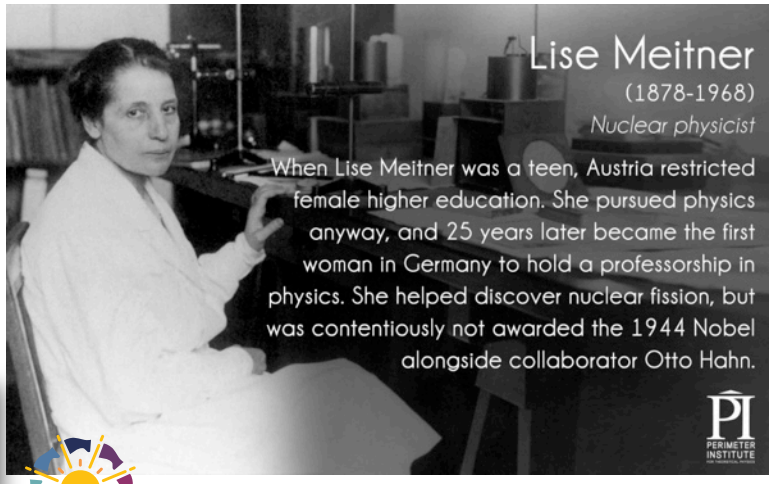
Star Gazer News

Astronomy News for Bluewater Stargazers
Vol 10 No. 2 February 2016



INTERNATIONAL YEAR OF LIGHT 2015

Perimeter Institute in Waterloo, ON, has issued a series of posters honouring Women in Physics. SGN 2016 issues will continue to feature women who have made major contributions to astronomy and physics.

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Theoretical Evidence Found For New Gas Giant Planet In Solar System

20 Jan , 2016 by Ken Kremer Universe Today

The astronomer known worldwide for vigorously promoting the demotion of Pluto from its decades long perch as the 9th Planet, has now found theoretical evidence for a new and very distant gas giant planet lurking way beyond Pluto out to the far reaches of our solar system.

In an obvious reference to the planethood controversy, the proposed new planet is nicknamed 'Planet Nine' and its absolutely huge!

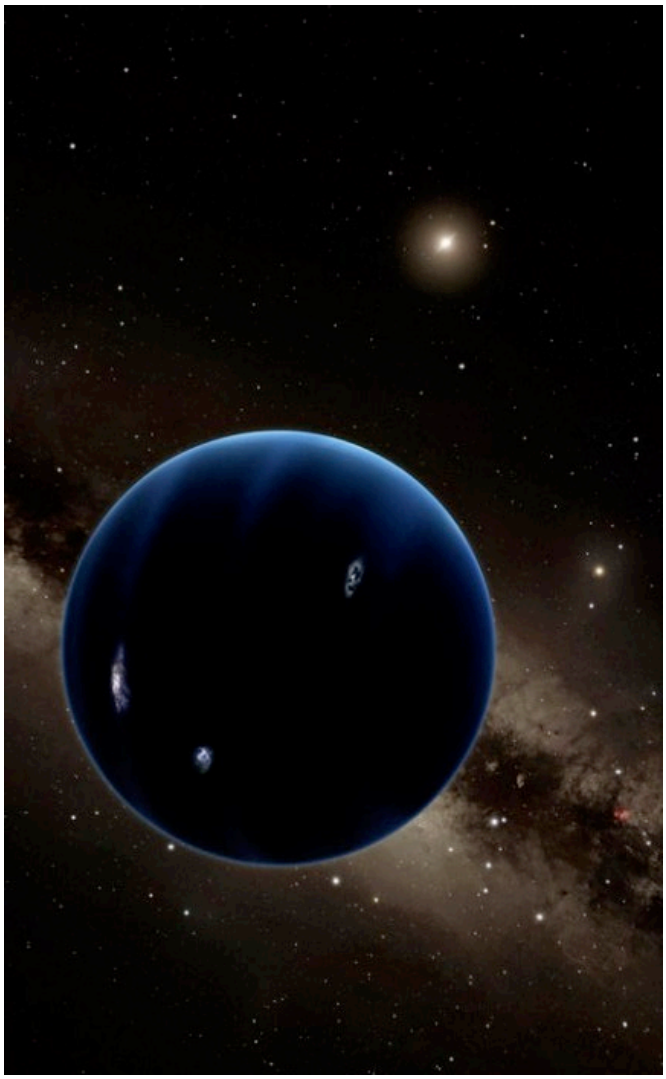
The possible planet has a mass about 10 times that of Earth and is believed to be gaseous, like Uranus and Neptune, according to Mike Brown of Caltech, who became famous during the contentious debate on Pluto's planetary status. He announced the new finding Jan. 20, along with fellow Caltech researcher Konstantin Batygin.

The giant new planet [might] orbit the sun some 20 times farther out than Neptune in the distant reaches of the Kuiper Belt. Neptune orbits the sun at an average distance of 4.5 Billion km.

Astronomers have been searching for decades for "Planet X" a large theorized planet beyond the orbit of Pluto. Pluto's eccentric orbit ranges from 4.4–7.4 billion km.

The theorized 'Planet Nine' travels in a highly elongated path that takes between 10,000 and 20,000 years to complete according to Caltech statement describing the work. (cont'd below)

Is Planet "X" on Verge of Discovery?



Artistic rendering shows the distant view from theoretical Planet Nine back towards the sun. The planet is thought to be gaseous, similar to Uranus and Neptune. Hypothetical lightning lights up the night side. Credit: Caltech/R. Hurt (IPAC)

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Perturbations Indicate Orbit for Planet Nine

Caltech astronomers Mike Brown and Konstantin Batygin coauthored a paper describing their work on the discovery of the existence of the proposed gas giant in the current issue of the Astronomical Journal.

The paper is titled; "EVIDENCE FOR A DISTANT GIANT PLANET IN THE SOLAR SYSTEM" and is available here.

"This would be a real ninth planet," says Brown, the Richard and Barbara Rosenberg Professor of Planetary Astronomy, in a statement. "There have only been two true planets discovered since ancient times, and this would be a third. It's a pretty substantial chunk of our solar system that's still out there to be found, which is pretty exciting."

So far there is no confirmation of the existence of the planet.*

It has not actually been observed but its existence is theorized through complex mathematical modeling and computer simulations. Brown's discovery of Eris in 2005, which orbits farther out than Pluto and is almost the same size as Pluto but smaller, sparked the IAU to demote Pluto to a dwarf planet in 2006.

In the Astronomical Journal paper, Batygin and Brown "show how Planet Nine helps explain a number of mysterious features of the field of icy objects and debris beyond Neptune known as the Kuiper Belt."

"Although we were initially quite skeptical that this planet could exist, as we continued to investigate its orbit and what it would mean for the outer solar system, we become increasingly convinced that it is out there," says Batygin, an assistant professor of planetary science.
"For the first time in over 150 years, there is solid evidence that the solar system's planetary census is incomplete."

Batygin and Brown are hunting for 'Planet Nine' and they encourage others to search too.

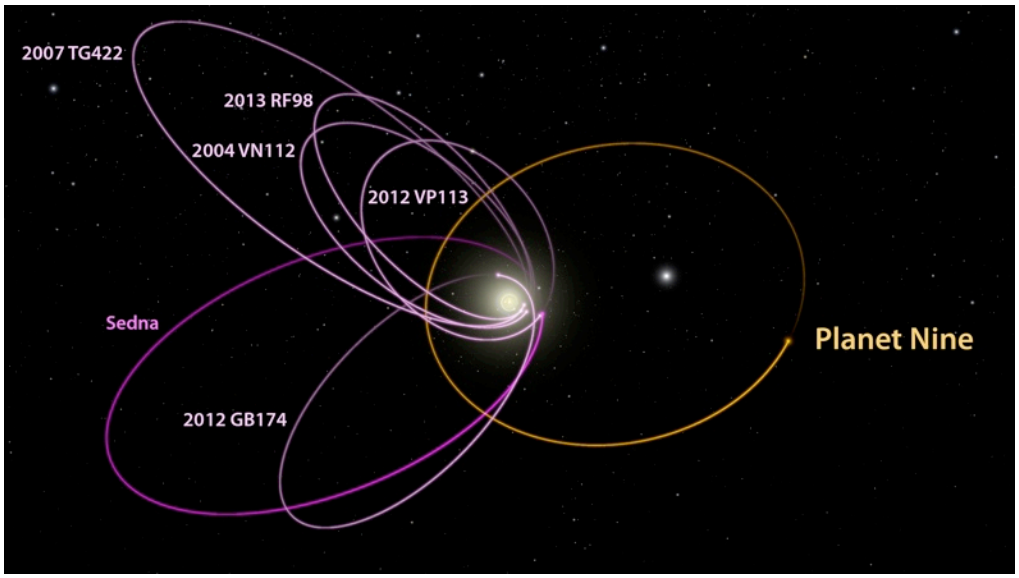
Since they only know the rough orbit of the object, they continue to "refine their simulation" to better pin down its location to more productively aim the telescopes along the highly elliptical path.

