Star Gazer News

Astronomy News for Bluewater Stargazers
Vol 10 No. 6 June 2016

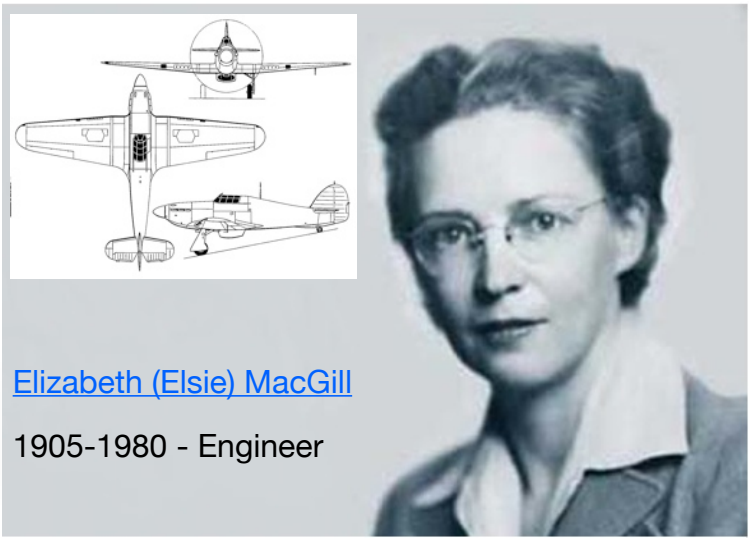
June 2016 Contents

Mercury Transit Success!

Clear skies and gentle cool breezes made the Transit of Mercury a very special occasion for BAS stargazers Monday May 9. The sky over this area and much of Ontario was clear for some or all of the event. The viewers at the Fox Observatory set up 5 telescopes including an H-alpha solar scope to record the transit. Students on program at the BOEC had personally-narrated views of an phenomenon that many have never seen before. Those of us that saw the Venus Transit in 2012 remarked on how miniscule the silhouette of Mercury was in comparison. See the images comparing the two on our FB page.

The images here were kindly provided by several of our BAS photographers who recorded the transit through H-alpha scopes as well as conventionally-filtered instruments from 3-inch refractors to our 10-inch Bishop scope in the observatory, An interesting aspect of the day was that since we had 7.5 hours for the transit, we were able to examine the Sun through the various instruments, compare the views and finding features on the surface that might have escaped attention if there was less time. There was an interesting white feature (a plage) that we noticed at the edge of the Sun and right beside it a darker spot that seemed associated with it. We also all noticed the changes in the appearance of sunspots as well. An especially large group of four near the centre of the Sun were of particular interest. There was also one fainter group that looked like a large smiley face -at least to one of us anyway. Image at right is by Steve Irvine.

A MERCURY SPECIAL issue is now available and can be downloaded from the BAS website.

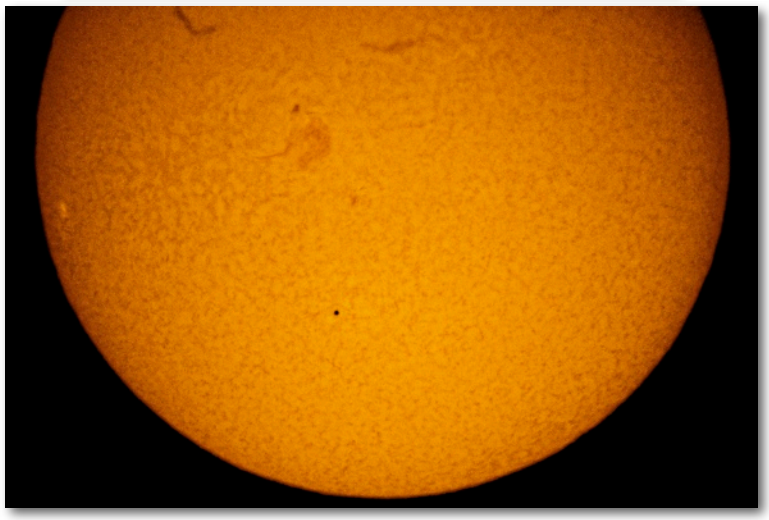


Elizabeth (Elsie) MacGill

1905-1980 - Engineer

Elizabeth MacGill is one of the 12 finalist in the running to appear on a new Canadian bank note. Read on to see why she has my vote!

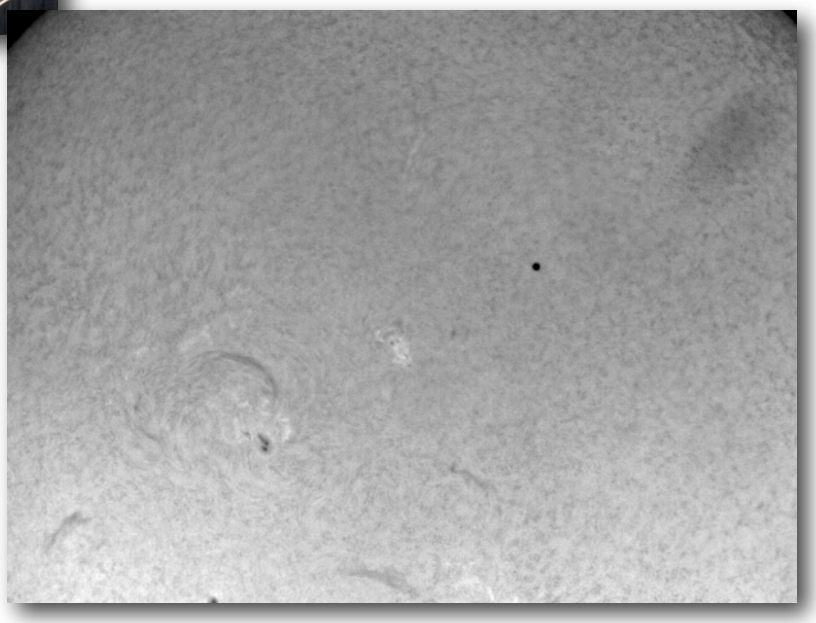
Elizabeth MacGill was the first woman in Canada to receive a bachelor's degree in electrical engineering (U of T, 1927) and a masters in aeronautical engineering (University of Michigan, 1929). She was the first woman aircraft designer in the world and is perhaps best known as "Queen of the Hurricanes" for her work on the Hawker Hurricane fighter planes used during the Second World War in the Battle of Britain. MacGill headed the production and design of a winterized version of the aircraft, more than 1,400 of which were built under her leadership. An active feminist, she was president of the Canadian Federation of Business and Professional Women (1962-64) and a member of the Royal Commission on the Status of Women.



Mallincam Views of Mercury

The club's H-alpha scope was employed to produce the image at right -a metre-across view of the Sun. We had it working for the first while but then decided that the poor final resolution (Mallincam to LCD projector to screen) was not worth the effort and we returned to just visual viewing through the eyepiece of the Lunt. Mercury was just too tiny to see well. The setup with Mallincam is shown below.

Above: Mallincam view through the LCD projector onto the big screen was less than high resolution. Look centre left of disk for a faint dot.



BAS member-at-large Robert A. got H-alpha images as well as some video at last contact. Direct imaging through the H-alpha scope was the way to go.

Report from A Veteran Observer

This email from Paul Zelichowski was received only minutes after the call went out for observations and it sums up the experience very well:

"There's a little black spot on the sun today." I recalled the lyrics to this song as I peered through the eyepiece at around 8:35 am and first spotted Mercury on the face of the sun. I had set up my 6 inch Celestron f/8 refractor on my Losmandy mount just outside of Starbase Six.

I stopped down the aperture to 110 mm and added a Baader solar filter which renders the sun a pastel blue. The sky was bit turbulent as I looked through the 42 mm eyepiece but the sun was a nice size and the tiny disc of Mercury was distinct.

I hadn't watched the transit for much more than a minute or so when the lyrics from another popular song would reverberate through my mind. A "Big old jet aeroliner" passed right across the disc of the sun as I was observing Mercury. The plane's angular size was about 2/3 the apparent size of the sun in the eyepiece and flashed by very quickly, but I was simply amazed that I got to see that. I figure I was the only person to have that unique perspective of seeing this plane and Mercury on the face of the sun at the same time! Blew my socks off!

Viewed the transit off and on for the rest of the day. In moments of steady seeing I could discern about 16 sunspots near the center of the sun. There was a very large grouping of five or so with a number of surrounding smaller ones popping into view off and on. A short distance from that group was another smaller group that again had smaller ones being discerned from time to time. During steady conditions Mercury was a nice tight black disc with the sunspots garnering some attention as well.

I basically stuck to the eyepiece for the last 10 minutes of the transit and watched Mercury slowly leave the solar disc until it was gone. I couldn't discern any "drop" effect as Mercury approached the solar limb. The seeing was a bit turbulent by this time. Overall, the weather was clear with a bit of haze now and again. I did try to get a photo with my phone but will have to sift through them and see if anything good came through.

So overall, a pleasing observing session with minimal equipment. I didn't even plug in the mount...just hand slewed. :)

***Below**: An image from the internet -**"a Big old jet aeroliner"** [see text left, paragraph 3 -ed].*

BAS Executive 2015-2017

President:	John Hlynialuk	stargazerjohn@rogers.com
Vice-President:	Zoë Kessler	zoe@zoekessler.com
Secretary:	Lorraine Rodgers	lrodgers@bmts.com
Treasurer:	Cheryl Dawson	cheryl.dawson@bell.net
Past-Pres.	Aaron Top	aarontop@hotmail.com
Past-Past-Pres:	Brett Tatton	bretttatton@gmail.com
Membership:	David Skelton	dskel@golden.net
Social Media:	Zoë Kessler	zoe@zoekessler.com
Member-at-Large:	Robert Atkinson	robotbo@gmail.com

Calling all BAS campers with telescopes!

Our "red-light ladies" Cheryl and Cora check out a sky sight.

Dark Sky Weekend at BPNP Dark Sky Preserve June 30 to July 3

This year's Dark Sky Weekend at Bruce Peninsula National Park will occur over the Canada Day weekend from Thu. June 30 to Sun. July 3, 2016. Started in the International Year of Astronomy when BPNP was declared a Dark Sky Preserve, BAS has made a trek up to the exquisitely dark skies of N. Bruce Peninsula and in return for sharing views of the night sky with campers Friday and Saturday nights, we get free accommodations at a Group Campsite. It has become a tradition for the Webster to make an appearance at this event c/o Brett T. If the skies are clear, they are DARK and worth the effort. BAS members are invited to sign up for a camping weekend and we usually get a good group of BAS attendees. Note that the folks at the gate need to know that you are a BAS member so pre-register with Brett asap. He will be sending in the final list of attendees in mid-June. Register with Brett Tatton <bretttatton@gmail.com> asap.

