**Highlights of the May Sky...**

- **5th**
  - AM: Eta Aquarid meteor shower peaks before dawn. Expect ~20 meteors per hour.

- **6th**
  - New Moon
  - 3:29 pm EDT

- **7th**
  - DUSK: A razor thin waxing crescent Moon is about 5.5° to the lower right of Aldebaran.

- **8th**
  - Transit of Mercury begins at 7:13 am EDT. See page 6 for details.

- **10th**
  - First Quarter Moon
  - 1:02 pm EDT

- **11th**
  - PM: Regulus is 3° or 4° above the Moon, while Jupiter is 15° to their upper left.

- **12th**
  - PM: Jupiter is about 4° to the upper left of a waxing gibbous Moon.

- **13th**
  - Full Moon
  - 5:14 pm EDT

- **14th**
  - AM: Mars at opposition with the full Moon about 7° to the upper left.
  - PM: Saturn is about 4° to the right of the Moon.

- **15th**
  - Last Quarter Moon
  - 8:12 am EDT

- **16th**
  - PM: Mars is closest to Earth (0.503 AU) and 18.6” in angular diameter, the closest and largest the Red Planet has been for 10½ years.

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**Prime Focus**

*A Publication of the Kalamazoo Astronomical Society*

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**May 2016**

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**This Month’s KAS Events**

- **General Meeting:** Friday, May 6 @ 7:00 pm
  - Kalamazoo Area Math & Science Center - See Page 10 for Details

- **Astronomy Day:** Saturday, May 14 @ 11:00 am
  - Day & Evening Activities - See Page 5 for Details

- **Board Meeting:** Sunday, May 22 @ 5:00 pm
  - Sunnyside Church - 2800 Gull Road - All Members Welcome

- **Observing Session:** Saturday, May 28 @ 9:00 pm
  - Mars, Jupiter & Saturn - Kalamazoo Nature Center

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**Inside the Newsletter...**

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**www.kasonline.org**
The general meeting of the Kalamazoo Astronomical Society was ordered by President Richard Bell on Friday, April 1, 2016 at 7:15 pm. Approximately 56 members and guests were in attendance at the Kalamazoo Area Math & Science Center (KAMSC).

Our featured speaker (via Skype) was Dr. Fred Espenak, a retired astrophysicist from NASA's Goddard Space Flight Center and a world renowned expert on eclipses. In fact, Dr. Espenak is known as "Mr. Eclipse" because of his work on predicting and observing solar eclipses. He has also written over a dozen books on eclipses and has witnessed 27 total solar eclipses to date. The title of Dr. Espenak’s presentation was The Great American Total Eclipse of 2017.

Dr. Espenak took a quick poll before starting his talk. Of the 56 members in attendance, about ⅓ of them have seen a total solar eclipse before. He saw his first solar eclipse (a partial) on July 20, 1963. He soon learned that a total solar eclipse was going to be visible along the east coast on March 7, 1970. (Fun Fact: The KAS logo is based on one of the pictures of this eclipse taken by Bill Nigg.) Dr. Espenak then shared time-lapse and real time video of the total solar eclipse that occurred in China on August 1, 2008. For over 45 years, Dr. Espenak has chased solar eclipses all over the world. He’s witnessed an eclipse from every continent — including Antarctica. Dr. Espenak also shared images and video of the March 9, 2016 total solar eclipse. He observed from the deck of a cruise ship in the Makassar Strait, located between Borneo and Sulawesi.

The presentation then turned to the Great American Eclipse on August 21, 2017. It has been 38 years since a total solar eclipse has been visible from the continental United States. The 2017 eclipse path is about 8,600 miles long and is between 60 - 70 miles wide. It’ll take the Moon’s shadow about 3 hours to traverse the entire path. The continental United States is the only land mass along the eclipse path. Everyone in the United States will be able to enjoy at least a 70% partial eclipse, but Dr. Espenak reminded everyone that you don’t even want to settle for a 99% solar eclipse. You want to experience a 100% solar eclipse!