BAS & Astronomy Events for February

Feb	**3**	**Wed**	**No BAS meeting** tonight. Next meeting is March 2, 2016
	6	Sat	Fox Dark of the Moon Viewing night (weather permitting) Venus & Mercury near Moon this morning.
	8	Mon	NM
	14	Sun	C. Catalina 17.5° from Double Cluster
	15	Mon	FQ
	22	Mon	FM

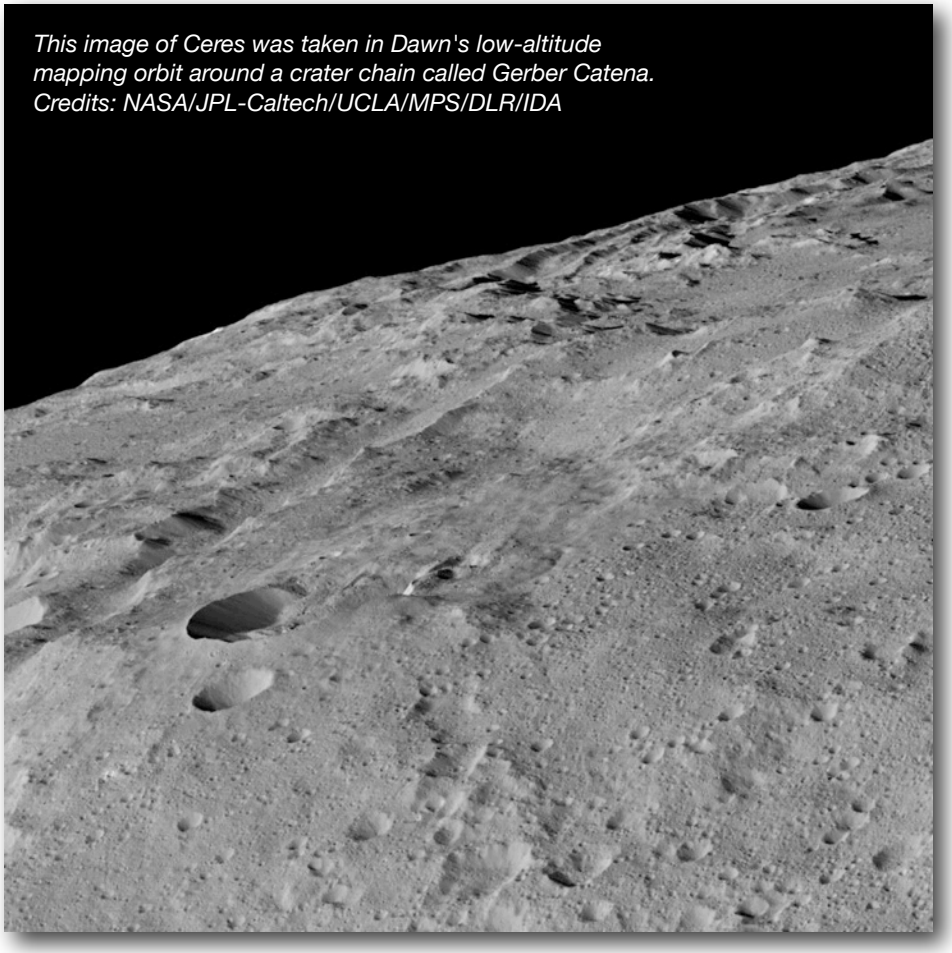
"I would love to find it," says Brown. "But I'd also be perfectly happy if someone else found it. That is why we're publishing this paper. We hope that other people are going to get inspired and start searching."

*[Amateur astronomers out there need not get their telescopes out to start hunting. The brightness of the supposed planet is well below the limits of even our big 30 inch aperture telescopes. -ed]



The six most distant known objects in the solar system with orbits exclusively beyond Neptune (magenta) all mysteriously line up in a single direction. Also, when viewed in three dimensions, they tilt nearly identically away from the plane of the solar system. Batygin and Brown show that a planet with 10 times the mass of the earth in a distant eccentric orbit anti-aligned with the other six objects (orange) is required to maintain this configuration. Credit: Caltech/ R. Hurt (IPAC); [Diagram created using WorldWide Telescope.]

Dawn Now in Lowest Mapping Orbit



This image of Ceres was taken in Dawn's low-altitude mapping orbit around a crater chain called Gerber Catena. Credits: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

NASA's Dawn spacecraft, cruising in its lowest and final orbit at dwarf planet Ceres, has delivered the first images from its best-ever viewpoint. The new images showcase details of the cratered and fractured surface. 3-D versions of two of these views are also available.

Dawn took these images of the southern hemisphere of Ceres on Dec. 10, at an approximate altitude of 240 miles (385 kilometers), which is its lowest-ever orbital altitude. Dawn will remain at this altitude for the rest of its mission, and indefinitely afterward. The resolution of the new images is about 120 feet (35 meters) per pixel.

Among the striking views is a chain of craters called Gerber Catena, located just west of the large crater Urvara. Troughs are common on larger planetary bodies, caused by contraction, impact stresses and the loading of the crust by large mountains -- Olympus Mons on Mars is one example. The fracturing found all across Ceres' surface indicates that similar processes may have occurred there, despite its smaller size (the average diameter of Ceres is 584 miles, or 940 kilometers). Many of the troughs and grooves on Ceres were likely formed as a result of impacts, but some appear to be tectonic, reflecting internal stresses that broke the crust.

"Why they are so prominent is not yet understood, but they are probably related to the complex crustal structure of Ceres," said Paul Schenk, a Dawn science team member at the Lunar and Planetary Institute, Houston.

Dawn's other instruments also began their intense period of observations this month. The visible and infrared mapping spectrometer will help identify minerals by looking at how various wavelengths of light are reflected by the surface of Ceres. The gamma ray and neutron detector is also active. By measuring the energies and numbers of gamma rays and neutrons, two components of nuclear radiation, it will help scientists determine the abundances of some elements on Ceres.

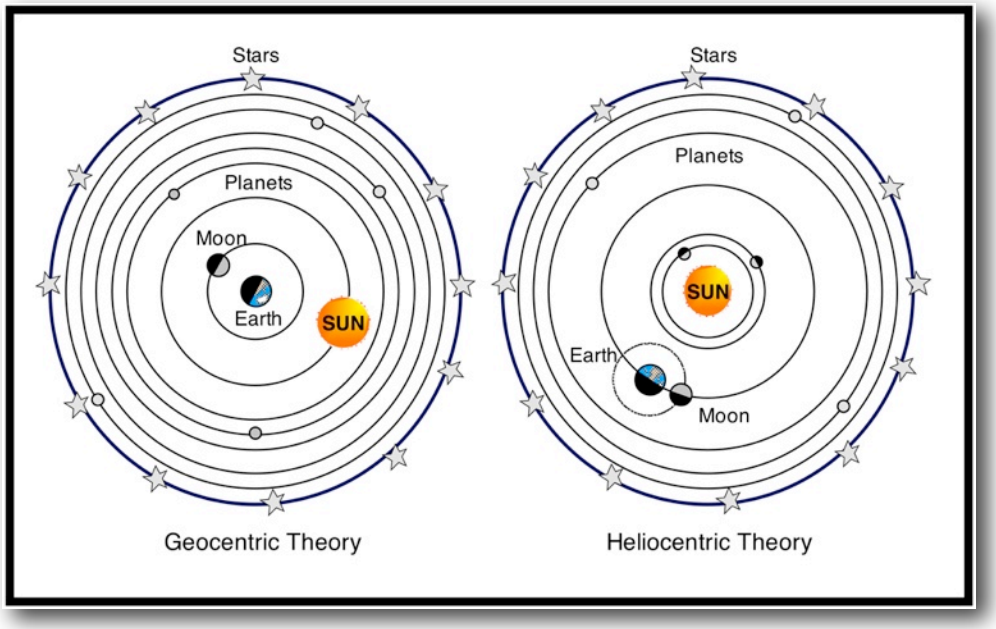
Earlier in December, Dawn science team members revealed that the bright material found in such notable craters as Occator is consistent with salt -- and proposed that a type of magnesium sulfate called hexahydrite may be present. A different group of Dawn scientists found that Ceres also contains ammoniated clays. Because ammonia is abundant in the outer solar system, this finding suggests that Ceres could have formed in the vicinity of Neptune and migrated inward, or formed in place with material that migrated in from the outer solar system.

"As we take the highest-resolution data ever from Ceres, we will continue to examine our hypotheses and uncover even more surprises about this mysterious world," said Chris Russell, principal investigator of the Dawn mission, based at the University of California, Los Angeles.

Elizabeth Landau / Preston Dyches
NASA's Jet Propulsion Laboratory, Pasadena, Calif.

This view of Ceres, taken Dec 10, shows an area in the southern hemisphere near the south pole of Ceres with the Sun 4° north of the equator. The spacecraft took this image in its low-altitude mapping orbit from an approximate distance of 385 km from Ceres.

1. Geocentric Model



During the many thousand years that human beings have been looking up at the stars, our concept of what the Universe looks like has changed dramatically. At one time, the magi and sages of the world believed that the Universe consisted of a flat Earth (or a square one, a zigarrut, etc.) surrounded by the Sun, the Moon, and the stars. Over time, ancient astronomers became aware that some stars did not move like the rest, and began to understand that these too were planets.

In time, we also began to understand that the Earth was indeed round, and came up with rationalized explanations for the behavior of other celestial bodies. And by classical antiquity, scientists had formulated ideas on how the motion of the planets occurred, and how all the heavenly orbs fit together. This gave rise to the Geocentric model of the universe, a now-defunct model that explained how the Sun, Moon, and firmament circled around our planet.

The notion that the Earth was the center of the Universe is certainly an understandable one. To ancient people, looking up at the skies, it seemed evident that the Sun, the Moon and the stars rotated around the Earth once a day. For the Earth-bound observer, the ground that they stood on seemed like a fixed point of reference, a flat plane from which to watch the circling cosmos.

And over time, thanks to centuries of record-keeping by various civilizations – from ancient Babylonian and Egyptian astronomers to contemporary Mediterranean ones – a formalized system began to emerge that put the Earth at the center of all things. This would continue to endure well into the 17th and 18th centuries, by which point, the model's inherent inconsistencies would lead to it being abandoned in favor of the heliocentric model.

Ancient Greece:

The earliest recorded example of a geocentric universe comes from around the 6th century BCE. It was during this time that Pre-Socratic philosopher Anaximander proposed a cosmological system where a cylindrical Earth was held aloft at the center of everything. Meanwhile, the Sun, Moon, and planets were holes in invisible wheels surrounding the Earth, through which humans could see concealed fire.

During this same century, the Pythagoreans began to propose that the Earth was circular, based on observation of eclipses (and in all likelihood, observations of the zodiac from different latitudes). By the 4th century BCE, this idea combined with the concept of a geocentric universe to create the cosmological system that most Greeks subscribed to.

It was also during the 4th century BCE that Plato and Aristotle would create works on the geocentric universe that would secure its place as the predominant cosmological theory. According to Plato, the Earth was a sphere and the stationary center of the universe. The stars and planets were carried around the Earth on spheres or circles, arranged in the order of distance from the center. These were the Moon, the Sun, Venus, Mercury, Mars, Jupiter, Saturn and the fixed stars.

His system was expanded by Eudoxus of Cnidus, a contemporary of Plato's who developed a less mythical, more mathematical explanation of the planets' motion based on the Platonic idea of uniform circular motion. Aristotle elaborated on Eudoxus' system, placing a spherical Earth at the center and all other heavenly bodies arranged in concentric crystalline (i.e. transparent) spheres around it.

These spheres all moved at different uniform speeds to create the rotation of bodies around the Earth and were composed of an incorruptible substance called "aether". He further described his system by explaining the natural tendencies of the terrestrial elements, which in accordance with contemporary belief were earth, water, fire, air; though Aristotle included a fifth element of "celestial aether".

Earth was the heaviest element, so it moved towards the center; whereas water, fire and air formed layers around it. Beyond these layers, lay the solid spheres of aether in which the celestial bodies were embedded. Another important aspect of his model was the inclusion of the "Prime Mover", a sort of deistic concept whereby all motion in the Universe is initiated by a being or force that is themselves "unmoved".