Main BAS & Astronomy Events in June

Event times in DST with 24-h clock unless indicated otherwise

June 1	**Wed**		**Regular Meeting Tom Thomson Art Gallery**
			7 pm, Topic: "SkyLab" -John H. Public Welcome
3	**Fri**	**00:43**	**Saturn at Opposition (magn. 0.0)**
		04:47	Mercury 0.7° N of Moon
4	**Sat**	22:00	**NM** rises locally at 5:38 am DST
			Huron Fringe Birding Festival MacGregor Pk
			(star talk & tour, helpers needed contact John H.)
5	**Sun**	**03:59**	**Mercury Greatest Elongation W 24.2°**
11	Sat	14:35	Jupiter 1.6° N of Moon
12	Sun	03:10	**FQ Moon** rises 1:39 pm DST
18	Sat	19:40	Saturn: 3.6° S of Moon
		22:39	Mercury 3.8° N of Aldebaran
20	Mon	06:02	**Full Moon** rises at 9:13 pm DST
		17:35	**Summer Solstice Keppel Henge**
			Celebration at 11 am, Sun highest 1:25 pm DST
27	Mon	13:19	**LQ Moon** rises locally at 1:05 am DST
30	**Thu**		**Start of Canada Day Dark Sky Weekend** at
			Bruce Peninsula National Park

June 4 is our annual visit to MacGregor Park to show off the stars to the Huron Fringe Birders. If you have a scope to share please join BAS at the Visitor's Centre. An indoor star talk is set for about 9 pm followed by stargazing with telescopes along the board walk after dark. Contact stargazerjohn@rogers.com to sign up. Free park admission.

The scientist Mary Somerville will be the first woman other than a royal to appear on a Royal Bank of Scotland banknote – but only after a steward's inquiry over an apparent attempt to rig the vote. Some 4,100 people voted via Facebook for Somerville, whose academic writing played a pivotal role in the discovery of the planet Neptune, to appear on a new £10 note.

A groundswell of support, including a Facebook campaign by students at the Oxford University college bearing her name, put Somerville way out in front on Sunday, the last day of voting. Rival candidate Thomas Telford, the civil engineer known affectionately as the "Colossus of Roads", could only muster a meagre 500 votes with just hours to spare.

But a last-minute surge of voting, much of it from India but also from other countries, saw Telford accelerate past Somerville to reach 5,100 votes by the deadline. James Clerk Maxwell, the physicist whose study of electromagnetism inspired Albert Einstein, limped home a distant third.

But after discussions between Facebook and RBS, the late influx of votes was deemed suspicious. RBS later declared the result null and void, meaning Somerville's face will adorn the bank's new polymer £10 notes from 2017. "It looks as if something dodgy has gone on. Mary Somerville was clearly the public's choice," said the source.

The decision to overturn the result means Somerville will become the first woman other than the Queen to appear on a mainstream RBS banknote issue since they were first printed in 1727. Having the opportunity to choose the face of our new £10 notes obviously meant a great deal to a great number of people," said the RBS Scotland chair, Malcolm Buchanan. "Mary Somerville's immense contribution to science and her determination to succeed against all the odds clearly resonate as much today as they did during her lifetime."

Born in 1780, Somerville's relative wealth allowed her access to education in astronomy and geography, despite living in an age when women were discouraged from studying science. She is credited with an instrumental role in the discovery of Neptune, thanks to her writing on a hypothetical planet perturbing the orbit of Uranus.

Somerville, who died in 1872, is also indelibly linked to the advancement of women in academia, having given her name to the Oxford college that initially only admitted women. Alumni of Somerville College, founded in 1879, include the former prime minister Margaret Thatcher, the TV presenter Esther Rantzen and the former Indian prime minister Indira Gandhi.

RBS's decision to include a woman on its shortlist follows a high-profile row in 2013, when the Bank of England faced criticism for replacing the prison reformer Elizabeth Fry with Winston Churchill on the £5 note from 2016. The decision left no women on English banknotes at all, prompting a successful campaign led by the journalist Caroline Criado-Perez to put the face of Jane Austen on the £10 note.

The Neptune Connection

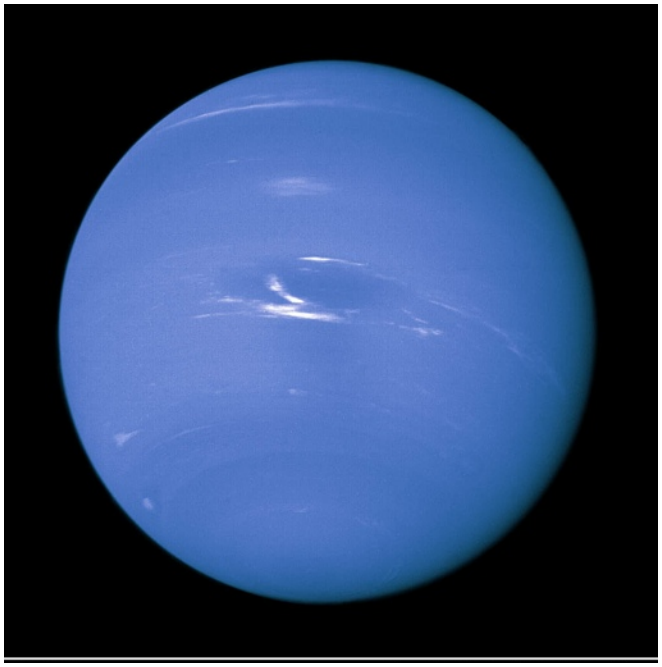
Mary Somerville published her first paper, "The magnetic properties of the violet rays of the solar spectrum", in the Proceedings of the Royal Society in 1826. Having been requested by Lord Brougham to translate for the Society for the Diffusion of Useful Knowledge the Mécanique Céleste of Laplace, she popularised its form, and its publication in 1831, under the title of The Mechanism of the Heavens, at once made her famous. Mary went beyond a mere translation. She stated, "I translated Laplace's work from algebra into common language".

In 1835, she and Caroline Herschel became the first women members of the Royal Astronomical Society. In 1838 she and her husband went to Italy, where she spent much of the rest of her life.

Much of the popularity of her writings was due to her clear and crisp style and the underlying enthusiasm for her subject which pervaded them. Somerville's writing influenced James Clerk Maxwell and John Couch Adams.

She was among those who discussed a hypothetical planet perturbing Uranus, in the 6th edition of On the Connexion of the Physical Sciences (1842: "If after the lapse of years the tables formed from a combination of numerous observations should be still inadequate to represent the motions of Uranus, the discrepancies may reveal the existence, nay, even the mass and orbit of a body placed for ever beyond the sphere of vision".

Predictions was fulfilled in 1846, by the discovery of Neptune revolving at the distance of 4,800,000,000 km from the sun. "The mass of Neptune, the size and position of his orbit in space, and his periodic time, were determined from his disturbing action on Uranus before the planet itself had been seen. **[from Wikipedia]**



Neptune as imaged by Voyager 2: Not seen like this by Mary Somerville, but she did predict that perturbations in the orbit of Uranus could be due to another planet.
Credit: NASA/Voyager 2

Makemake has a Moon

At the outskirts of our solar system, NASA's Hubble Space Telescope has spotted a small, dark moon orbiting Makemake, the second brightest icy dwarf planet (after Pluto) in the Kuiper Belt.

The moon —provisionally designated S/2015 (136472) 1 and nicknamed MK 2 —is more than 1,300 times fainter than Makemake. MK 2 was seen approximately 21,000 km from the dwarf planet, and its diameter is estimated to be 160 km across. Makemake is 1400 kms wide. The dwarf planet, discovered in 2005, is named for a creation deity of the Rapa Nui people of Easter Island.

The Kuiper Belt is a vast reservoir of leftover frozen material from the construction of our solar system 4.5 billion years ago and home to several dwarf planets. Some of these worlds have known satellites, but this is the first discovery of a companion object to Makemake. Makemake is one of five dwarf planets recognized by the International Astronomical Union.

The observations were made in April 2015 with Hubble's Wide Field Camera 3. Hubble's unique ability to see faint objects near bright ones, together with its sharp resolution, allowed astronomers to pluck out the moon from Makemake's glare. The discovery was announced today in a Minor Planet Electronic Circular.

The observing team used the same Hubble technique to observe the moon as they did for finding the small satellites of Pluto in 2005, 2011, and 2012. Several previous searches around Makemake had turned up empty. "Our preliminary estimates show that the moon's orbit seems to be edge-on, and that means that often when you look at the system you are going to miss the moon because it gets lost in the bright glare of Makemake," said Alex Parker of the Southwest Research Institute, Boulder, Colorado, who led the image analysis for the observations.

A moon's discovery can provide valuable information on the dwarf-planet system. By measuring the moon's orbit, astronomers can calculate a mass for the system and gain insight into its evolution.

Uncovering the moon also reinforces the idea that most dwarf planets have satellites. "Makemake is in the class of rare Pluto-like objects, so finding a companion is important," Parker said. "The discovery of this moon has given us an opportunity to study Makemake in far greater detail than we ever would have been able to without the companion."

Finding this moon only increases the parallels between Pluto and Makemake. Both objects are already known to be covered in frozen methane. As was done with Pluto, further study of the satellite will easily reveal the density of Makemake, a key result that will indicate if the bulk compositions of Pluto and Makemake are also similar. "This new discovery opens a new chapter in comparative planetology in the outer solar system," said team leader Marc Buie of the Southwest Research Institute, Boulder, Colorado.

The researchers will need more Hubble observations to make accurate measurements to determine if the moon's orbit is elliptical or circular. Preliminary estimates indicate that if the moon is in a circular orbit, it completes a circuit around Makemake in 12 days or longer.

Determining the shape of the moon's orbit will help settle the question of its origin. A tight circular orbit means that MK 2 is probably the product of a collision between Makemake and another Kuiper Belt Object. If the moon is in a wide, elongated orbit, it is more likely to be a captured object from the Kuiper Belt. Either event would have likely occurred several billion years ago, when the solar system was young.

The discovery may have solved one mystery about Makemake. Previous infrared studies of the dwarf planet revealed that while Makemake's surface is almost entirely bright and very cold, some areas appear warmer than other areas. Astronomers had suggested that this discrepancy may be due to the sun warming discrete dark patches on Makemake's surface. However, unless Makemake is in a special orientation, these dark patches should make the dwarf planet's brightness vary substantially as it rotates. But this amount of variability has never been observed.

