow straight across the great deserts of Ares
Like the Roman roads of old.

And each they snapped into focus Lowell held his breath,
Imagining the view if he flew through the eyepiece
To stand beside one of them and stare down into it,
At the precious polar water sluicing along it, splashing,
Flashing amber and gold in the cold light of the Martian Sun…

For a while the world believed him,
Fell in love with his vision of dry-throated Martians
Gulping down flagons full of melted polar ice,
But then the first of the silver butterflies
From Earth fluttered by and their portraits of Mars
Showed the planet was dead, a corpse of a world,
And Lowell's canals were banished into history,
To a Mars of make believe…


THERE IS LIFE ON THE PLANET MARS

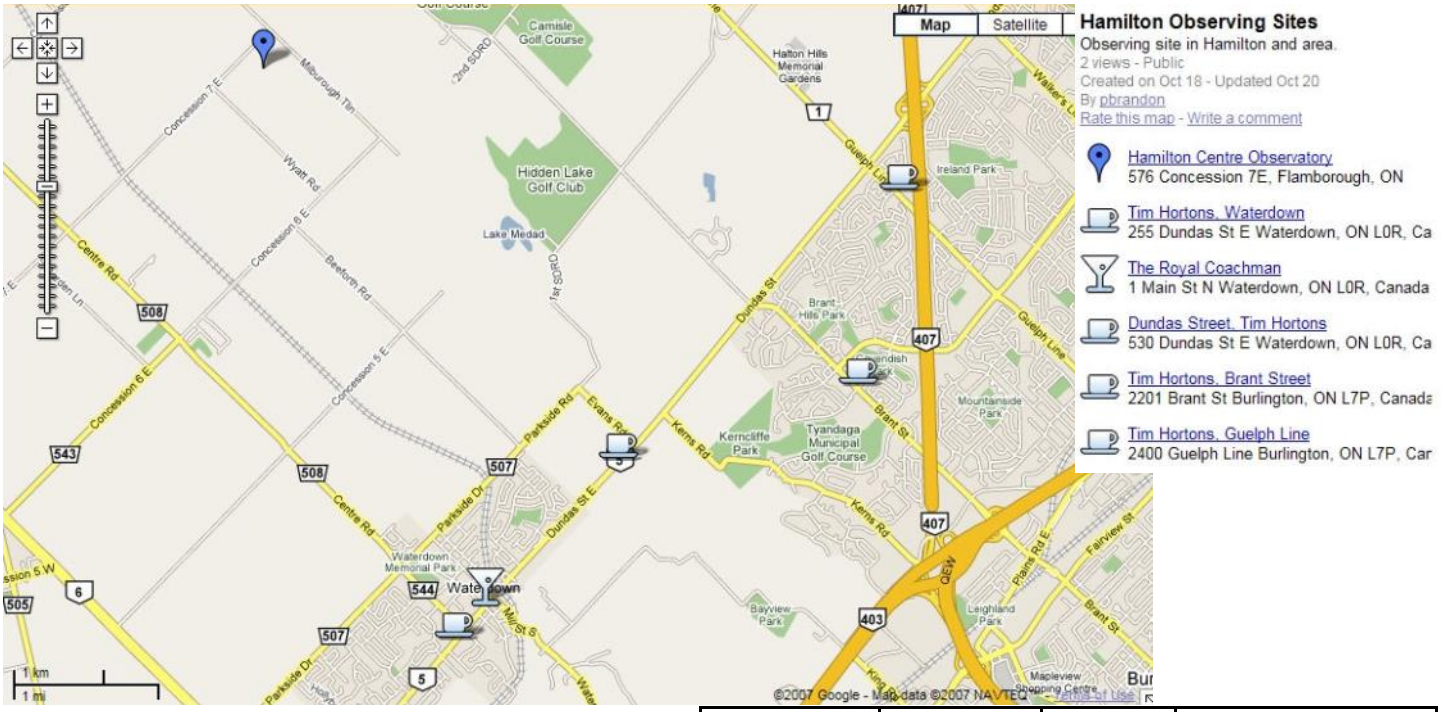
Prof. Percival Lowell, recognised as the greatest authority on the subject, declares there can be no doubt that living beings inhabit our neighbor world.

By Lilian Whiting.

THE logicia of canals on Mars, forming a colossal and a wisely planned system designed to irrigate the oases of the vast deserts which make up the surface of this planet, are an unanswerable argument for the existence of conscious, intelligent life. A thing made predicates a maker. This truism, of course, was Paley's favorite assertion, but it is none the worse for that. Schiaparelli discovered 104 canals; Prof. Percival Lowell and his staff of the

yet safe to assume that the professional tea-taster can so distinguish." In fact, Prof. Lowell lays

The Peaks at Flagstaff, Arizona.



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There were a number of really great images produced in March from the growing troupe of imagers we have in the Centre.

The Horsehead Nebula near Alnitak (Easternmost star in the belt of Orion) particularly featured. Chris Talpas, for instance, produced a lovely OIII and Hα image (you should go to the Forum and check it out..really...go now...I'll wait).

This is the second image of the area that I took, and it consists of 60x2 minute exposures, stacked in Deep Sky Stacker and crudely played with in Photoshop.

Why have I put mine on the back cover? Well...I'm editor, and I can, but I also liked mine just a bit better.