Support for this cosmological principle was based on a number of accepted theories. For one, if the Earth were to move, scholars believed that there would be an observable change in the positions of the fixed stars and constellations (aka. stellar parallax). This could be explained by reasoning that they were either motionless, or much further away than believed. Naturally, they chose to believe the former, as it was the simpler explanation.

Another observation that supported geocentric theory was the apparent consistency in Venus' luminosity, which was interpreted to mean that it was the same distance from Earth at any given time. While this would later come to be explained as the result of Venus' phases compensating for its increase in apparent size, ancient astronomers lacked the means to see this taking place (i.e. telescopes).

This is not to say, however, that the Eudoxian-Artisotelian model was without its share of flaws. For example, the apparent luminosity of Mercury, Mars and Jupiter were subject to change over time. In addition, the passage of Mars and Jupiter through the sky was subject to "retrograde motion", a phenomena where they would

appear to slow down, move backwards, and then move forwards again through the zodiac. All of this contradicted the belief in uniform circular motion, which would have meant that there should be changes in apparent luminosity or changes in the apparent motion of the planet's across the sky.

2. Ptolemaic Model

This is not to say, however, that the Eudoxian-Artisotelian model was without its share of flaws. For example, the apparent luminosity of Mercury, Mars and Jupiter were subject to change over time. In addition, the passage of Mars and Jupiter through the sky was subject to "retrograde motion", a phenomena where they would appear to slow down, move backwards, and then move forwards again through the zodiac. All of this contradicted the belief in uniform circular motion, which would have meant that there should be changes in apparent luminosity or changes in the apparent motion of the planet's across the sky.

Resolving these issues, and standardizing the many aspects of the Aristotelian system, would become the work of Egyptian-Greek astronomer Claudius Ptolemaeus (aka. Ptolemy). In his treatise *Almagest*, which was released in the 2nd century CE, Ptolemy unveiled his concept for a geocentric universe, which would remain the accepted view for the next 1500 years.

Drawing on centuries of astronomical traditions, ranging from Babylonian to modern times, Ptolemy argued that the Earth was in the center of the universe, the planets and Sun revolved around it, and the stars were all at a modest distance from the center. Each planet in this system was also moved by a system of two spheres – a deferent and an epicycle. The deferent is a circle whose center point is removed from the Earth, which was used to account for the differences in the lengths of the seasons. The epicycle is embedded in the deferent sphere, acting as a sort of “wheel within a wheel”. The purpose of he epicycle was to account for retrograde motion, where planets in the sky appear to be slowing down, moving backwards, and then moving forward again.

Unfortunately, these explanations did not account for all the observed behaviors of the planets. Most noticeably, the size of a planet’s retrograde loop (especially Mars) were sometimes smaller, and larger, than expected. To alleviate the problem, Ptolemy developed the equant – a geometrical tool located near the center of a planet’s orbit that causes it to move at a uniform angular speed. To an observer standing at this point, a planet’s epicycle would always appear to move at uniform speed, whereas it would appear to be moving at non-uniform speed from all other locations.

While this system remained the accepted cosmological model within the Roman, Medieval European and Islamic worlds for over a thousand years, it was unwieldy by modern standards. Granted, it did manage to predict planetary motions with a fair degree of accuracy, and was used to prepare astrological and astronomical charts until replaced by the heliocentric model of the Universe. At the same time, however, every planet in the model required an epicycle revolving on a deferent and offset by an equant, which were also different for each planet. In time, these complexities would come to be challenged.

Medieval Geocentrism:

During the Middle Ages, the geocentric model gained new power and as it became synthesized with Christian theology to become an essential canon. As part of a general trend whereby classical knowledge was being rediscovered by the 13th century and after, the adoption of the Aristotelian-Ptolemiac model of the Universe was part of a marriage between Faith and Reason champion by scholars like St. Thomas Aquinas.

For starters, the separation of the Universe into the "heavens" and the Earth, with the Earth at the center of creation and the heavens beyond, agreed with the Christian view of mankind being the pinnacle of God's creation. Second, the Prime Mover of Aristotle's cosmos was interpreted as being the God of Christian theology, and the outermost sphere of the Prime Mover was equated with the Christian Heaven. As a result of this, challenging the view that the heavens revolved around the Earth was not merely a scientific matter, but a matter of heresy. Thus, it did not come to be challenged until the 16th century with the publication of Nicolaus Copernicus' *De revolutionibus orbium coelestium (On the Revolutions of the Heavenly Spheres),* which was only published posthumously to avoid controversy. It is also why support for the heliocentric model of the Universe was also carefully tempered and its adoption gradual.

The geocentric view of the Universe was also the accepted cosmological model in the Islamic world during the Middle Ages. However, beginning in the 10th century CE, there were several Muslim astronomers who challenged one of more aspects of Ptolemy's work.

Alhazen (965 - 1040)

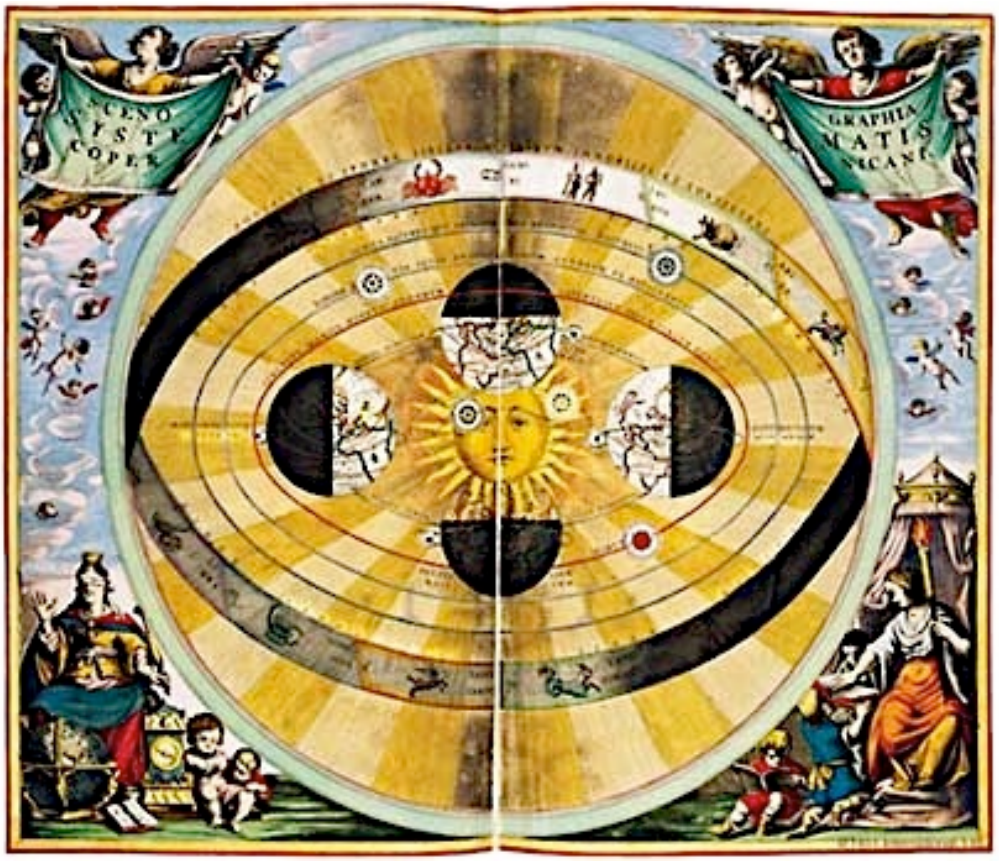
For instance, Iranian astronomer Abu Sa'id al-Sijzi (ca. 945 - ca. 1020) contradicted the Ptolemaic model by asserting that the Earth revolved on its axis, thus explaining the apparent diurnal cycle and the rotation of the stars relative to Earth.In the early 11th century, Egyptian-Arab astronomer Alhazen wrote a critique entitled *Doubts on Ptolemy* (ca. 1028) in which he criticized many aspects of his model. Around the same time, Iranian philosopher Abu Rayhan Biruni (973 - 1048) discussed the possibility of Earth rotating about its own axis and around the Sun - though he considered this a philosophical issue and not a mathematical one.In the 11th and 12th centuries several Andalusian astronomers, centered in the Almohad (Moorish) territory of Spain, challenged the geocentric model of the Universe as well. For instance, 11th century astronomer Abu Ishaq Ibrahim al-Zarqali (aka. Arzachel) departed from the ancient Greek idea of uniform circular motions by hypothesizing that the planet Mercury moves in an elliptic orbit.

In the 12th century, fellow Andalusian Nur ad-Din al-Bitruji (aka. Alpetragius) proposed a planetary model that abandoned the equant, epicycle and eccentric mechanisms. This was followed by Fakhr al-Din al-Razi's (1149–1209) publication of his treatise *Matalib*, which dealt with conceptual physics. In it, he rejected the notion of the Earth's centrality within the universe and instead proposed a cosmology in which there were a "thousand thousand worlds beyond this world...". And at the Maragha Observatory in eastern Iran, the Damascus mosque, and the Ulugh Beg (aka. Samarkand) Observatory in modern-day Kazakhstan, the Earth's rotation was discussed by several generations of astronomers between the 13th and 15th centuries. Though these were largely philosophical in nature and did not result in the adoption of heliocentrism, many of the arguments and evidence put forward resembled those used later by Copernicus.

3. The Heliocentric Model

In the 16th century, Nicolaus Copernicus began devising his version of the heliocentric model, which represented the culmination of years worth of research. Like others before him, Copernicus built on the work of a number classical astronomers who did not support the geocentric view, as well as paying homage to the Maragha school and several notable philosophers from the Islamic world.By 1514 century, Copernicus summarized his ideas in a short treatise titled *Commentariolus* ("Little Commentary"), which he began circulating to friends. This forty-page manuscript described his ideas about the heliocentric hypothesis, which was based on seven general principles. These principles stated that:

- Celestial bodies do not all revolve around a single point
- The center of Earth is the center of the lunar sphere—the orbit of the moon around Earth
- All the spheres rotate around the Sun, which is near the center of the Universe
- The distance between Earth and the Sun is an insignificant fraction of the distance from Earth and Sun to the stars, so parallax is not observed in the stars
- The stars are immovable – their apparent daily motion is caused by the daily rotation of Earth
- Earth is moved in a sphere around the Sun, causing the apparent annual migration of the Sun. Earth has more than one motion
- Earth's orbital motion around the Sun causes the seeming reverse in direction of the motions of the planets



Heliocentric System painting in 1660. Image credit: The Harmonia Macrocosmica of Andreas Cellarius.