Dr. Espenak then began his detailed analysis of the most important factor to consider on Eclipse Day: the weather. The eclipse first makes landfall in Lincoln City Beach, Oregon where the average amount of cloud cover is 65%. The eclipse occurs here at 10am PDT, so the chance of morning fog rules this location out. The average amount of cloud cover decreases as you move away from the coast. It’s only 35% from satellite data and 24% from ground-based information in Madras, Oregon (Note: this will be shown as 35% (24%) for the remainder of this report.) Additionally, the Cascade Mountains west of Madras help keep the air dry. These factors give Madras the highest probability of clear skies on Eclipse Day.

The chances of cloud cover in eastern Oregon are still fairly good. However, average cloud cover increases to 55% when you reach the Sawtooth Range in Idaho, due to the western side of the mountains producing cloud cover. The cloud cover decreases on the east side of the mountains. Basically, you want to be located on the east side of mountain ranges for a morning eclipse. One unknown in this region is forest fires. They can occur at any time without notice.

Average cloud cover is also very good at Grand Teton National Park in Wyoming 50% (34%). The problem here is that the Grand Tetons are a major tourist attraction. This will likely be even more true on Eclipse Day. Plus, it’s difficult to exit the park if the weather fails to cooperate. Riverton, Wyoming is also a fairly good choice for Eclipse Day, with an average cloud cover of 40% (32%). The chance of cloud cover increases to 45% (40%) in Casper, Wyoming. This is where the Astronomical League has chosen to hold its convention (Astrocon) from August 16th - 19th. Casper also has highways and interstates that can allow you to quickly head east or west depending on the 24 - 48 hour weather forecast. Several KAS members are strongly considering attending Astrocon and then searching for the highest probability of clear skies. (Note: A quick check online shows that all hotels in this region are already sold out!)

Moisture from the Gulf of Mexico leads to a higher chance of convective clouds in Nebraska. Another good strategic region is Grand Island, Nebraska. The average cloud cover here is 52% (49%), but a good highway system allows for a quick “escape” to clearer skies. The northern part of Kansas City, Missouri is just on the southern half of the eclipse path. Average cloud cover in this region is 54% (56%). The duration of totality is also very short (at least 10 seconds) so close to the edge of the eclipse path.

The eastern half of the eclipse path has the highest probability of cloudy weather, since there are no mountains to help create dry conditions. There’s also ample humidity from the Gulf of Mexico and the eclipse occurs later in the afternoon there, so you get more convection which leads to the formation of more clouds. The point of greatest duration of totality is just south of Carbondale, Illinois. Totality here
The monthly meeting of the KAS Board was held on April 10, 2016 at Sunnyside Church. The meeting was called to order by President Richard Bell at 5:05 pm. Board members present were Joe Comiskey, Mike Cook, Scott Macfarlane, Rich Mather, Jack Price, Don Stilwell, and Roger Williams.

Rich gave the Treasurer’s Report, showing the account balances as usual and an expanded expense report showing in more detail the expenses since February 1st. Not surprisingly, many of the expenses were associated with the Robotic Telescope Project. Rich mentioned that some of the balances had not yet been credited to the proper accounts, but that this would be done soon. Richard cautioned that a very complete, audit-ready account was needed soon so that we could submit our final report required by the Gilmore Foundation.

In the summary of April/May events, Richard mentioned that the last public viewing session was canceled fairly early in the day, but that later the weather would probably have permitted viewing (assuming that the cold didn’t discourage viewers). For this reason, the decision time for canceling will be moved later in the day. For the next general meeting on May 6th, Rich and Richard (along with Jean DeMott) will be attending the Texas Star Party. It was agreed that Mike or Jack will record the program (using Richard’s camcorder, if needed) and that Joe would be responsible for setting up snacks.

Discussion of follow-up items began with the Robotic Telescope Project. Rich summarized the problems with the observatory’s roll-off roof, which relate to the failure of Windows 10 to allow communication between the laptop that controls the observatory and a controller board from Elk Products. The PlaneWave people seem to know little about the problem. Rich has received help from elsewhere, and some communication was established through use of Windows 7. However, after an update to the latest firmware edition, the system has not worked at all. Rich is still working on the problem. Richard mentioned news from a PlaneWave Yahoo users group that a remotely-operated mirror cover for our system should be available in about a year, and the Board agreed that we should get one as soon as it is available. Deferred Owl Observatory maintenance was discussed, with the to-do list the same as listed in the previous month’s minutes. The work date was set for Saturday, June 11th at 12pm.