These previous infrared data did not have sufficient resolution to separate Makemake from MK 2. The team's reanalysis, based on the new Hubble observations, suggests that much of the warmer surface detected previously in infrared light may, in reality, simply have been the dark surface of the companion MK 2.

There are several possibilities that could explain why the moon would have charcoal-black surface, even though it is orbiting a dwarf planet that is as bright as fresh snow. One idea is that, unlike larger objects such as Makemake, MK 2 is small enough that it cannot gravitationally hold onto a bright, icy crust, which sublimates, changing from solid to gas, under sunlight. This would make the moon similar to comets and other Kuiper Belt Objects, many of which are covered with very dark material.

When Pluto's moon Charon was discovered in 1978, astronomers quickly calculated the mass of the system. Pluto's mass was hundreds of times smaller than the mass originally estimated when it was found in 1930. With Charon's discovery, astronomers suddenly knew something was fundamentally different about Pluto. "That's the kind of transformative measurement that having a satellite can enable," Parker said.

Donna Weaver / Ray Villard
Space Telescope Science Institute, Baltimore, Maryland
dweaver@stsci.edu / villard@stsci.edu

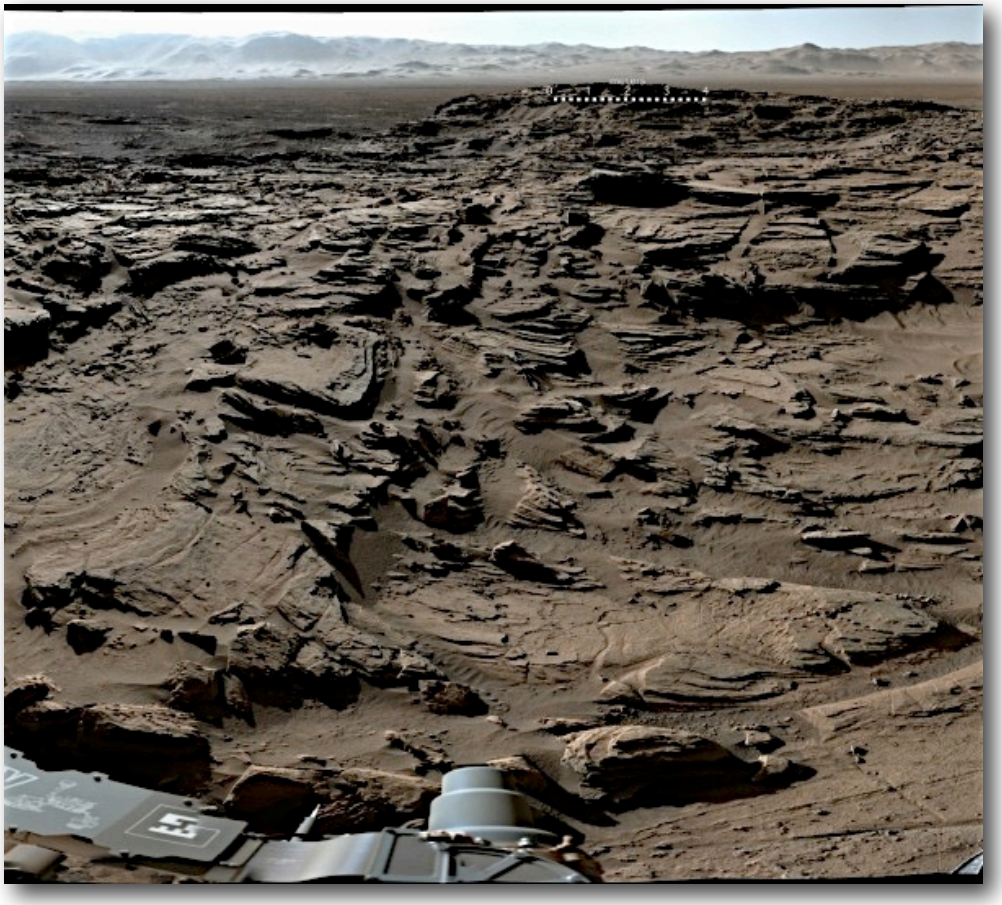
Alex Parker
Southwest Research Institute, Boulder, Colorado
alex.parker@swri.org

Curiosity Gets Tested in Rugged Terrain

NASA's Curiosity Mars rover has nearly finished crossing a stretch of the most rugged and difficult-to-navigate terrain encountered during the mission's 44 months on Mars.

The rover climbed onto the "Naukluft Plateau" of lower Mount Sharp in early March after spending several weeks investigating sand dunes. The plateau's sandstone bedrock has been carved by eons of wind erosion into ridges and knobs. The path of about a quarter mile (400 meters) westward across it is taking Curiosity toward smoother surfaces leading to geological layers of scientific interest farther uphill.

The roughness of the terrain on the plateau raised concern that driving on it could be especially damaging to Curiosity's wheels, as was terrain Curiosity crossed before reaching the base of Mount Sharp. Holes and tears in the rover's aluminum wheels became noticeable in 2013. The rover team responded by adjusting the long-term traverse route, revising how local terrain is assessed and



Above: *Image taken from the Mastcam on NASA's Curiosity Mars rover shows the rugged surface of the Naukluft Plateau, plus upper Mount Sharp at right and part of the rim of Gale Crater.* ***Image credit: NASA/JPL-Caltech/MSSS***

Above*: Mt. Sharp rises in the background while the shadow of the MastCam casts an angry? quizzical? look on the landscape. Another face on Mars.*
Image credit: NASA/JPL-Caltech/MSSS

refining how drives are planned. Extensive Earth-based testing provided insight into wheel longevity.The rover team closely monitors wear and tear on Curiosity's six wheels. "We carefully inspect and trend the condition of the wheels," said Steve Lee, Curiosity's deputy project manager at NASA's Jet Propulsion Laboratory, Pasadena, California. "Cracks and punctures have been gradually accumulating at the pace we anticipated, based on testing we performed at JPL. Given our longevity projections, I am confident these wheels will get us to the destinations on Mount Sharp that have been in our plans since before landing."

Inspection of the wheels after crossing most of the Naukluft Plateau has indicated that, while the terrain presented challenges for navigation, driving across it did not accelerate damage to the wheels.

On Naukluft Plateau, the rover's Mast Camera has recorded some panoramic scenes from the highest viewpoints Curiosity has reached since its August 2012 landing on the floor of Gale Crater on Mars. Examples are available online at NASA/JPL

The scenes show wind-sculpted textures in the sandstone bedrock close to the rover, and Gale Crater's rim rising above the crater floor in the distance. Mount Sharp stands in the middle of the crater, which is about 154 kilometers in diameter.

The next part of the rover's route will return to a type of lake-deposited mudstone surface examined previously.

Farther ahead on lower Mount Sharp are three geological units that have been key destinations for the mission since its landing site was selected. One of the units contains an iron-oxide mineral called hematite, which was detected from orbit. Just above it lies a band rich in clay minerals, then a series of layers that contain sulfur-bearing minerals called sulfates. By examining them with Curiosity, researchers hope to gain a better understanding of how long ancient environmental conditions remained favorable for microbial life, if it was ever present on Mars, before conditions became drier and less favorable.

Each of Curiosity's six wheels is about 50 centimetres in diameter and 40 centimetres wide, milled out of solid aluminum. Most of the wheel's circumference is a metallic skin that is about half the thickness of a U.S. dime. Nineteen zigzag-shaped treads, called grousers, extend about a quarter inch (three-fourths of a centimeter) outward from the skin of each wheel. The grousers bear much of the rover's weight and provide most of the traction and ability to traverse over uneven terrain.

The team operating NASA's Curiosity Mars rover uses the MAHLI camera on the rover's arm to check the condition of the wheels at routine intervals. ***Image credit: NASA/JPL-Caltech/MSSS***

The holes seen in the wheels so far perforate only the skin. Wheel-monitoring images obtained every 500 metres) have not yet shown any grouser breaks on Curiosity. Earth-based testing examined long-term wear characteristics and the amount of damage a rover wheel can sustain before losing its usefulness for driving. The tests indicate that when three grousers on a wheel have broken, that wheel has reached about 60 percent of its useful mileage.

At a current odometer reading of 12.7 kilometres since its August 2012 landing, Curiosity's wheels are projected to have more than enough life remaining to investigate the hematite, clay and sulfate units ahead, even in the unlikely case that up to three grousers break soon. The driving distance to the start of the sulfate-rich layers is roughly 7.5 kilometres from the rover's current location.

Curiosity reached the base of Mount Sharp in 2014 after fruitfully investigating outcrops closer to its landing site and then trekking to the layered mountain. For more information about Curiosity, visit: http://mars.jpl.nasa.gov/msl