Thereafter he continued gathering data for a more detailed work, and by 1532, he had come close to completing the manuscript of his magnum opus – *De revolutionibus orbium coelestium (On the Revolutions of the Heavenly Spheres).* In it, he advanced his seven major arguments, but in more detailed form and with detailed computations to back them up.https://youtu.be/opY4i_g_pQ8
By placing the orbits of Mercury and Venus between the Earth and the Sun, Copernicus was able to account for changes in their appearances. In short, when they are on the far side of the Sun, relative to Earth, they appear smaller but full. When they are on the same side of the Sun as the Earth, they appear larger and "horned" (crescent-shaped).

It also explained the retrograde motion of planets like Mars and Jupiter by showing that Earth astronomers do not have a fixed frame of reference but a moving one. This further explained how Mars and Jupiter could appear significantly larger at certain times than at others. In essence, they are significantly closer to Earth when at opposition than when they are at conjunction.

However, due to fears that the publication of his theories would lead to condemnation from the church (as well as, perhaps, worries that his theory presented some scientific flaws) he withheld his research until a year before he died. It was only in 1542, when he was near death, that his treatise was sent to Nuremberg to be published.

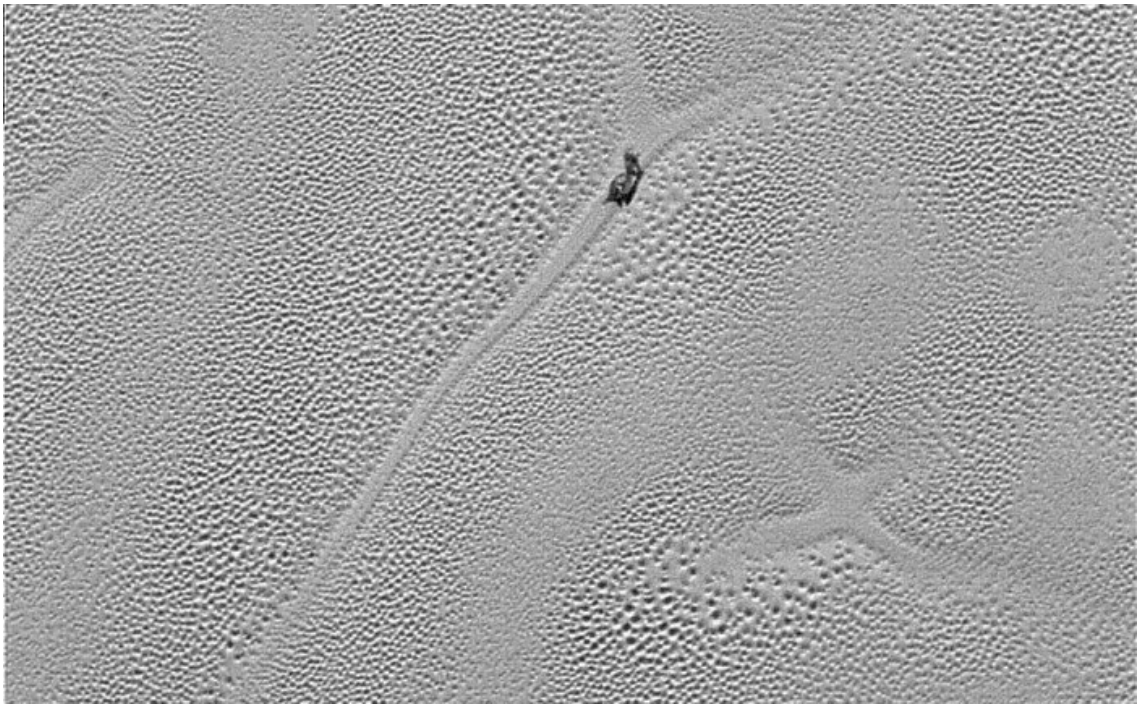
Thanks to the invention of the telescope, ongoing observations about the motions of the planets, and refined calculations, astronomers would come to understand that the Earth was not immovable. Nevertheless, for thousands of years, the geocentric model of the universe would remain the accepted cosmological system, and was used to calculate the positions of the planet, eclipses, and other astronomical phenomena. In the end, the geocentric model of the universe succumbed to the same fate as many other accepted notions of its day. Much like the true age of the Earth, humanity's biological origins, and astrology, the belief that the Earth was the center of the universe did not survive the expansion in learning that was taking place by the 17th century. More interesting articles on the various models of the Universe can be found at Universe Today.

Here is What Is The Difference Between The Geocentric and Heliocentric Universe?, Where Is The Center Of The Universe, and The Earth Goes Around The Sun? Astronomy Cast also has an episode on the subject, titled Episode 77: Where Is The Center Of The Universe

For more information, check out the NASA Earth Observatory's page on Planetary Motion, and the Polaris Project's page on the The Ptolemaic Model.

The post What Is The Geocentric Model Of The Universe? appeared first on Universe Today.

Convective Churning on Pluto



"X" marks the spot that's illustrative of "convective churning" resulting from subsurface planetary heating, as seen in a fascinating new super high resolution image received from NASA's New Horizons spacecraft on Christmas Eve, Dec. 24, 2015. Its situated at the very center of the left ventricle of Pluto's huge "heart" - an icy flow plain that's informally named "Sputnik Planum.

"The "X" feature (lower corner image right) is located in an area of intersecting cells, shaped like polygons, on the plains of "Sputnik Planum" which are mostly comprised of frozen nitrogen ices. So what's really piqued the interest of scientists leading the New Horizons mission, is that the "X" feature is a residue of "convective churning" or internal heating and it has changed over time.Indeed the "X" is found at what appears to be the melted remnants of a quadruple junction of the polygonal or cellular patterns, that dominate Sputnik Planum. And it's not tiny!

"This part of Pluto is acting like a lava lamp," said William McKinnon, deputy lead of the New Horizons Geology, Geophysics and Imaging team, from Washington University in St. Louis, "if you can imagine a lava lamp as wide as, and even deeper than, the Hudson Bay."The polygonal cell features are believed to have arisen over time from the slow thermal convection of the icy plains that are composed of a slushy mixture of mostly nitrogen ices along with some water ice mixed in.The image was taken by the probes telescopic Long Range Reconnaissance Imager (LORRI) at a distance of approximately 10,000 miles (17,000 kilometers), about 15 minutes before New Horizons' closest approach to Pluto.

Scientists currently interpret the dark patch near the top of the image to be a dirty water "iceberg" that's "floating in denser solid nitrogen, and which has been dragged to the edge of a convection cell." Also visible are thousands of surface pits arising from sublimation.

New Horizons made history when it became Earth's first emissary to hurtle past the small planet on July 14, 2015.Pluto - also now known as the 'Other Red Planet' - was the last unexplored planet in our solar system.The LORRI image nearly completes a mosaic of New Horizons' highest-resolution images taken of Pluto along a swath at the center of Sputnik Planum. They have a resolution of about 250-280 feet (77-85 meters) per pixel – "revealing features smaller than half a city block on Pluto's surface," according to the team in a NASA statement.

The newly released images, from NASA and the New Horizons team, illustrate the polygonal or cellular pattern of the plains, which "are thought to result from the convective churning of a deep layer of solid, but mobile, nitrogen ice." The LORRI images also reveal numerous, active triple junctions spread across the terrain.Based on the data returned thus far, researcher say "the pattern of the cells stems from the slow thermal convection of the nitrogen-dominated ices that fill Sputnik Planum.""Computer models by the New Horizons team show that these blobs of overturning solid nitrogen can slowly evolve and merge over millions of years."The nitrogen ices rise and sink over time forming ridges along the edges of the polygonal cells that change with time due to the subsurface heating.The polygons range in width from to 25 miles (16 to 40 kilometers). They are somewhat dome-like and rise slightly about 100 yards (100 meters) in the center.

Researchers say Sputnik Planum itself is likely several miles or kilometers deep in some places and the icy plains are a few miles lower that the surrounding areas on Pluto."The solid nitrogen is warmed at depth by Pluto's modest internal heat, becomes buoyant and rises up in great blobs, and then cools off and sinks again to renew the cycle."

The "Sputnik Planum" region dominates the left side of Pluto's "heart-shape" feature informally dubbed "Tombaugh Regio."So far New Horizon has transmitted back only about 20 percent of the data gathered, according to mission Principal Investigator Alan Stern of the Southwest Research Institute, Boulder, Colorado."It's hard to imagine how rapidly our view of Pluto and its moons are evolving as new data stream in each week. As the discoveries pour in from those data, Pluto is becoming a star of the solar system," says Stern."Moreover, I'd wager that for most planetary scientists, any one or two of our latest major findings on one world would be considered astounding. To have them all is simply incredible.

"The piano shaped probe gathered about 50 gigabits of data as it hurtled past Pluto, its largest moon Charon and four smaller moons.Stern says it will take about a year for all the data to get back. Thus bountiful new discoveries are on tap for a long time to come.

New Horizons remains on target to fly by a second Kuiper Belt Object (KBO) on Jan. 1, 2019 - tentatively named PT1, for Potential Target 1. It is much smaller than Pluto and was recently selected based on images taken by NASA's Hubble Space Telescope.

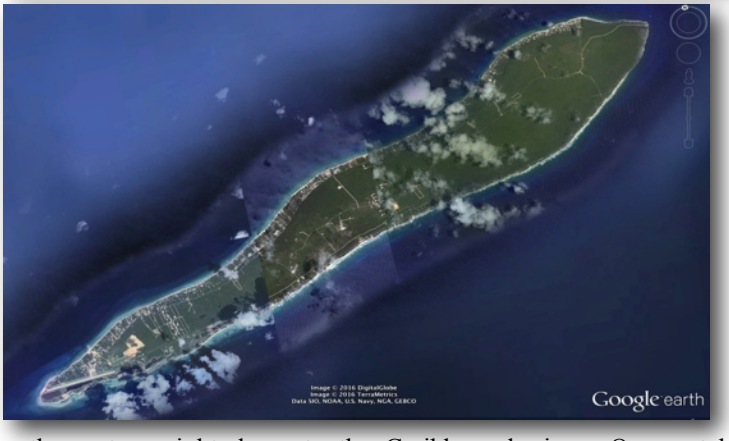
Stay tuned here for Ken's continuing Earth and planetary science and human spaceflight news.Ken Kremer

Winter Stargazing from Cayman Brac

"I stood and stared; the sky was lit,
The sky was stars all over it.
I stood, I knew not why,
Without a wish, without a will,
I stood upon that silent hill
And stared into the sky until
My eyes were blind with stars and still
I stared into the sky."
Ralph Hodgson "Song of Honor" (1913)

There is a small Caribbean island, called Cayman Brac, located off the beaten tourist track, about 145 km NE of Grand Cayman. The island is shaped like a paramecium and is 19 km long and, at most, 2 km wide. It has just about everything for the Caribbean tourist except the crowds and crime ! This island is also a naturalist's delight ! It has a parrot preserve, numerous karst caves, opportunities for beach and cove swimming, reef snorkeling, wall diving, deep sea fishing, birding, and wonderful stargazing. The locals are called "Brackers", have never been slaves, and are beautiful, engaging, people.