Plans were discussed for Astronomy Day 2016 (May 14th), with daytime activities at Portage District Library and evening activities at KNC. Setup help is needed at PDL on May 13th (3pm) and at KNC on May 14th (6 pm). The keynote speaker at KNC is Dean Regas, co-host of PBS Star Gazers. The next board meeting was set for 5pm on May 22, 2016 at Sunnyside Church. The meeting was adjourned at 6:30 pm. Respectfully submitted by Roger Williams

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Nashville, Tennessee is the largest city in the path of the eclipse. Average cloud cover in Nashville is 70% (58%). Nashville can be a good starting point, since you can easily flee to clearer skies. The worst weather prospects are in North Carolina’s Smokey Mountains. Average cloud cover here is 75%. The prospects level off around 72% - 74% in South Carolina. Charleston, South Carolina is on the southern edge of the eclipse path.

Dr. Espenak recommended Jay Anderson’s website Eclipsophile for additional weather information. Michael Zeiler, a professional cartographer, has gorgeous eclipse maps on his Great American Eclipse website. Dan McGlaun maintains the Eclipse2017 website. Dan has hundreds of links to small towns and cities along the eclipse path with meteorological and weather information. Naturally, Dr. Espenak also recommended one of his own websites called EclipseWise. It includes a variety of eclipse maps, an eclipse calculator for various cities, and an interactive Google Earth eclipse map that a you can zoom into and get detailed information for any point along the eclipse path.

Several books were also recommended. The first is Eclipse Bulletin: Total Solar Eclipse 2017 August 21 by Fred Espenak and Jay Anderson. There are versions with grayscale and color maps. Dr. Espenak also published a second book entitled Road Atlas for the Total Solar Eclipse of 2017. This features even more detailed maps when you’re on the road looking for a good spot with clear skies. Dr. Espenak’s wife, Patricia, wrote a book for children called Total Eclipse or Bust: A Family Road Trip. He also co-wrote a book with Mark Littmann entitled Totality: The Great American Eclipses of 2017 and 2024. That will be published later this year.

Lastly, Dr. Espenak offered his strategy for successful eclipse viewing. The first tip was mobility, mobility, mobility! Use a private or rental vehicle and carry a GPS and eclipse path maps. Be sure to arrive in or near the central eclipse path about 2 days early and be ready to move to a better location if the weather fails to cooperate. Dr. Espenak also mentioned that weather prospects are better for the 2017 eclipse than the 2024 event, so don’t miss out on this opportunity to witness Nature’s grandest spectacle.

Richard gave a brief President’s Report after the snack break. He thanked Beverly Byle, Davin & Liam Baal, Jean DeMott, Jack Price, Avika Jayatilaka, and Roger Williams for volunteering at Vicksburg Middle School’s Science Night on March 9th. Beverly, Jean, Jack, and Don Stilwell also volunteered during Neil deGrasse Tyson’s appearance at Miller Auditorium on March 22nd. Instead of the usual observing reports and astronomical news, those in attendance discussed plans for the 2017 eclipse. This will be covered in an upcoming issue of Prime Focus. The meeting concluded at approximately 9:15 pm.
May is going to be an incredibly busy and [hopefully] fun month of astronomy (especially the first half). A small group of KAS members (including yours truly) will be attending the 35th annual Texas Star Party, which takes place from May 1st - May 8th at the magnificent Prude Ranch near Fort Davis. This will be the first time I’ve attended the Texas Star Party in 14 years. A half dozen members attended both the 2001 and 2002 Texas Star Party. Aside from Starfest in Canada, this was the first major star party I ever attended. I’m really looking forward to spending a week under incredibly dark and transparent skies. If time and weather permit, I’ll try to post some photos on the KAS Twitter feed. Naturally, I’ll have a full report in a future edition of *Prime Focus*.