Guy Webster, JPL

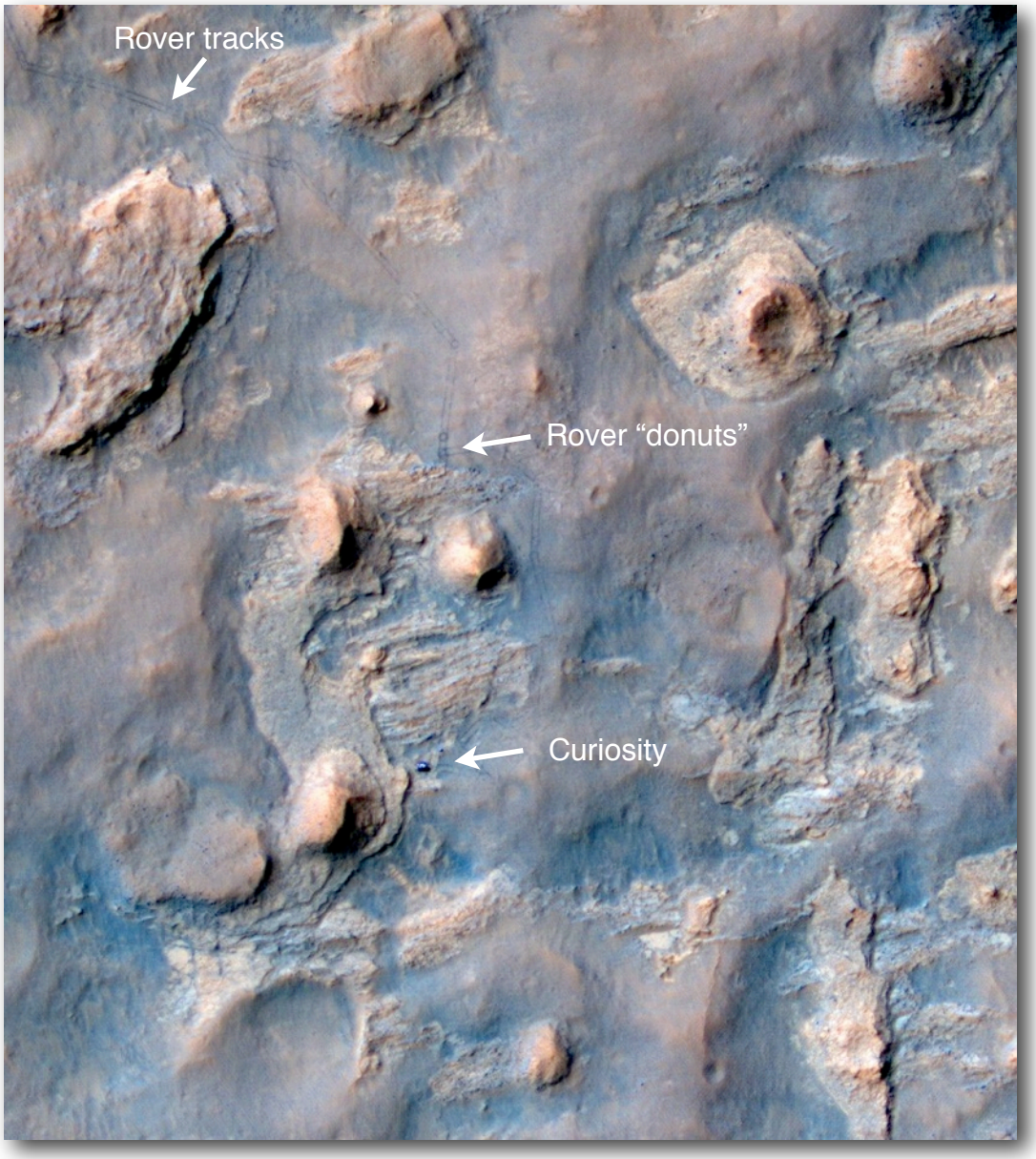
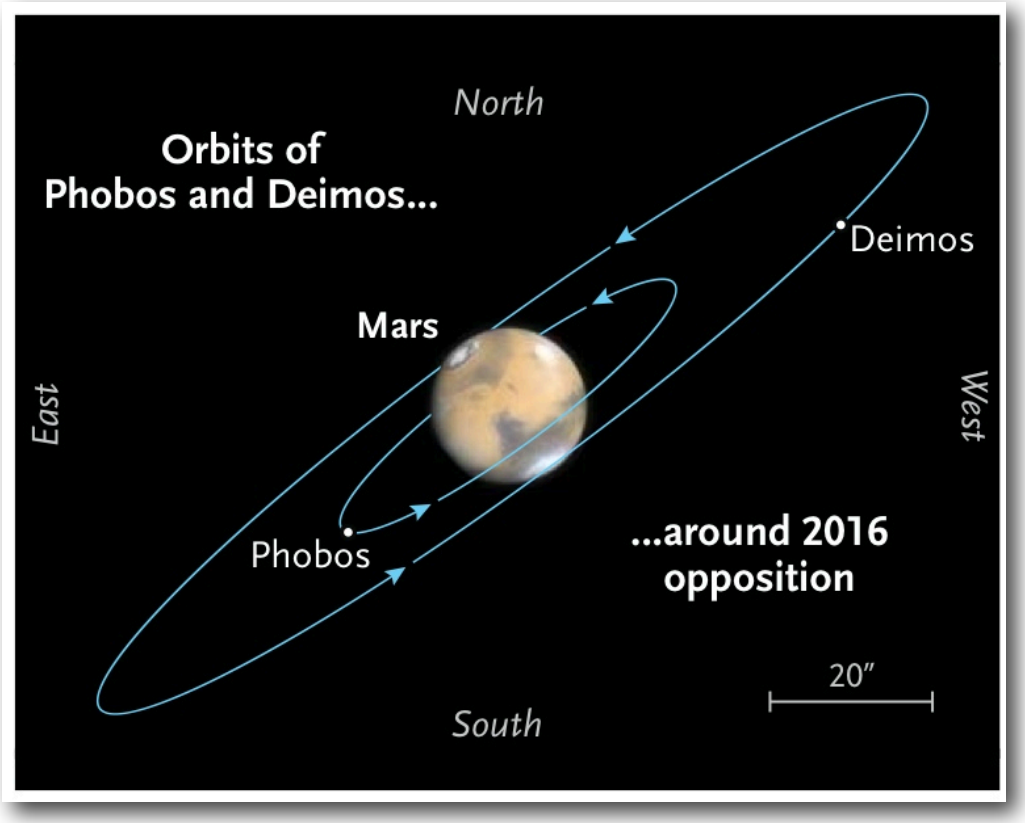


Image right: *Some of the mission's most important science has been done here at the Kimberley Location. Careful navigation through this multi-layered area of Mars has required a number of twists and turns evidenced by the donuts left in the tracks made by the SUV-sized rover.* ***Mars Reconnaissance Orbit Image***

Observing Challenge: Spotting the Moons of Mars

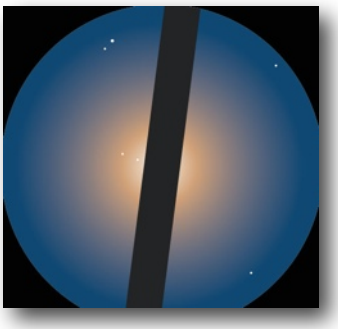


On paper, spotting the two moonlets of Mars should be a piece of cake. After all they reach the ends of their orbits and are separated from Mars by a comfortable margin of 25" and 63" or arc respectively. Those who have spotted the separate components of Albireo at 34" know that 63" is easy and 25" is also not that big a separation. The two double-double components are 2" and 3" and they can be picked out on most nights. Yes, the two Mars moons are faint but not invisible, even in 8-inch scopes which can regularly reach the fainter moon's 12.5 magnitude. The faint star limit for an 8-inch is between 14 and 15th magnitude according to reliable sources.

So what's the problem? Ans: Mars. The glare from Mars is over-powering and it usually hides the faint moons effectively. Only at the elongations of their orbits can you have a remote chance of success.

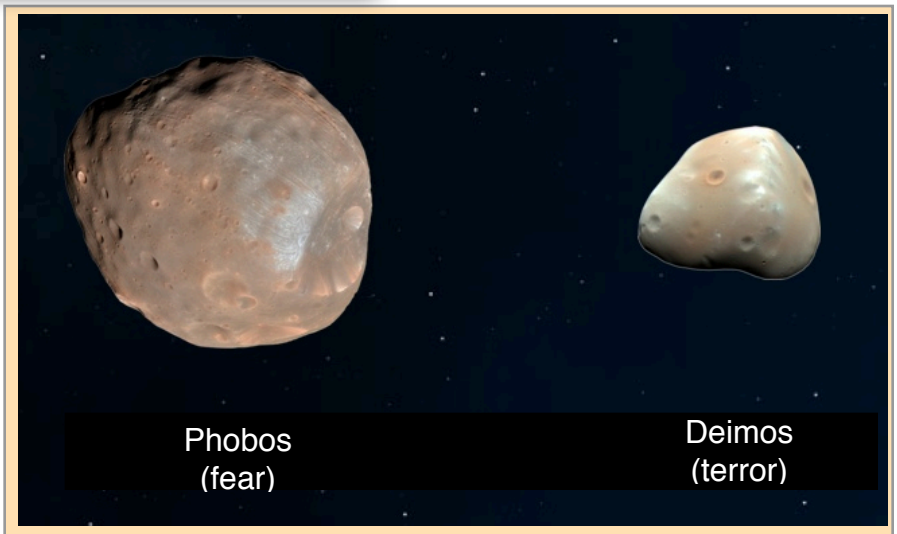
The two programs I tested out, Starry Night and Sky Safari show accurate moon positions for Phobos and Deimos, and so it is possible to use them to determine the times when the moons are at maximum separation from Mars and easier to see.

Several sources suggest using an occulting bar in the eyepiece to block much of the light from Mars and make the odds of seeing one or both moons better. An occulting bar can be simply made from a strip of aluminum foil as described by S&T for the 2007/8 Mars close approach. See link at bottom right.



An eyepiece with an occulting bar is not readily available commercially, so you need to add a bar as a temporary modification to a normal eyepiece. A narrow strip of aluminum foil works well, as does a strip of deep-blue or violet Wratten gelatin filter.

S&T photo by Craig Michael Utter.



	Phobos	Deimos
Diameters:	26x18 km	16x10 km
Distance from Mars:	9400 km	23 400 km
Periods:	7.7 h	30.3 h
Magnitudes:	11.4	12.5
Max. Separation from Mars:	63"	25"
Compare to Albireo separation:	34"	

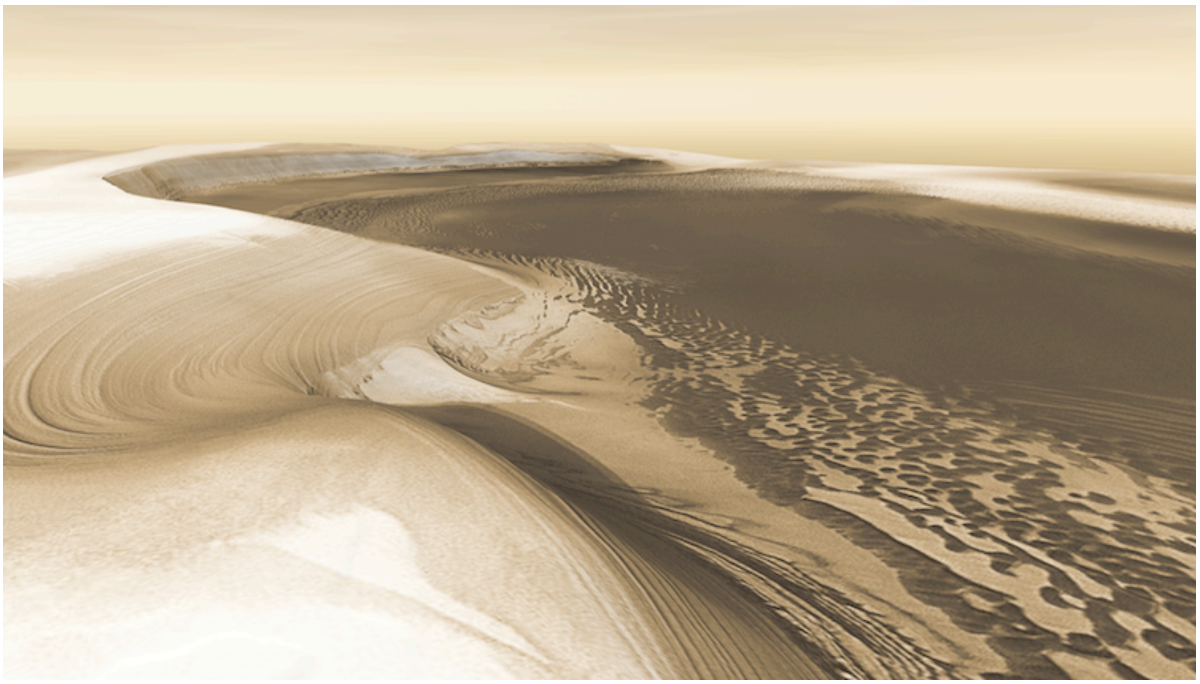
Because Phobos and Deimos lie roughly east or west of Mars at their greatest elongations, rotate the eyepiece so that your homemade occulting bar runs roughly north-south. Then try to spot the dim moons in the planet's background glow. in image at left, they're both to the left of the bar, at center.