***Above**: Three Palms Sunset*
***Right**: Google view of Cayman Brac*



This year Paula and I visited Cayman Brac for the third time. However, this year our trip was more expensive than we had planned.Thanks really, to the drop in oil prices, the value of our Canadian dollar against both American and Caymanian currencies took a hit. When we purchased Caymanian dollars this year the exchange rate was $1.72 Canadian for each Caymanian dollar and the dollar cost of living on Cayman Brac was more expensive than in Canada because everything must be brought in by barge once a week from Grand Cayman. Thankfully, we had reserved our rental cottage many months prior and got a small break on the exchange, and we were able to use our VISA Avion points for our airfare.

We usually like to rent a cottage on the south side of the island because at that location we have an unobstructed view of the southern stars, right down to the Caribbean horizon. Our rental cottage was called Three Palms, and we learned after we arrived, it had been built by an American astronomer who currently manages SOPHIA, (the Stratospheric Observatory for Infrared Astronomy) for NASA. For our own stargazing, we took our Canon Image Stabilized Binoculars, Paula's Pronto, a suite of Tele-Vue eyepieces, two tripods, two cameras, an iOptron Sky Tracker, two star atlases and one lunar atlas.

About 3:00 AM on January 9th ,I woke up for a normal call of nature and then decided to check out the southern sky. There were stars everywhere and they plunged right down to the Caribbean horizon ! Ralph Hodgson's poem at the beginning of this Article captures my emotional connection. In the above photo, the meridian meets the southern horizon just above the fireplace at the right side of the beach. That morning, straddling the meridian, was the Southern Cross, then to its west was Eta Carina, and to the east of the meridian was Omega Centauri. I took my 15 x 50 IS Canon Binoculars and settled into a chaise and just soaked in the sights. I then set up the iOptron Sky Tracker and attached my Canon 60 Da with its 18mm -55 mm lens. The image left was a 159 second exposure, @ 2500 ISO, and f/5.6.

Both long exposure and high ISO noise reduction functions were activated. Crux is positioned just above and slightly to the left of the bottom leaf design, Eta Carina is the reddish patch to the right of the leaf design, and great globular cluster, Omega Centauri, is located from the top left moving 1/4 of the FOV down and to the right.

I continued my imaging and observing until around 5:30 AM morning when I noticed a beautiful conjunction of Venus and Saturn in the eastern sky. I moved my camera and took a 59 second exposure @ ISO 2500 and f/5.6. Saturn was positioned just beside Venus. (Image next page)

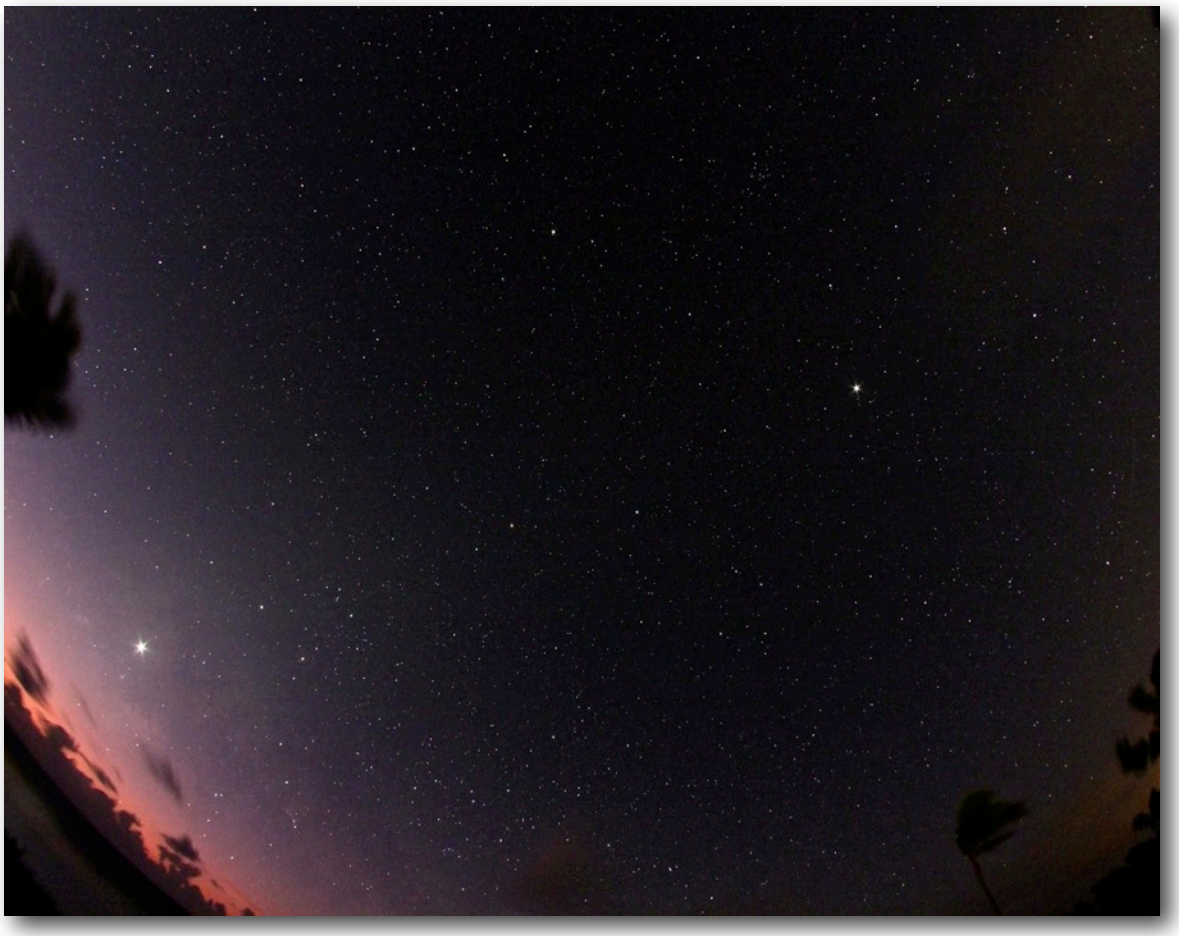
Later that afternoon, Paula and I went swimming at Buccaneer Cove and we met Susan and Michael Hundt, both local school teachers, and their Godson, Jovanni, an engineer who was visiting them from Grand Cayman. When they found out that we were interested in astronomy and were stargazing on clear nights, they asked to join us. We spent three nights observing with them and, during those times, we discussed the potential of stargazing as a tourist attraction on Cayman Brac. At the eastern end of the island is a dark sky bluff, (the Brac) which provides a perfect location for an observatory and public stargazing. Actually, it provides a better location than our rental cottage. Susan mentioned this idea to her friend, Chevala Burke, who is the Marketing and Promotional Director for Cayman Brac. Chevala contacted Paula and myself and suggested a meeting. So, just before we flew home to Ontario, we met Chevala in her government office to talk about the Brac's potential for astronomy tourism. She owned her own Orion 6 inch reflector, and was very receptive to this idea. She explained that the Cayman Brac Tourism Department already has two local employees whose job is to showcase the natural wonders of Cayman Brac, for free, to the tourists. If an astronomy outreach program was implemented they would be trained to deliver the program. We thought that was a great idea. We said we would stay in touch and exchanged email addresses.

Conjunction of Venus, and Saturn in Scorpius, from Cayman Brac, January 9th, 2016 Doug Cunningham photo

On our second last morning I rose early for, what turned out to be, my last clear night on the Brac. There was a widely publicized planetary alignment, involving all 5 naked eye planets, which would be visible in the eastern sky, just before sunrise. The weather forecast for much later in the day predicted high winds and torrential rain, so this morning was going to be my only chance to observe and image the alignment.

I arose about 5:15 AM , opened the patio door, and walked down to our beach. My eyes were nicely dark adapted. Facing south-south east I saw a striking alignment of bright stars and planets positioned along, or near, the ecliptic line. Regulus, Jupiter, Spica, Mars, Saturn, Antares, Venus and Arcturus were all there. I missed seeing Mercury because of the eastern horizon clouds. Jupiter was positioned to the left of Regulus in Leo Major, while Venus, bathed in the pink glow of dawn, was positioned to the left of Antares, in Scorpius. There is something special about seeing the asterism of Scorpius near the horizon because it always appears huge! I wanted a picture. I attached my Rokinon 8mm, f/3.5 fisheye lens to my Canon 60 Da camera and took the dawnscape photo shown at bottom right. It was an exposure of 96 seconds, @ 2500 ISO, and the fisheye lens was set to f/8. Although starscape photos provide a good rendition of a celestial apparition, for myself, they never fully capture the entire sensory drama. On this Cayman Brac morning, the wonderfully clear dawn skies, were accompanied by the smell of the ocean and the sounds of waves advancing and receding on the limestone shore. Like an orchestra! What a wonderful parting gift from Cayman Brac skies.