My presence at TSP means I’ll be absent from the meeting on May 6th, but I’ve asked that our special presentation be recorded since it’ll be a good one. Professor Richard Bellon, from Michigan State University, presents *John Herschel, Charles Darwin and the “Mystery of Mysteries.”* We have had a tremendous variety of talks on amateur and professional astronomy in recent months. I thought it would be a nice change of pace to have a presentation on two great figures in the history of science.

A Transit of Mercury will occur on Monday, May 9th. I’ll be heading home from the Texas Star Party at that time and will do my best to observe it on the road (not literally, of course). Reading the special article on page 5, it sounds like a fair number of members are planning to observe this rare event at Richland Township Park. That’s an ideal spot, since the park is very open with good horizons. The Sun will only be about 6° above the horizon when the transit begins. If the weather cooperates and you take pictures of the transit, please be sure to share them with your fellow members — along with a report — in a future issue of *Prime Focus*.

Astronomy Day 2016 occurs on Saturday, May 14th. Daytime activities will again be held at the Portage District Library from 11am - 4pm. We’ve got some really fun hands-on activities planned that children of all ages will enjoy. I’m also especially proud of the displays that Jean DeMott and I have put together this year. Many of you have already seen our new display on the robotic telescope. Just wait until you see our new galaxies display! I’ll also be giving special presentations on galaxies and our new robotic telescope. I hope you can attend, because I hate small crowds!

Evening activities begin at the Kalamazoo Nature Center at 7pm. This includes our keynote presentation. This year’s special guest is Dean Regas, an astronomer at the Cincinnati Observatory and co-host of the popular PBS television series *Star Gazers.* Mr. Regas will take us on a tour of the universe. This presentation will be ideal for the whole family. It’ll be followed by observing in and around Owl Observatory. Thanks to those that have volunteered their time. The rest of you just need to attend and have fun!

The farther away you look in the distant universe, the harder it is to see what's out there. This isn't simply because more distant objects appear fainter, although that's true. It isn't because the universe is expanding, and so the light has farther to go before it reaches you, although that's true, too. The reality is that if you built the largest optical telescope you could imagine - even one that was the size of an entire planet - you still wouldn't see the new cosmic record-holder that Hubble just discovered: galaxy GN-z11, whose light traveled for 13.4 billion years, or 97% the age of the universe, before finally reaching our eyes.

There were two special coincidences that had to line up for Hubble to find this: one was a remarkable technical achievement, while the other was pure luck. By extending Hubble's vision away from the ultraviolet and optical and into the infrared, past 800 nanometers all the way out to 1.6 microns, Hubble became sensitive to light that was severely stretched and redshifted by the expansion of the universe. The most energetic light that hot, young, newly forming stars produce is the Lyman-α line, which is produced at an ultraviolet wavelength of just 121.567 nanometers. But at high redshifts, that line passed not just into the visible but all the way through to the infrared, and for the newly discovered galaxy, GN-z11, its whopping redshift of 11.1 pushed that line all the way out to 1471 nanometers, more than double the limit of visible light!

Hubble itself did the follow-up spectroscopic observations to confirm the existence of this galaxy, but it also got lucky: the only reason this light was visible is because the region of space between this galaxy and our eyes is mostly ionized, which isn't true of most locations in the universe at this early time! A redshift of 11.1 corresponds to just 400 million years after the Big Bang, and the hot radiation from young stars doesn't ionize the majority of the universe until 550 million years have passed. In most directions, this galaxy would be invisible, as the neutral gas would block this light, the same way the light from the center of our galaxy is blocked by the dust lanes in the galactic plane. To see farther back, to the universe's first true galaxies, it will take the James Webb Space Telescope. Webb's infrared eyes are much less sensitive to the light-extinction caused by neutral gas than instruments like Hubble. Webb may reach back to a redshift of 15 or even 20 or more, and discover the true answer to one of the universe's greatest mysteries: when the first galaxies came into existence!
Astronomy Day 2016
Saturday, May 14th

Portage District Library
11 am - 4 pm | 300 Library Lane

Solar Observing
View our star close up with safe solar filters (weather permitting).