S&T illustration.

See more at: http://www.skyandtelescope.com/observing/celestial-objects-to-watch/the-martian-moons-in-200708/#sthash.buWT010k.dpuf

Scientists using radar data from NASA's Mars Reconnaissance Orbiter (MRO) have found a record of the most recent Martian ice age recorded in the planet's north polar ice cap.

The new results agree with previous models that indicate a glacial period ended about 400,000 years ago, as well as predictions about how much ice would have been accumulated at the poles since then. The results, published in the May 27 issue of the journal Science, help refine models of the Red Planet's past and future climate by allowing scientists to determine how ice moves between the poles and mid-latitudes, and in what volumes.



LAYER CAKE. Image above shows the head of Chasma Boreale, a canyon that reaches 570 km into the north polar cap. Canyon walls rise about 1,400 meters above the floor. Where the edge of the ice cap has retreated, sheets of sand are emerging that accumulated during earlier ice-free climatic cycles. Winds blowing off the ice have pushed loose sand into dunes, then driven them down-canyon in a westward direction, toward our viewpoint. Credit: NASA/JPL/Arizona State University, R. Luk (vertical exaggeration 2.5x).

Mars has bright polar caps of ice that are easily visible from telescopes on Earth. A seasonal cover of carbon-dioxide ice and snow is observed to advance and retreat over the poles during the Martian year. During summertime in the planet's north, the remaining northern polar cap is all water ice; the southern cap is water ice as well, but remains covered by a relatively thin layer of carbon dioxide ice even in southern summertime.

But Mars also undergoes variations in its tilt and the shape of its orbit over hundreds of thousands of years. These changes cause substantial shifts in the planet's climate, including ice ages. Earth has similar, but less variable, phases called Milankovitch cycles.

Scientists use data from MRO's Shallow Subsurface Radar (SHARAD) to produce images called radargrams that are like vertical slices though the layers of ice and dust that comprise the Martian polar ice deposits. For the new study, researchers analyzed hundreds of such images to look for variations in the layer properties. The researchers identified a boundary in the ice that extends across the entire north polar cap. Above the boundary, the layers accumulated very quickly and uniformly, compared with the layers below them.

"The layers in the upper few hundred meters display features that indicate a period of erosion, followed by a period of rapid accumulation that is still occurring today," said planetary scientist Isaac Smith, the study's lead author. Smith led the work while at Southwest Research Institute in Boulder, Colorado, but is now at the Planetary Science Institute in Tucson, Arizona.

On Earth, ice ages take hold when the polar regions and high latitudes become cooler than average for thousands of years, causing glaciers to grow toward the mid-latitudes. In contrast, the Martian variety occurs when -- as a result of the planet's increased tilt -- its poles become warmer than lower latitudes. During these periods, the polar caps retreat and water vapor migrates toward the equator, forming ground ice and glaciers at mid-latitudes. As the warm polar period ends, polar ice begins accumulating again, while ice is lost from mid-latitudes. This retreat and regrowth of polar ice is exactly what Smith and colleagues see in the record revealed by the SHARAD radar images.

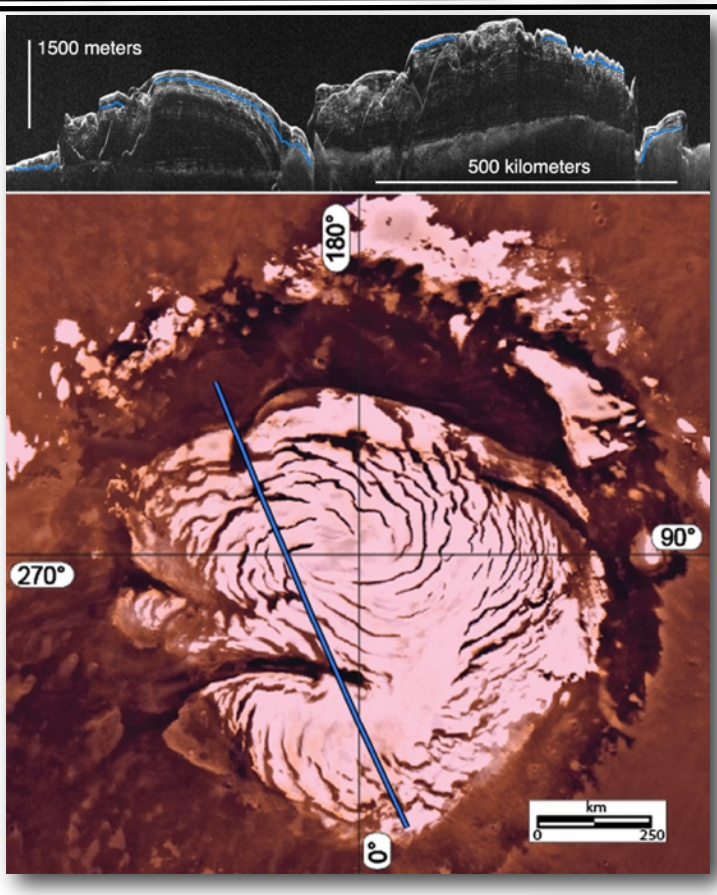
An increase in polar ice following a mid-latitude ice age is also expected from climate models that show how ice moves around based on Mars' orbital properties, especially its tilt. These models predict the last Martian ice age ended about 400,000 years ago, as the poles began to cool relative to the equator. Models suggest that since then, the polar deposits would have thickened by about 980 feet (300 meters).

The upper unit identified by Smith and colleagues reaches a maximum thickness of 1,050 feet (320 meters) across the polar cap, which is equivalent to a 2-foot-thick (60-centimeter-thick) global layer of ice. That is essentially the same as model predictions made by other researchers in 2003 and 2007.

"This suggests that we have indeed identified the record of the most recent Martian glacial period and the regrowth of the polar ice since then. Using these measurements, we can improve our understanding of how much water is moving between the poles and other latitudes, helping to improve our understanding of the Martian climate," Smith said.

After 10 years in orbit, Mars Reconnaissance and its six science instruments are still in excellent shape. "The longevity of the mission has enabled more thorough and improved radar coverage of the Martian poles," said Richard Zurek, the mission's project scientist at NASA's Jet Propulsion Laboratory, Pasadena, California. "Our long life in orbit and powerful 3-D analysis tools are allowing scientists to unravel Mars' past climate history."

Written by Preston Dyches
NASA-JPL News Office



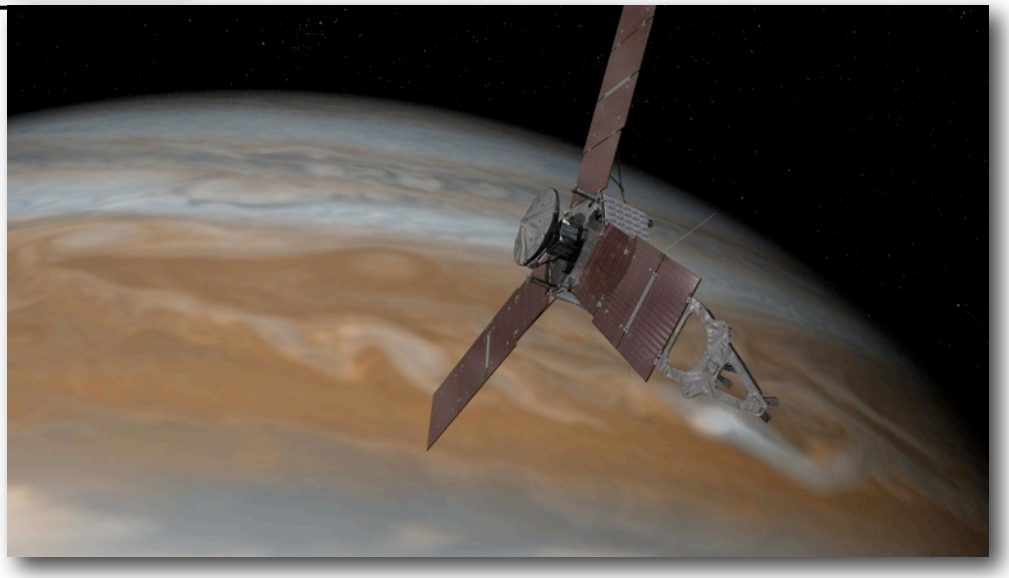
This image montage features a two-dimensional radar cross section of Mars' north polar cap collected by the Shallow Radar (SHARAD) instrument on NASA's Mars Reconnaissance Orbiter spacecraft (at top), and a color image mosaic of the polar cap from NASA's Viking project (at bottom). By analyzing radar images like the one at top, scientists discovered evidence for a past ice age in the northern polar ice cap of Mars.

The top 100 to 300 m of layered ice in the polar deposits reveal a stark change in properties between layers representing an ice age and a subsequent inter-glacial period. In the radar image, layers below the blue line show migration of spiral features in the polar cap, toward the left. Above the blue line, those features disappear or reverse their migration direction -- an indication of changes in accumulation rate and wind patterns associated with climate change. In other regions of the polar cap, the blue line is associated with widespread erosion -- an event that corresponded with an ice age.

A blue line across the Viking map indicates the ground track of the radar cross section. Vertical height in the radar image has been exaggerated to improve the visibility of the layers.

SHARAD was provided by the Italian Space Agency. Its operations are led by Sapienza University of Rome, and its data are analyzed by a joint U.S.-Italian science team. NASA's Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the Mars Reconnaissance Orbiter for the NASA Science Mission Directorate, Washington. Lockheed Martin Space Systems, Denver, built the spacecraft.