Below: *Morning Planetary Alignment, Venus,Saturn, Mars, Jupiter on*



Largest Age Map of Milky Way Reveals How Our Galaxy Grew Up

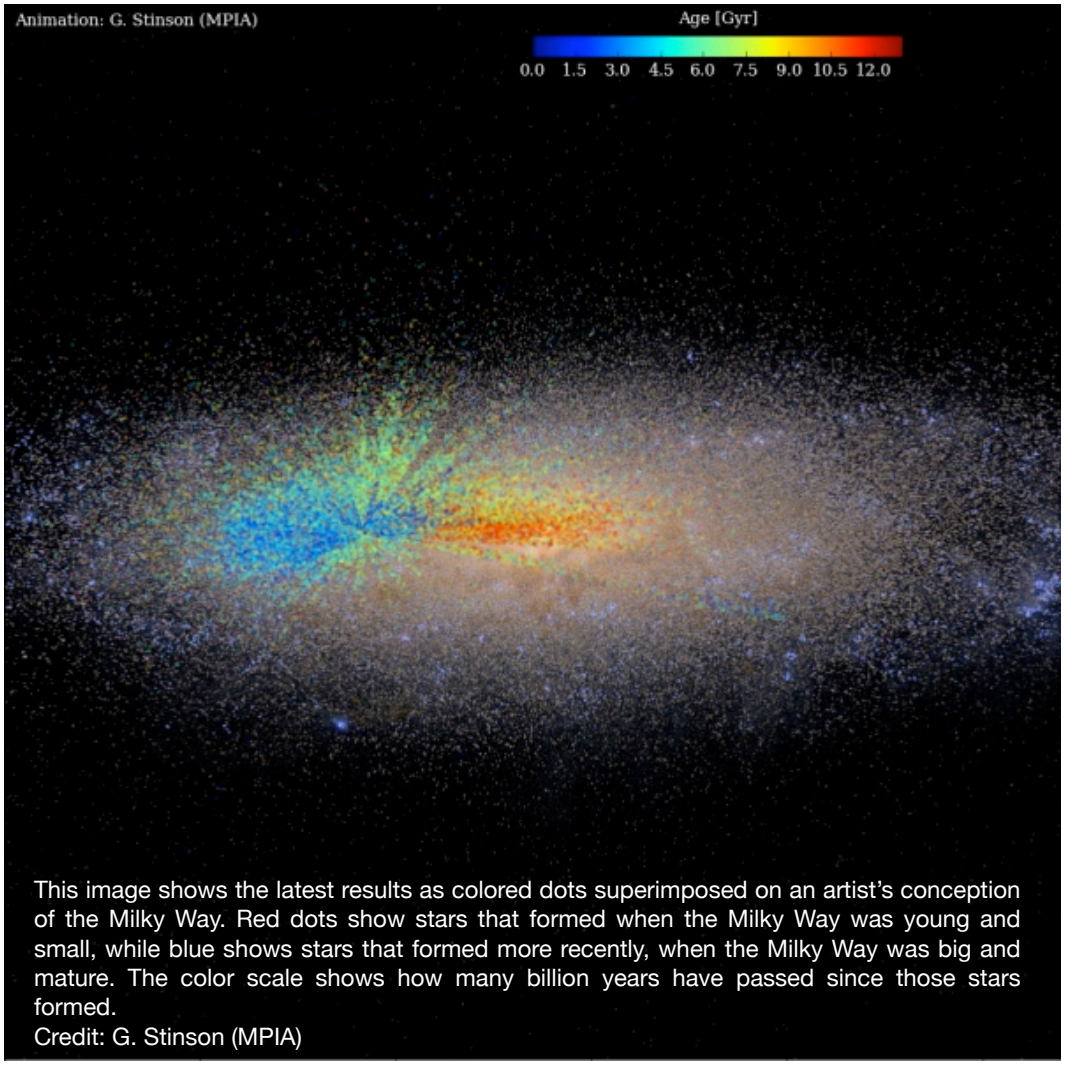
January 8, 2016 Sloan Sky By Jordan Raddick

Proud parents chart the growth of their children, but astronomers from the Sloan Digital Sky Survey (SDSS) have taken on a bigger task: charting the growth of our own Milky Way.

In a result presented today at the American Astronomical Society meeting in Kissimmee, Florida, a team led by Melissa Ness of the Max Planck Institute for Astronomy in Heidelberg, Germany created the first-ever "growth chart" for our Milky Way Galaxy. Their chart, which uses the ages of more than 70,000 stars and extends halfway across our Galaxy to 50,000 light-years away, helps us read the story of how our Galaxy grew from its infancy to the bright spiral galaxy we see today.

"Close to the center of our Galaxy, we see old stars that were formed when it was young and small. Farther out, we see young stars. We conclude that our Galaxy grew up by growing out," says Ness, lead author of the study. "To see this, we needed an age map spanning large distances, and that's what this new discovery gives us."

The researchers mapped the Galaxy by observing red giants, bright stars in the final stages of their lives that can be observed out to large distances from our Sun, into the very inner and outer reaches of the Milky Way. "If we know the mass of a red giant star, we know its age by using the fusion clock inside every star," says Marie Martig, lead author of a related study and a co-author of Ness's study. "Finding masses of red giant stars has historically been very difficult, but surveys of the Galaxy have made new, revolutionary techniques possible."



This image shows the latest results as colored dots superimposed on an artist's conception of the Milky Way. Red dots show stars that formed when the Milky Way was young and small, while blue shows stars that formed more recently, when the Milky Way was big and mature. The color scale shows how many billion years have passed since those stars formed.
Credit: G. Stinson (MPIA)

The team started with spectra taken from one of the SDSS's component surveys, the Apache Point Observatory Galaxy Evolution Experiment (APOGEE). "APOGEE is the ideal survey for this work because it can get high-quality spectra for 300 stars simultaneously over a large area of sky," says Steve Majewski of the University of Virginia and Principal Investigator of the APOGEE survey. "Seeing so many stars at once means getting spectra of 70,000 red giants is actually possible with a single telescope in a few years' time."

The ages of stars cannot be measured with APOGEE spectra alone, but the APOGEE team realized that light curves from the Kepler satellite, a NASA space mission whose main goal is to find planets around stars, could provide the missing link between APOGEE spectra and stellar ages. APOGEE therefore observed thousands of red giants that had also been seen by Kepler. After combining information from the APOGEE spectra and Kepler light curves, the researchers could then apply their methods to measure ages for all 70,000 red giant stars sampling all parts of the galaxy.

"In the galaxy we know best – our own – we can clearly read the story of how galaxies form in a Universe with large amounts of cold dark matter," says Ness. "Because we can see so many individual stars in the Milky Way, we can chart its growth in unprecedented detail. This unprecedented, enormous map really is one for the ages."

Contacts
1 Melissa Ness, Max-Planck-Institut fur Astronomie, ness@mpia-hd.mpg.de, 49-6221-528-412
2 Marie Martig, Max-Planck-Institut fur Astronomie, martig@mpia.de, 49-6221-528-455
3 Steve Majewski, University of Virginia, srm4n@virginia.edu, 434-924-4893

Voyager Mission Celebrates 30 Years Since Uranus

Humanity has visited Uranus only once, and that was 30 years ago. NASA's Voyager 2 spacecraft got its closest look at the mysterious, distant, gaseous planet on Jan. 24, 1986.

Voyager 2 sent back stunning images of the planet and its moons during the flyby, which allowed for about 5.5 hours of close study. The spacecraft got within 50,600 miles (81,500 kilometers) of Uranus during that time.

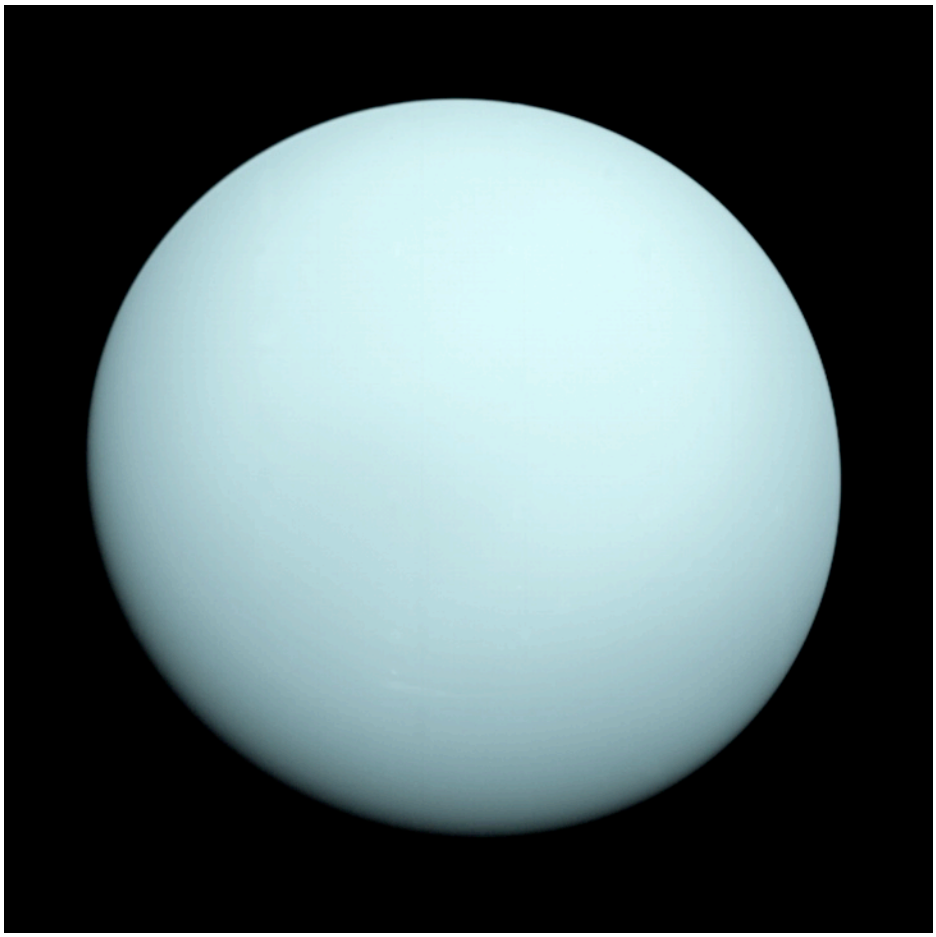
"We knew Uranus would be different because it's tipped on its side, and we expected surprises," said Ed Stone, project scientist for the Voyager mission, based at the California Institute of Technology, Pasadena. Stone has served as project scientist since 1972, continuing in that role today.

Uranus revealed itself to be the coldest planet known in our solar system, even though it's not the farthest from the sun. This is because it has no internal heat source.

Scientists determined that the atmosphere of Uranus is 85 percent hydrogen and 15 percent helium. There was also evidence of a boiling ocean about 500 miles (800 kilometers) below the cloud tops.

Scientists found that Uranus has a magnetic field different from any they had ever encountered previously. At Mercury, Earth, Jupiter and Saturn, the magnetic field is aligned approximately with the rotational axis.

"Then we got to Uranus and saw that the poles were closer to the equator," Stone said. "Neptune turned out to be similar. The magnetic field was not quite centered with the center of the planet."



Voyager 2 image of Uranus taken in January 1986 from 81, 500 km away as the spacecraft swept by (on its way to Neptune). Voyager 2 is well out of our solar system presently. Image credit: NASA

This surface magnetic field of Uranus was also stronger than that of Saturn. Data from Voyager 2 helped scientists determine that the magnetic tail of Uranus twists into a helix stretching 6 million miles (10 million kilometers) in the direction pointed away from the sun. Understanding how planetary magnetic fields interact with the sun is a key part of NASA's goal to understand the very nature of space. Not only does studying the sun-planet connection provide information useful for space travel, but it helps shed light on the origins of planets and their potential for harboring life.