Displays
Learn about our new robotic telescope, the variety of galaxies in the universe, and the different types of amateur telescopes. Check out the best astrophotographs by KAS members.

Hands-on Activities
Make a Pinwheel Galaxy pinwheel, build a balloon powered rover, and construct a straw rocket.

Ask the Astronomer
Have a question about the universe? Our experts will be on duty from 12pm - 4pm.

Special Presentations
KAS President Richard Bell presents the following:

12:00 pm
Galaxies: Island Universes
Voyage through our galaxy, the Milky Way, and the countless other galaxies in this vast, infinite universe.

2:00 pm
The KAS Robotic Telescope
Learn about the 20-inch telescope the KAS just installed in Arizona and how you can get involved.

Kalamazoo Nature Center
7:00 pm | 7000 N. Westnedge Ave.

Keynote Presentation by Dean Regas
Mr. Regas, an astronomer for the Cincinnati Observatory and the co-host of the PBS syndicated astronomy program Star Gazers, presents Tour of the Universe: You Are Here in the Cooper’s Glen Auditorium. Rocket through space and sail among billions of stars and galaxies. Utilizing some amazing simulation software Mr. Regas guides you through the mind-boggling scale of the universe. Along the way you’ll stop at the Moon and individual planets. Then you’ll make the jump to light speed and head to interstellar space and see all the galaxies in the universe. Admission is FREE and tickets are not required.

Observe the Moon, Mars, Jupiter and much more after the talk.

→ → → astroday.kasonline.org ← ← ←
There are many different astronomical events that thrill us regular sky observers: solar and lunar eclipses, approaching comets, meteor showers, and for some of us, the transit of inner planets across the face of the Sun. On Monday, May 9th, we will have the opportunity to see Mercury make that journey.

A transit is, simply, when an inner planet crosses the face of its star. The last time we observed a transit was on June 6, 2012, when Venus made the slow traverse over the Sun’s disk; unfortunately, we won’t get a chance to see Venus repeat this process since the next occurrence will be on December 11, 2117. Our previous observation of a transit of Mercury (which was under absolutely perfectly clear skies) was on May 7, 2003. There was a transit of Mercury on November 6, 2006, but a combination of completely overcast skies and the transit beginning just before sunset precluded us from catching that one.

However, this upcoming month we will have an excellent chance – assuming clear skies in southwest Michigan – of seeing another transit of Mercury. Don’t worry if there’s bad weather though; the next transit is on November 11, 2019…a month which generally has even worse weather than May. So let’s keep our fingers crossed on this one.

For those (like me) with high hopes for clear skies, here’s a quick run-down of the day’s events:

1. Sunrise in Kalamazoo is at 6:27 am EDT.
2. First contact of the leading edge of Mercury with the Sun is at 7:13 am.
3. Internal ingress – where the full disk of Mercury “enters” the Sun – occurs at 7:16 am.
4. Internal egress – where the full disk of Mercury “exits” the Sun – occurs at 2:38 pm.
5. Last contact takes place at 2:41 pm.

Most members of the Kalamazoo Astronomical Society who are planning on observing this event will be gathering at the Richland Township Park on 32nd Street, about a half mile south of East DE Avenue and due southeast of Gull Meadows Farm. That’s where I’m planning to complete a test run of my equipment for the upcoming Great American Solar Eclipse on August 21, 2017…and this transit will be the perfect opportunity to run my cameras and practice taking pictures of a solar-related activity.

You will need some special equipment for this transit. Telescopes and binoculars will be essential since the size of Mercury with respect to the Sun means it will not be observable with the naked eye. Most importantly, you must use a solar filter to view the transit. Under no circumstances should you look at the Sun without proper eye protection. This is not a solar eclipse, where the Moon can completely cover the face of our star; the Sun will be 99.9% (less 0.1% due to Mercury) visible the entire transit. Therefore, solar filters are required. If you’re using binoculars, you can cover each objective lens with the solar filters from a pair of eclipse glasses in order to view the transit. Just be sure the eclipse glass “lens” completely covers the binocular lens (I do this by securely wrapping duct tape around the eclipse lenses when I attach them to the binoculars).