Juno Feels Jupiter's Tug



Since its launch five years ago, there have been three forces tugging at NASA's Juno spacecraft as it speeds through the solar system. The sun, Earth and Jupiter have all been influential -- a gravitational trifecta of sorts. At times, Earth was close enough to be the frontrunner. More recently, the sun has had the most clout when it comes to Juno's trajectory. Today, it can be reported that Jupiter is now in the gravitational driver's seat, and the basketball court-sized spacecraft is not looking back.

"Today the gravitational influence of Jupiter is neck and neck with that of the sun," said Rick Nybakken, Juno project manager at NASA's Jet Propulsion Laboratory in Pasadena, California. "As of tomorrow, and for the rest of the mission, we project Jupiter's gravity will dominate as the trajectory-perturbing effects by other celestial bodies are reduced to insignificant roles."

Juno was launched on Aug. 5, 2011. On July 4 of this year, it will perform a Jupiter orbit insertion maneuver -- a 35-minute burn of its main engine, which will impart a mean change in velocity of 1,212 mph (542 meters per second) on the spacecraft. Once in orbit, the spacecraft will circle the Jovian world 37 times, skimming to within 3,100 miles (5,000 kilometers) above the planet's cloud tops. During the flybys, Juno will probe beneath the obscuring cloud cover of Jupiter and study its auroras to learn more about the planet's origins, structure, atmosphere and magnetosphere.

Juno's name comes from Greek and Roman mythology. The mythical god Jupiter drew a veil of clouds around himself to hide his mischief, and his wife -- the goddess Juno -- was able to peer through the clouds and reveal Jupiter's true nature.

NASA's Jet Propulsion Laboratory, Pasadena, California, manages the Juno mission for the principal investigator, Scott Bolton, of Southwest Research Institute in San Antonio. Juno is part of NASA's New Frontiers Program, which is managed at NASA's Marshall Space Flight Center in Huntsville, Alabama, for NASA's Science Mission Directorate. Lockheed Martin Space Systems, Denver, built the spacecraft. The California Institute of Technology in Pasadena manages JPL for NASA.

For more information about Juno visit these sites:
http://www.nasa.gov/juno or http://missionjuno.swri.edu

Interesting Cerean Geology

In its lowest-altitude mapping orbit, at a distance of 385 km from Ceres, Dawn has provided scientists with spectacular views of the dwarf planet.

Haulani Crater, with a diameter of 34 km, shows evidence of landslides from its crater rim. Smooth material and a central ridge stand out on its floor. **An enhanced false-color view allows scientists to gain insight into materials and how they relate to surface morphology. This image shows rays of bluish ejected material. The color blue in such views has been associated with young features on Ceres.**

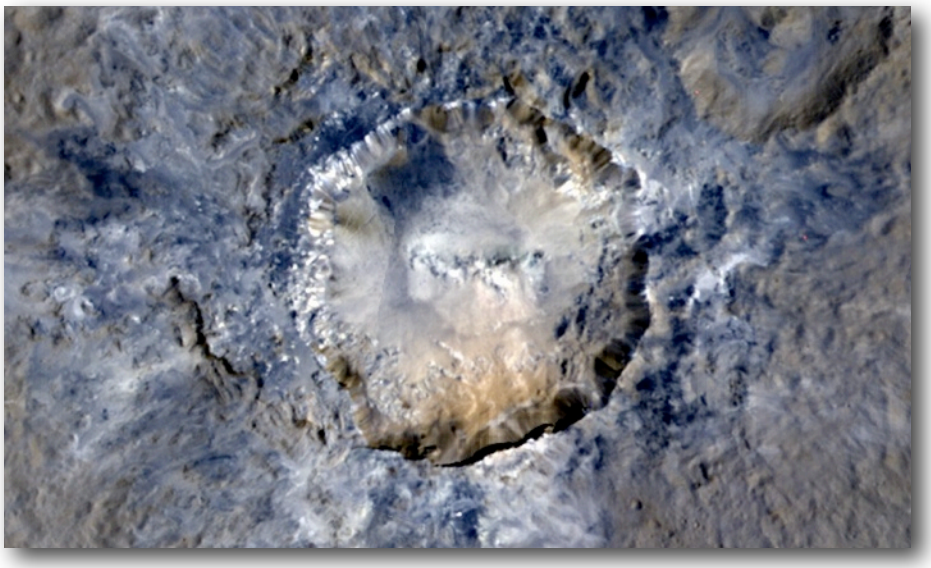
"Haulani perfectly displays the properties we would expect from a fresh impact into the surface of Ceres. The crater floor is largely free of impacts, and it contrasts sharply in color from older parts of the surface," said Martin Hoffmann, co-investigator on the Dawn framing camera team, based at the Max Planck Institute for Solar System Research, Göttingen, Germany.

The crater's polygonal nature (meaning it resembles a shape made of straight lines) is noteworthy because most craters seen on other planetary bodies, including Earth, are nearly circular. The straight edges of some Cerean craters, including Haulani, result from pre-existing stress patterns and faults beneath the surface.

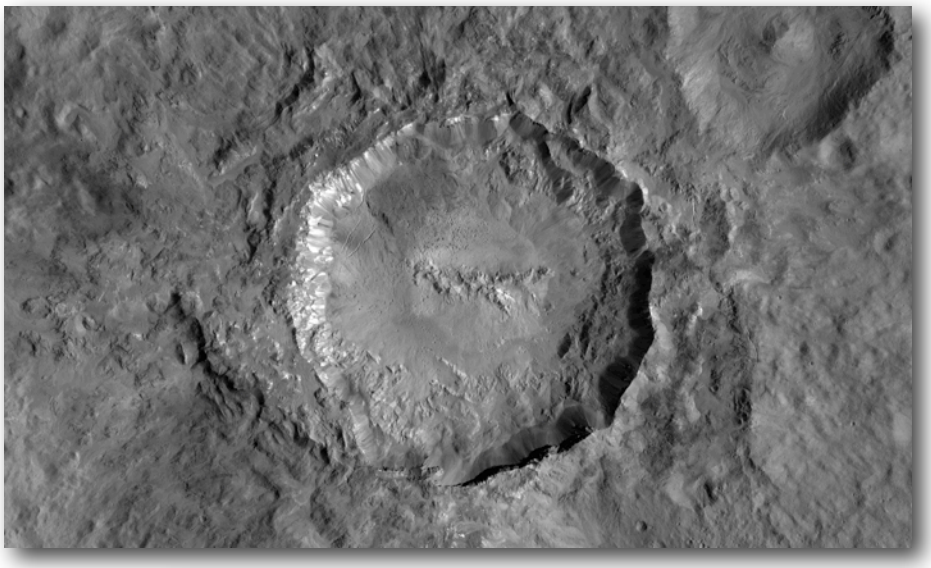
A hidden treasure on Ceres is the 10-km-wide Oxo Crater, which is the second-brightest feature on Ceres (only Occator's central area is brighter). Oxo lies near the 0 degree meridian that defines the edge of many Ceres maps, making this small feature easy to overlook. Oxo is also unique because of the relatively large "slump" in its crater rim, where a mass of material has dropped below the surface. Dawn science team members are also examining the signatures of minerals on the crater floor, which appear different than elsewhere on Ceres.

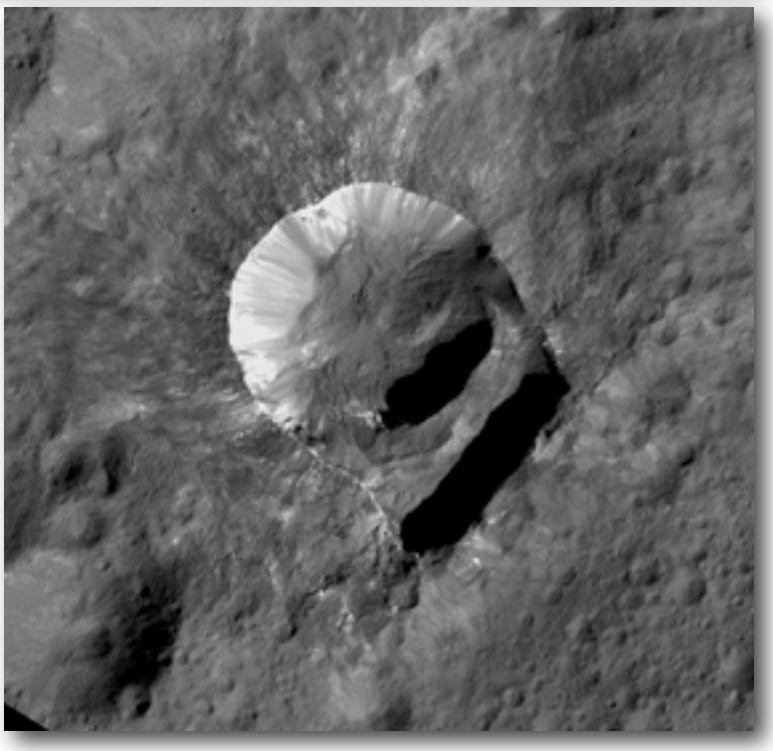
"Little Oxo may be poised to make a big contribution to understanding the upper crust of Ceres," said Chris Russell, principal investigator of the mission, based at the University of California, Los Angeles.

Dawn's mission is managed by JPL for NASA's Science Mission Directorate in Washington. Dawn is a project of the directorate's Discovery Program, managed by NASA's Marshall Space Flight Center in Huntsville, Alabama. UCLA is responsible for overall Dawn mission science. Orbital ATK Inc., in Dulles, Virginia, designed and built the spacecraft. The German Aerospace Center, Max Planck Institute for Solar System Research, Italian Space Agency and Italian National Astrophysical Institute are international partners on the mission team. For a complete list of mission participants, visit: **http://dawn.jpl.nasa.gov/mission**



Haulani Crater above, colourized version (see text left) and original grayscale image (below) both cropped to show the same terrain.





Oxo Crater right, with very unusual slump in the crater wall at lower right which does not even look to be related to the crater.