Voyager 2 also discovered 10 new moons (there are 27 total) and two new rings at the planet, which also proved fascinating. An icy moon called Miranda revealed a peculiar, varied landscape and evidence of active geologic activity in the past. While only about 300 miles (500 kilometers) in diameter, this small object boasts giant canyons that could be up to 12 times as deep as the Grand Canyon in Arizona. Miranda also has three unique features called "coronae," which are lightly cratered collections of ridges and valleys. Scientists think this moon could have been shattered and then reassembled.

Mission planners designed Voyager 2's Uranus encounter so that the spacecraft would receive a gravity assist to help it reach Neptune. In 1989, Voyager 2 added Neptune to its resume of first-ever looks.

"The Uranus encounter was very exciting for me," said Suzanne Dodd, project manager for Voyager, based at NASA's Jet Propulsion Laboratory, Pasadena, California, who began her career with the mission while Voyager 2 was en route to Uranus." It was my first planetary encounter and it was of a planet humanity had never seen up close before. Every new image showed more details of Uranus, and it had lots of surprises for the scientists. I hope another spacecraft will be sent to explore Uranus, to explore the planet in more detail, in my lifetime."

Voyager 2 was launched on Aug. 20, 1977, 16 days before its twin, Voyager 1. In August 2012, Voyager 1 made history as the first spacecraft to enter interstellar space, crossing the boundary encompassing our solar system's planets, sun and solar wind. Voyager 2 is also expected to reach interstellar space within the next several years.

The Voyagers were built by JPL, which continues to operate both spacecraft. JPL is a division of Caltech. For more information about the Voyager spacecraft, visit:

http://www.nasa.gov/voyager

http://voyager.jpl.nasa.gov

Media Contact Elizabeth Landau

NASA's Jet Propulsion Laboratory, Pasadena, Calif.

818-354-6425

elizabeth.landau@jpl.nasa.gov

Eridanus (Eri)

α-Eridani - Achernar (not visible in northern latitudes of Bruce/Grey)

Eridanus is a quite extensive, winding constellation of faint stars that cannot be seen in its entirety from northern latitudes. It begins just to the west of the left foot of Orion [Rigel] and traces a long, sinuous line heading generally westward, then curving south and back to the east, finally dropping south below the horizon. There is a fine field of stars around β-Eridani that can be observed in binoculars; also note the fine pair of orange stars below ν-Eridani.

DOUBLE STARS

	Mag.	Sep'n (s)	Location	Remarks
γ	3.5-13.0	53	035514	
θ	3.1-4.1	8	025740	
o2	4.5-9.2	82	041308	[9.2 mag star is 40-Eri-B, the famous white dwarf]
32	5.0·6.3	7	035203	Topaz-Pale Blue, fine contrast
39	5.1-9.0	6	041210	
55	6.7-6.8	9	044109	Yellow-White
Σ570	7.0-8.0	13	043310	

Other Objects of Interest (Eri)

NGC 1535 - An unusual planetary nebula with a faint star in its centre, well worth observation. Location 041213.

Lepus (Lep)

α–Leporis - Arneb β-Leporis - Nihal

Lepus is located at the feet of Orion, the Hunter; its four brightest stars, all of the 3rd magnitude, form an easily identified trapezoidal figure. Four smaller stars in a rough rectangle (λ, κ, ι and υ Leporis) represent the long ears of the hare. λ Leporis is a fieldglass double.

DOUBLE STARS

	Mag.	Sep'n (s)	Location	Remarks
α	2.7-12.0	36	053118	Yellow-Grey
β	2.8-9.4	3	052721	
γ	3.8-6.4	95	054222	Yellow-Garnet
κ	4.5-7.5	2.5	051113	Yellow-Blue
H3752	5.5-6.7-	3-59-9.0	052025	Triple
H3780	-- --		053718	A beautiful multiple star; very fine in small telescopes

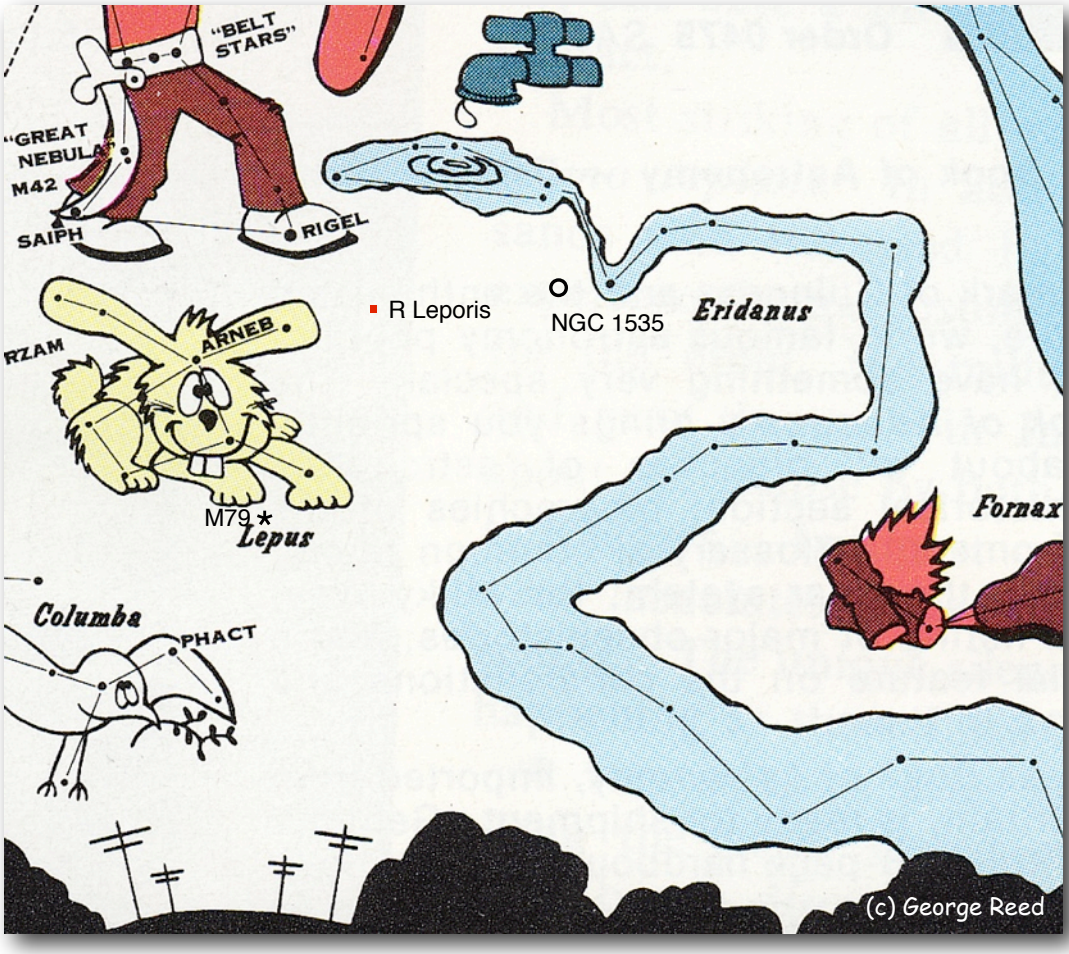
MESSIER OBJECTS

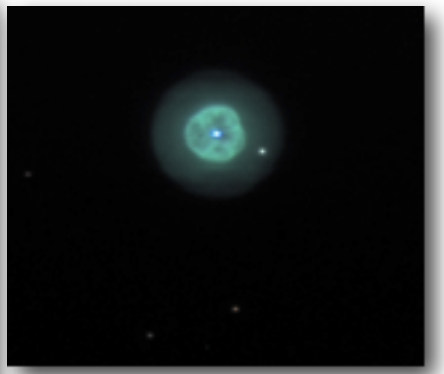
	Mag	Location	Remarks
M 79	7.9	052225	Globular Cluster, fairly bright, beautiful

Other Objects of Interest (Eri)

R Leporis - Hind's "Crimson Star," a long period (436 days) variable, magnitude range 6-11. Location 045715.

The Location column in the tables above gives the RA (1st 4 digits) and Dec (2 last digits, bold=negative) for the object. For ex. 162726 means 16 h 27 min RA and **minus 26** degrees Dec.





NGC 1535 Planetary Nebula in Eridanus (vis mag 9.6)
Image credit: Adam Block NOAO/ AURA/NSF taken with a 20" RC Optical Systems telescope at f/8.4 Paramount ME Robotic Telescope Mount SBIG ST10XME CCD camera with color filter wheel.

HIND'S CRIMSON STAR (R Leporis). Though stars are colored their shades are subtle. There is little doubt, however, about the redness of "carbon stars." Not only are they among the coolest known stars, they have also -- through internal nuclear fusion and convection, changed their surface ratios of carbon to oxygen. In carbon stars, carbon is in the ascendancy, and those molecules remove what little blue light is left, leaving the stars a vivid red. Among the best of them is R Leporis, discovered in 1845 in Lepus by J. R. Hind (1823-1895). it is worth a look!
From: **One Minute Astronomer** Brian Ventrudo

Date: (Time given on 24 h clock EST unless otherwise noted).

Jan	**31**	10:28	**LQ Moon** rises locally at 12:18 am EST
Feb	**01**	03:48	Mars 2.7°S of Moon
	03	14:05	Saturn 3.5°S of Moon
	06	02:32	Venus 4.3°S of Moon
		09:47	Mercury 3.8°S of Moon
		20:00	Mercury at Greatest Elong: 25.6°W
	08	09:39	**NM rises locally at 7:21 am** EST
	10	21:42	Moon at Perigee: 364 358 km
	12	22:00	Mercury 4.0° of Venus
	15	02:46	**FQ rises locally at 11:41 am**
	16	02:41	Aldebaran 0.3°S of Moon (below horizon locally)
	22	07:48	Regulus 2.5°N of Moon
		13:20	**FM rises locally at 6:13 pm EST**
	23	22:58	Jupiter 1.7°N of Moon
	26	14:05	Spica 5.1°S of Moon
		22:28	Moon at Apogee: 405 383 km
	29	13:16	Mars 3.6°S of Moon **LEAP DAY!**

BAS/Astronomy Events

Feb 3	**Wed**	**No BAS meeting** tonight. Next meeting is March 2, 2016
6	Sat	Fox Dark of the Moon Viewing night (weather permitting)
8	Mon	NM
14	Sun	C. Catalina 17.5° from Double Cluster
15	Mon	FQ
22	Mon	FM
29	**Mon**	**Leap Day!**

Special Events

Solar Eclipse Aug 21, 2017

The first solar eclipse that crosses the US in a generation will happen on Monday Aug 21, 2017. It is a major event and BAS is starting planning for a trip to observe it.