In any case, let’s hope for clear skies and perfect viewing as we catch another wonderful astronomical event this May. See you there!

Here’s the author observing the Sun during the 2001 Starfest held near Mount Forest, Ontario, Canada.
It’s not over yet! Thanks to the generosity of KAS members, friends, and the Irving S. Gilmore Foundation over $109,000 has been raised toward the Robotic Telescope Project. The main telescope, a 20” PlaneWave CDK, was installed at the end of 2015, but this doesn’t conclude the project. We need to raise an additional $11,000 to purchase more equipment, including a Takahashi FSQ-106EDXIII refractor.

Donations can be made in one of two ways:

- **Via PayPal** (send money to kas@kasonline.org)
- **Check or Money Order** (made payable to the KAS - use return address shown on page 10)

Please remember that the KAS is a non-profit organization. All contributions are federally recognized as tax deductible per section 501(c)(3) of the IRS code.
Innermost planet Mercury transits the Sun on Monday, May 9th. The entire event can be viewed from West Michigan with the use of a properly filtered telescope.

Mercury begins its passage across the solar disk just after 7:12 am EDT when the Sun is 6° above the eastern horizon. It takes Mercury about 3 minutes to be fully immersed on the Sun’s face. Greatest transit occurs at 10:58 am and Mercury begins its exit at 2:39 pm. The transit ends at 2:42 pm and another won’t occur until November 11, 2019.

Mars reaches opposition (opposite the Sun on the celestial sphere) on May 22nd. On this date the Moon, Mars, Saturn, and Antares form a great square in the sky.

Mars will be closest to Earth (0.503 Astronomical Units) on May 30th. When viewed with a telescope it’ll appear as a ruddy disk 18.6 arc seconds across. This is the closest and largest Mars has been in 10½ years.
PST Available for Checkout!

The Kalamazoo Astronomical Society’s Coronado Personal Solar Telescope (PST), mounted on the light and ultra-portable Tele Vue Tele-Pod, is available for loan.

If you’d like to observe the Sun in hydrogen alpha and see prominences dance along the solar-limb and filaments crisscross its surface then contact the KAS Equipment Manager, Arya Jayatilaka, today:

http://www.kasonline.org/loanscopes.html

Get Your KAS Apparel Today!

It’s been well over ten years since the KAS has offered a full line of clothing. We now have several items in stock and ready for purchase. These include:

- Short-sleeve T-Shirts: $17.00
- Long-sleeve T-Shirts: $20.00
- Sweatshirts (unhooded): $17.00
- Sweatshirts (hooded): $22.00
- KAS Embroidered Caps: $15.00

Full details, including sizes and colors, will be listed on our online store, The SkyShop, soon. Clothing will also be available to purchase at most general meetings.

Public Observing Sessions

Saturday, May 14th
Feature: The Moon & Jupiter

Saturday, May 28th
Feature: Mars, Jupiter & Saturn

Gates Open: 9:00 pm • Observing Begins: 9:30 pm

Kalamazoo Nature Center
— 7000 N. Westnedge Ave. —
In February of 1836, the astronomer John Herschel wrote a letter to the geologist Charles Lyell where he alluded to the origin of species as “that mystery of mysteries.” Herschel at the time resided at the Cape of Good Hope where he was cataloging the constellations of the southern skies. Four months later HMS Beagle sailed into the South Africa port. Its young naturalist Charles Darwin used the opportunity to meet Herschel. Five years earlier, as a Cambridge undergraduate, Darwin had been mesmerized by Herschel’s Preliminary Discourse on the Study of Natural Philosophy. He considered it a stroke of the greatest luck to be able to dine with a man whose book taught him the fundamental principles of scientific research. Herschel’s influence on Darwin grew as the younger scientist began speculating on the “mystery of mysteries” upon his return to England. The relationship between the naturalist and the astronomer reveals the hidden history of the deep connection between the study of the heavens and the study of life on Earth.

Friday, May 6 @ 7:00 pm

Kalamazoo Area Math & Science Center
600 West Vine, Suite 400 • Use Dutton St. Entrance
Dutton Entrance Locked by 7:10 pm