All images: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA/PSI

Scorpius (Sco)

α-Scorpii - Antares
β–Scorpii - Graflias
δ–Scorpii - Dschubba
ε–Scorpii - Wei
θ–Scorpii - Sargas
κ–Scorpii - Girtab
λ–Scorpii - Shaula
ν–Scorpii - Jabbah
σ–Scorpii - Al Niyat
υ–Scorpii- Lesath
[Note: γ-Scorpii is now σ-Librae -ed]

Scorpius is a very conspicuous zodiacal constellation with many bright stars lying just south of Ophiuchus. It is the most aptly named of all the constellations bearing considerable resemblance to a giant scorpion with it's stinger poised to strike. Antares, a giant red star, is the brightest star in Sco at magnitude 1.2, making it the 16th brightest star in the sky. It is a supergiant star; if it were in the sun's position, its diameter (6,400,000,000 km) would engulf the orbits of the asteroids between Mars and Jupiter. Its density is very low; on Earth, it would be considered a vacuum. There are many objects worth observing with binoculars in this constellation; M6 and M7 are open clusters visible to the naked eye and are striking when viewed with fieldglasses. The star ν-Scorpii is a fieldglass double; μ–Scorpii is a fine wide double visible to the naked eye.

DOUBLE STARS

	Mag.	Sep (s)	Location	Remarks
α	1.2-5.2	3	162726	Red-Green
β	2.8-5.0-9.7	1-14	160320	Yell-Grn; striking contrast
υ	4.3-6.5-7.0-8.0	1-41-2	160919	Quadruple; called the most beautiful in sky.
ξ	4.2-7.2	8	160111	White-Grey; multiple
ρ	2.8-8.5	20	181825	White-Grey; multiple

MESSIER OBJECTS (Sco)

	Mag	Location	Remarks
M 4	6.4	162226	Globular Cluster
M 6	5.3	173732	Open Cluster. Beautiful; vis. naked eye. [Butterfly Cluster]
M 7	--	175135	Open Cluster, Visible to naked eye; two 5th magnitude doubles also in this field. [Ptolemy's Cluster]
M 80	7.7	161423	Globular Cluster. Very beautiful.

Other Objects of Interest in Scorpius

H12 - Open Cluster - Location 165341
NGC6124- Open Cluster- Location 162240.
NGC6231 -Open Cluster - Many doubles and triples in this field. Location 165142.
NOTE: Saturn and Mars are in Scorpius all summer.

Libra (Lib)

α-Librae - Zubenelgenubi
β-Librae - Zubenschamali
γ-Librae - Zubenhahkrabi
σ-Librae - Zubenalgubi [formerly γ- Scorpii]

Libra is a faint zodiacal constellation located between Scorpius and Virgo; its four stars form a distinct quadrilateral shape that will aid in its identification. β-Librae has an unusual blue hue, observe it in binoculars. [Wikipedia says: In earlier times, Libra was represented not by a balance, but as the claws of a scorpion. The reason is a confused translation of the words "zubana" in Arabic and "zibanitu" in Akkadian, which mean both 'weighing scale' and 'scorpion'. In ancient Mesopotamia, a weighing scale was often the arm and the pans without a stand, and was hung up by a string tied to the midpoint of the arm, resulting in a close resemblance to a scorpion hung up by the end of its tail with its arms stretched out. The double meaning of "zibanitu" resulted in the constellation being called Chelae Scorpionis (the scorpion's claws), and it originally formed part of the claws of Scorpius. The modern Libra is the youngest of the Zodiac signs and in Greek mythology, depicts the scales held by Astraea (identified as Virgo), the goddess of justice.]

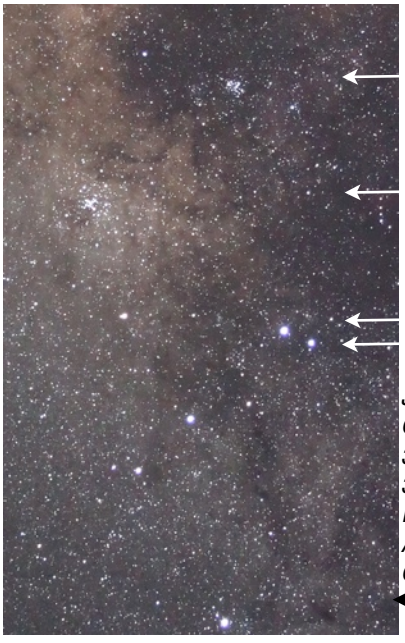
DOUBLE STARS (Lib)

	Mag.	Sep (s)	Location	Remarks
α	2.8-5.2	231	144816	
ι	4.7-9.7	58	150920	Yellow-Purple
Σ1962	6.3-6.4	12	153609	Both White; very fine.
P212	7.0-8.0	20	145521	

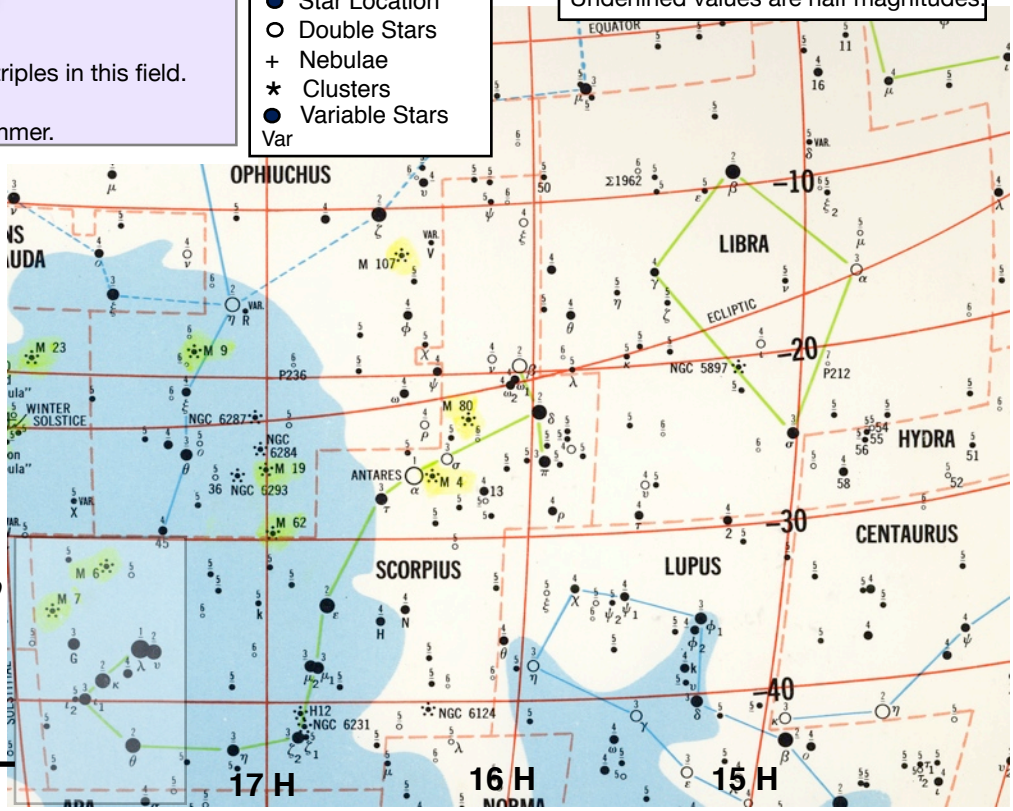
Other Objects of Interest in Libra

δ–**Librae** -Eclipsing var. period 2d 8h, mag. range 4.8-5.9 Location 145808
NGC 5897 - Globular Cluster- Location 151421.

Dschubba or δ–Scorpii, flared in Aug of 2000 from its usual 2.32 to mag. 1.9 and reached 1.6 or 1.7 in 2003. It then varied from 1.6 to 2.1 but to date, is not back to its original 2.3 magnitude. Most recent estimates are from 1.8 to 2.0. Its larger variations appear to have subsided but it is still brighter than listed on star charts.



JH image Canon 50D 33 mm fl, 3 min. exp. ISO 2000, Atacama, Chile



June 3	**Fri**	**00:43**	**Saturn at Opposition**
		04:47	Mercury 0.7° N of Moon
		05:55	Moon at Perigee: 361 100 km
4	Sat	22:00	**NM** rises locally at 5:38 am DST
5	**Sun**	**03:59**	**Mercury Greatest Elongation W 24.2°**
10	Fri	09:47	Regulus 2.2° N of Moon
11	Sat	14:35	Jupiter 1.6° N of Moon
12	Sun	03:10	**FQ Moon** rises 1:39 pm DST
13	Mon	05:06	Mercury 6.8° S of Pleiades
14	Tue	15:47	Spica 5.9° S of Moon
15	Wed	07:00	Moon at Apogee: 405 000 km
18	Sat	19:40	Saturn: 3.6° S of Moon
		22:39	Mercury 3.8° N of Aldebaran
20	Mon	06:02	**Full Moon** rises at 9:13 pm DST
		17:35	**Summer Solstice**
27	Mon	13:19	**LQ Moon** rises locally at 1:05 am DST
30	**Thu**		**Start of Canada Day Dark Sky Weekend** at Bruce Peninsula National Park

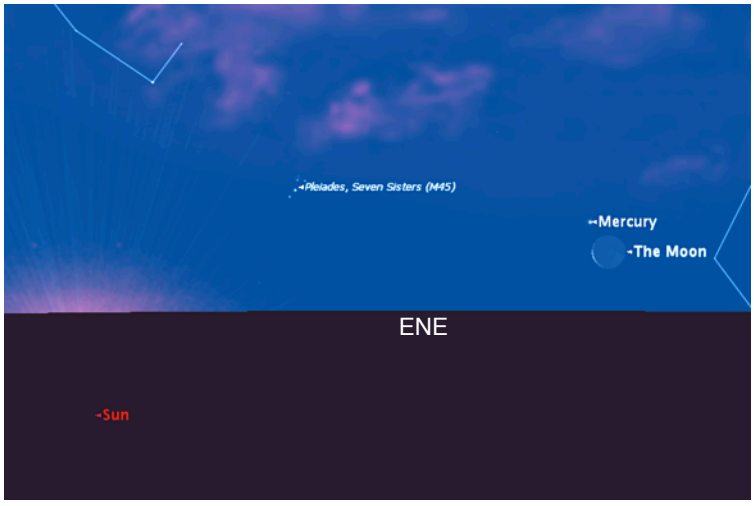
BAS Events

Jun 1	**Wed**	**Regular Meeting Tom Thomson Art Gallery** 7 pm: Topic: "SkyLab" -John H. Public Welcome
3	**Fri**	**Saturn at Opposition**
4	**Sat**	**Huron Fringe Birding Festival MacGregor Pk** (star talk & tour -helpers with telescopes needed
20	**Mon**	**Summer Solstice Keppel Henge** Celebration at 11 am Sun highest 1:26 pm DST
30	**Thu**	**Start of Canada Day Dark Sky Weekend** at Bruce Peninsula National Park