BAS is planning a camping trip to a location near the centre of the track. We are looking at central Nebraska between Grand Is. NE and Alliance, NE where the best chance of cloud-free skies exists for the eastern half of the track.

Distance is about 2000 km one way and would involve a two-day drive along a major interstate (I-90 and I-80) probably leaving Friday Aug 18, and returning midweek following the eclipse. Our plans are to reserve sites at a suitable campground, for at least the weekend prior to the Monday eclipse and a few days afterwards. We hope to find a facility within the track so that we would only need to move if the weather were an issue. Dates are tentative and you are not bound by our itinerary.

Please let us know as soon as you can if you are interested in joining the group. Send an email to Brett T or John H. We already have about a dozen interested members. Here are links to track maps, cloud maps, etc. that we are using in our planning:

The weather map from Jay Anderson. http://home.cc.umanitoba.ca/~jander/tot2017/tse17intro.htm

The high definition zoomable track map is here at the Mr. Eclipse website of Fred Espenak: http://eclipse-maps.com/Eclipse-Maps/Welcome_files/2017_LongMap_125dpi.jpg

Lots more on Espenak's site, of course...http://www.mreclipse.com/MrEclipse.html and

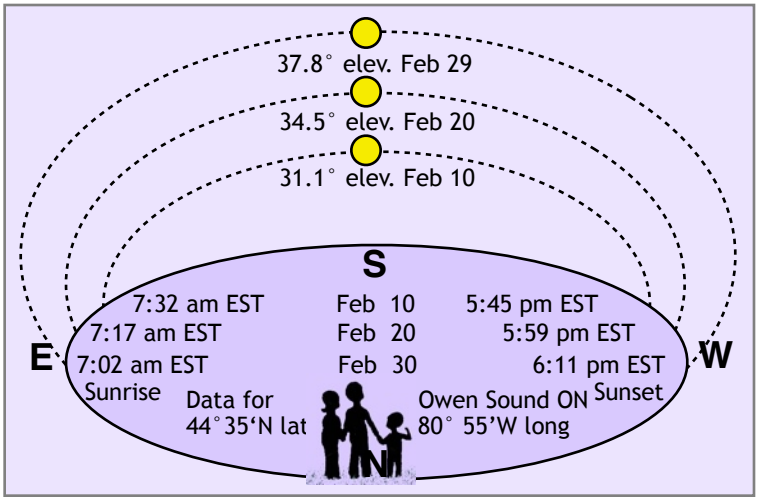
bunches of maps from Michael Zeiler here: http://www.greatamericaneclipse.com/

Planets

MERCURY is well placed in the morning sky early in the month and joins Venus and the Moon in a nice group Feb 6 morning.

VENUS, (-4.0) is a beautiful Morning Star and on Feb 6 makes a nice group with Mercury and the last crescent Moon.Venus follows Mercury towards the Sun all month. **MARS,** (mag. 0.7) rises after midnight and is high in the sky by dawn. **JUPITER**, (-2.4) rises by 8 pm by month end and is well placed for viewing in the evening sky. **SATURN,** (mag. 0.5) rises about 3 am by month end and follows Mars in the sky by about 25°. Only one of the gas giants, **URANUS,** (5.8) is still visible in the west for an hour or two before it sets. **NEPTUNE,** (7.9) is close to the Sun this month and difficult to observe in the glare. **Dwarf planet**, **Ceres (8.3)** is even closer to the Sun and at the end of its evening viewing season until spring. **Asteroid, Vesta (6.7)** is near Uranus and has the same viewing conditions until both set before midnight. **PLUTO** (mag. 14) is not visible in February since it is too close to the Sun. Charts for these planets and asteroids for the 2016 viewing season will soon be on the BAS website.

The diagram below gives the sunrise/sunset times and the Sun's altitude for February. The Sun continues its northward trek. 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. The Feb 16 Aldebaran-Moon event is a miss for us and below our horizon as well. Our next Aldebaran occultation takes place Apr 10.



Feb 2016

Sun	Mon	Tue	Wed	Thu	Fri	Sat
LQ	1	2	3	4	5	6
7	8 NM	9	10	11	12	13
14	15 FQ	16	17	18	19	20
21	22 FM	23	24	25	26	27
28	29					

← Leap Day!

By permission Univ. of Texas McDonald Obs.

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 by 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)

Light Series Takes Off!

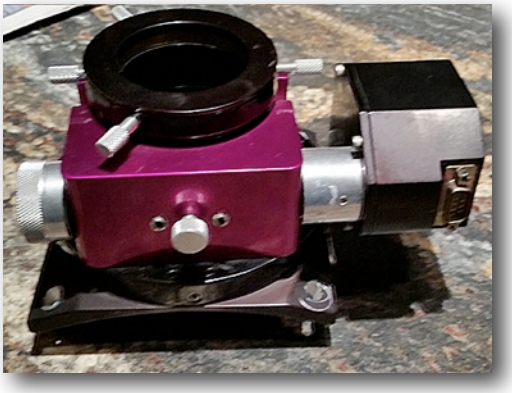
Image left shows the presenter having more fun than the audience although the guffaws from the floor did indicate some out there were enjoying themselves. Astronomy is after all done with mirrors, but here John H. shows us that mirrors have other uses. When asked what the point of this demo was, his response was to quote the now famous line from The Big Bang Theory when Sheldon Cooper said: “What’s life without whimsy?”

In celebration of the International Year of Light (2015), this series is sponsored by the **Bluewater Association of Lifelong Learners** and examines the science of light and the scientists who over the centuries have unlocked its secrets.

Bayshore Community Centre
Thursdays 10 am, Jan 7, 2016 to Feb 11, 2016
Price: $45.00 CAD
While it is true that the series is **sold out**, some seats are not occupied due to weather, etc. Take your chances at the door. They may be able to find you an empty chair.

FOR SALE:

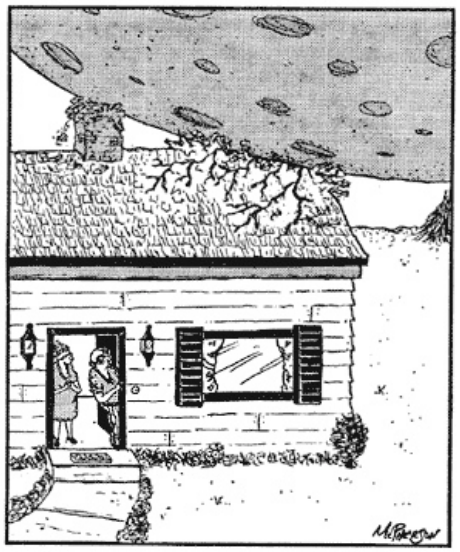
Moonlite CRL 2.5 inch Large Format **Crayford Newtonian Focuser** ($592.10 new -see https://focuser.com/products.php) with Hi-Res Stepper Motor ($252.81 new). Flange for 14" tube, accepts 2" accessories (EP/camera). This is a **true Crayford focuser**, not the cheap "Crayford-style" knock-off. Not set 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

Cartoon Corner



"They say this is the closest Mars has been to Earth in 60,000 years."

Crescent Moon near Saturn,Venus Jan 7 2016 -Robert Atkinson

This image of the crescent Moon with planets nearby goes to show that the cloudy weather locally is just that, local. Robert A. our Member-at-Large succeeded in finding a break in the clouds early in the morning of Jan 7, 2016 and captured Venus just above Saturn to the right of the Moon, all objects grouped in Ophiuchus. Yes, planets and the Moon can be found in the overlooked “zodiac” constellation, Ophiuchus. Scorpius is just off-frame to the right.

Two weeks later, Saturn and Venus just about merged into a single point of light during the close approach that brought them within 20 minutes of arc of each other at the same time of morning as this image was taken (6:08 am). Unfortunately it was cloudy pretty much over all of Ontario during the event.

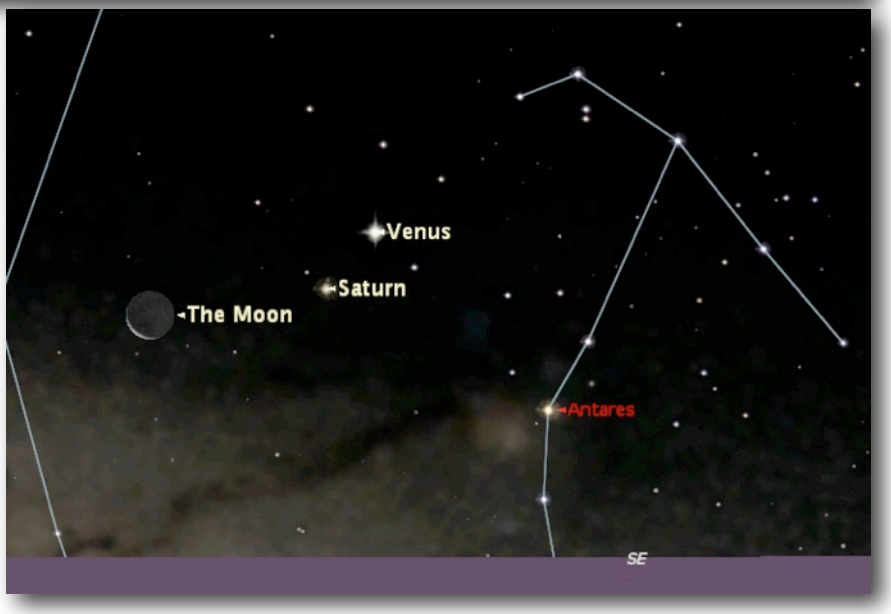
Image details: Canon 60Da 85mm f/2 @ 1s ISO 250
Taken at 6:08am Jan 7, 2016

Robert emailed:

Had to move fast! Took the last hour off work, drove to the "spot", after a couple of test shots, took this picture and clouds rolled in.
I waited, however either two, one, or all of the objects were obscured by the clouds. All three at the same time? Never to happen again. Welcome to SWO.

Enjoy.

Robert



Starry Night chart right shows the arrangement of objects on Jan 7. Venus will quickly drop towards the Sun (lower Left) but Saturn hangs around above Antares until Mars arrives (twice) later in the year. The second time, Mars slips nicely between Saturn and Antares onAug 23.