Special Events

Crescent Moon and Mercury Jun 3

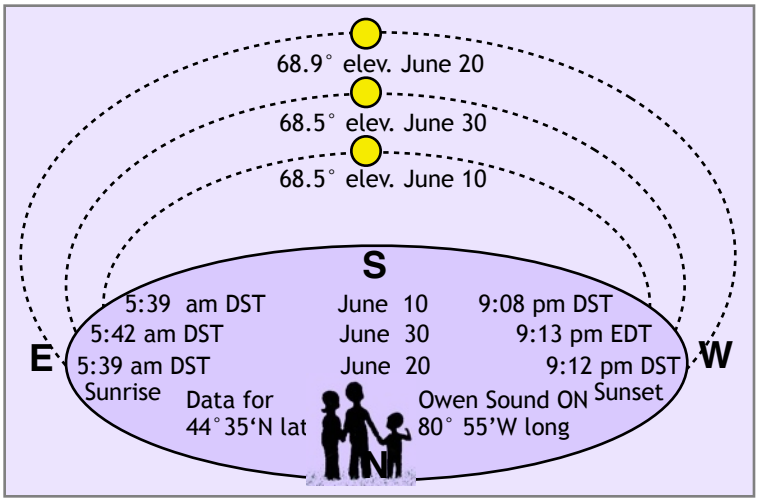
On the morning of June 3, (opposition day for Saturn), Mercury makes a close pass to the 5% sunlit crescent Moon. The diagram below shows the event at 5:09 am DST only 30 minutes before official sunrise when the Moon is a mere 2° high. The sky will be bright twilight and it will be a challenge to spot the pair. The Kemble Lookout is an ideal location for viewing and I will be there if the morning is clear. Mercury will be 1.5° from the Moon and a nice sight in binoculars or wide-field telescope. This is an ideal photo opportunity, so give it a shot. I will publish any images I get.



Planets

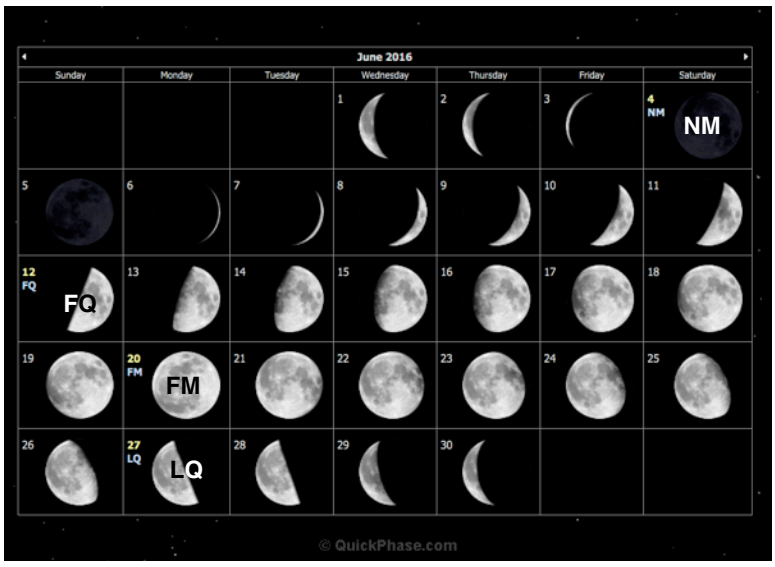
MERCURY is a morning planet now and has an unfavourable elongation west of the Sun Jun 5. Special Events has Jun 3 Mercury-Moon info. **VENUS,** (-3.9) is lost in the glare of the Sun and will not get better all month. By mid-July it starts to become visible in the evening sky. **MARS,** is mag. -1.4 (at month-end), and is still well placed for viewing in Libra after its opposition May 22. The disk is still a sizable 17.4" by June 30. **JUPITER**, (-2.0) is 35° high in the SW at sunset and sets before midnight. **SATURN,** (mag. 0.0) is its best this month and visible all night long. It reaches opposition June 3, rising at sunset and setting at sunrise. It will be great Saturn viewing all month. **URANUS,** (5.8) and **NEPTUNE,** (7.9) are morning planets with Neptune rising at midnight (by month end) followed by Uranus 1.5 h later. **Dwarf planet**, **Ceres** (8.2) rises an hour after Uranus. **Asteroid, Vesta** (6.7) is still near the Sun and difficult to see. **PLUTO** (mag. 14) rises before midnight in Sagittarius and is visible in dark sky at its meridian transit time about 2 am DST. Charts for these planets/asteroids for 2016 are now on the BAS website.

The diagram below gives the sunrise/sunset times and the Sun's altitude for June. Note that the highest solar elevation occurs June 20 at summer solstice (1:25 pm DST). The moon phase graphic at the bottom of this page shows the lunar phase for each night of the month. Times of moonrise for NM, FQ, FM and LQ for Owen Sound are in the Sky Calendar listing at left. See Special Events for details of the Mercury-Moon close approach June 3.



Moon Phase Chart for June 2016

created with QuickPhase Pro 4.0



BAS Member Loaner Scopes

Solar H-alpha scope now available.

Our Lunt solar scope can be borrowed by BAS members and it is waiting at the Fox! Contact John to get your hands on it. We now have a suitable mount for it as well. A short training session will be provided on pickup.

Several Dobs available.

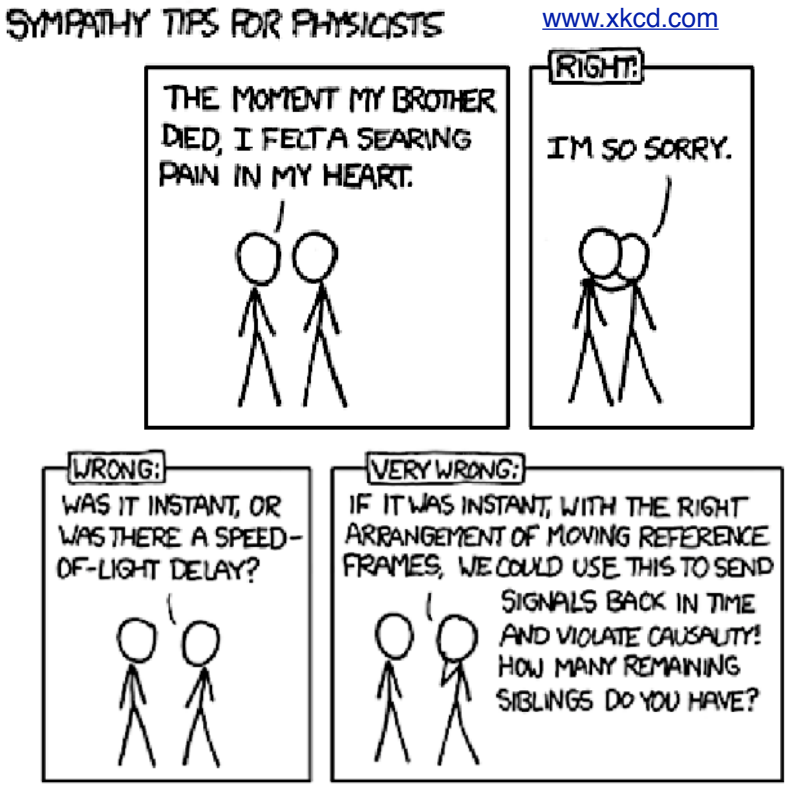
One 12-inch dobsonian loaner telescope is available for free loan to members. Smaller 8-inchers are also available. Contact John H. or Brett T. for availability. Scopes come in and out so keep checking with John or Brett if you are interested in a loaner.

S G N Classified Ads Section

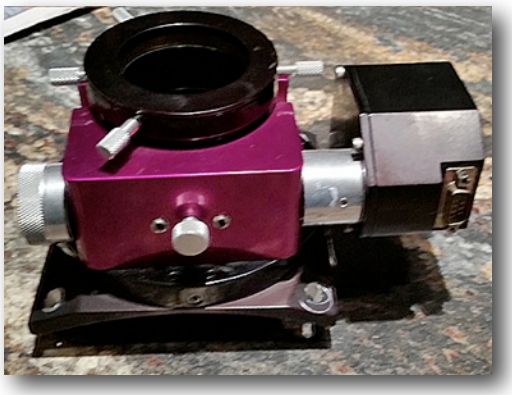
(Now also on our website)

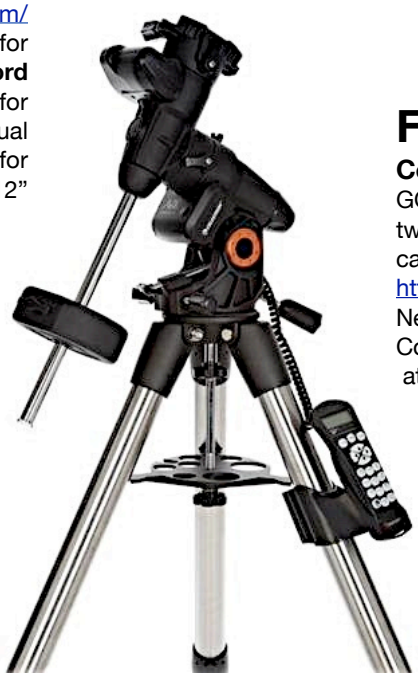
Mercury Transit Frivolity?

After many hours of watching a tiny dot crawl across the field of view of a telescope eyepiece, it is not surprising that some of us (yours truly excepted) got a little giddy. Here is a “transit of a Ritz cracker across the Moon” which caused peels of laughter from some of us (yours truly excepted). I had to play along because frankly I was scared of the consequences of not pretending to be getting the joke. I learned long ago that you do not mess with a woman (or women) who have not had enough sleep.



FOR SALE: Moonlite CRL 2.5 inch Large Format **Crayford Newtonian Focuser** ($592.10 new -see https://focuser.com/products.php) with Hi-Res Stepper Motor ($252.81 new). Flange for 14" tube, accepts 2" accessories (EP/camera). This is a **true Crayford focuser**, not the cheap "Crayford-style" knock-off. Not set up for manual focusing, requires hand paddle ($330 not included) for manual operation and computer control for remote focusing. This is meant for a remote imaging setup and comes from an abandoned project (12” scope). Over $850 plus taxes and shipping new.
Asking $600.00. Contact **Paul** at ski@bmts.com





FOR SALE:

Celestron AVX mount. Includes GOTO hand controller, tripod and two 10 pound counterweights. OTA capacity 30 pounds. Reviews at http://joebergeron.com/avx.htm
New $880, asking $650.00.
Contact **John H.**
at stargazerjohn@rogers.com