

The Reflector

Newsletter of the Peterborough Astronomical Association

NOAA's Joint Polar Satellite System (JPSS) to Monitor Earth as Never Before

ETHAN SEIGEL

LATER THIS YEAR, an ambitious new Earth-monitoring satellite will launch into a polar orbit around our planet. The new satellite — called JPSS-1 — is a collaboration between NASA and NOAA. It is part of a mission called the Joint Polar Satellite System, or JPSS.

At a destination altitude of only 824 km, it will complete an orbit around Earth in just 101 minutes, collecting extraordinarily high-resolution imagery of our surface, oceans and atmosphere. It will obtain full-planet coverage every 12 hours using five separate, independent instruments. This approach enables near-continuous monitoring of a huge variety of weather and climate phenomena.

JPSS-1 will improve the prediction of severe weather events and will help advance early warning systems. It will also be indispensable for long-term climate monitoring, as it will track global rainfall, drought conditions and ocean properties.

The five independent instruments on board are the main assets of this mission:



Ball and Raytheon technicians integrate the VIIRS Optical and Electrical Modules onto the JPSS-1 spacecraft in 2015. The spacecraft will be ready for launch later this year. Image Credit: Ball Aerospace & Technologies Corp.

- The Cross-track Infrared Sounder (CrIS) will detail the atmosphere's 3D structure, measuring water vapor and temperature in over 1,000 infrared spectral channels. It will enable accurate weather forecasting up to seven days in advance of any major weather events.
- The Advanced Technology Microwave Sounder (ATMS) adds 22 microwave channels to CrIS's measurements, improving temperature and moisture readings.
- Taking visible and infrared images of Earth's surface at 750 metre resolution, the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument will enable monitoring of weather patterns, fires, sea temperatures, light pollution, and ocean color observations at unprecedented resolutions.
- The Ozone Mapping and Profiler Suite (OMPS) will measure how ozone concentration varies with altitude

See "JPSS" on page 16

President's Message

Randy Attwood

On May 5, the Peterborough Astronomical Association will have the pleasure to welcome Randy Attwood, who will review the current status of amateur astronomy. To recognize Randy Attwood for his science public outreach, the astronomical community named asteroid 265235 after Attwood. In

addition, a long time PAA member Stanley Nowicki will share his memories of his personal stargazing experiences over the years. Do not miss our May 5 PAA meeting. See you there.

Jaime Morales

Letter from the Editor

Just Warming Up

Spring is definitely here. We will be hosting our annual Astronomy Day this year on May 27 at the Riverview Park and Zoo. We will be setup in and around the Visitors Orientation Centre just inside the main entrance. Note the change in venue and single day event.

So, let's get into this month's newsletter. As usual we have a number of submissions from John Crossen. I really appreciate his two articles about women in astronomy with a nod to the past and present. He also focusses on interesting facts about Earth, which is still astronomically relevant since it is a planet in our galaxy. And speaking of galaxies, he previews the upcoming collision between the Andromeda Galaxy and our Milky Way. But don't worry, you have about 4 billion years before you have to make viewing reservations.

Rick Stankiewicz brings us part four of us New Mexico road trip. This month he reflects on his visit to Alamogordo and the New Mexico Museum of Space History. Be-

ing the photographer that he is, he can turn any event into an opportunity. Check out his lightning photo and read his safety tips for capturing electricity in images.

It goes without saying, but John Chumack and Brian McGaffney are always welcome in our pages.

Till next month.

Phillip Chee
Editor, The Reflector



The Reflector

The Reflector is a publication of the Peterborough Astronomical Association (P.A.A.) Founded in 1970, the P.A.A. is your local group for astronomy in Peterborough and the Kawarthas.

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Facts About Earth So weird They're Well ... Unearthly



SLOTH IN A TREE. A sloth's claws are so strong that many are found still hanging from tree limbs long after the animal has expired. Image by Jakob Shokey.

JOHN CROSSEN

I SPENT A LOT OF TIME blathering about the planets, galaxies and all sorts of weird stuff. Today's article remains focused on the bizzare, only this time it's closer to home — like planet Earth. What astounding tidbits and treasures have I uncovered? Here's what's up down here.

Let's start at the beach where ocean researchers studying dolphins have deduced that these sea-dwelling mammals can not only communicate, but have names for each other. If they become any more human-like Wendy's will start opening underwater restaurants. Next we get even closer to home — inside you.

It has been estimated that your body has a total of 96,000 km (60,000 miles) of blood vessels in it. That's enough to stretch around the world almost two and a half times. And while we're talking about you, for one teeny-weeny split second in time

you were the youngest person on Earth. Chances are someone in India or China was next in line.

Ever looked at your dog's nose? Did you notice that funny patchwork of crossed markings? That's your dog's nose print and it's just as unique as a human finger print. Imagine poor Lassie down at Station #5 having her nose-print taken. She was collared for hydrant hosing and walking without a license. So far there's no word on cat snouts.

If you think the Earth is round, think about this. It's actually oblate as if some fat guy sat on your beach ball and it froze in that squished position. That's because what we like to call solid ground isn't solid at all. Earth's surface is actually quite pliable. Toss in a little centrifugal force from Earth's rotation and it really is bigger when measured

See "Earth Facts" on page 13

The Forgotten “Computers” — Women in Astronomy



Astronomer Edward Charles Pickering’s Harvard computers . It was the women who made sense out of what the men had observed. Photo courtesy of Harvard College Observatory.

JOHN CROSSEN

DURING THE LATE 1890S through to the early 1950s, observatories had computer rooms. But instead of being filled with electronic devices, they were filled with women — brilliant women who were gifted in mathematics. Yes, there were a few men but women were preferred. The reason was simple — the bosses could pay them less for doing the same work. Sound familiar?

As the ladies who crunched numbers for the famous astronomers of their times, a few went on to become recognized astronomers themselves and made immensely important discoveries such as Henrietta Swan Leavitt. Leavitt’s work with Cepheid variable stars helped Edwin Hubble establish that the Andromeda Galaxy was a separate galaxy, far distant from the Milky Way.

Annie Jump Canon was another incredible female stargazer who clawed her way up

the ladder to international success. Annie developed the star temperature classification system we still use today. O, B, F, G, K, M. The mnemonic Oh Be a Fine Girl Kiss Me may be more familiar.

Williamina Fleming was another woman who in the early years of astronomy made her mark in the United States. About a year after her arrival on American shores her husband abandoned her along with her newborn child. Desperate for work she hired on as a housekeeper for the astronomer Edwin Charles Pickering.

One day, fed up with the slow work of his male number-tumblers, Pickering said that his Scottish maid could do better. To prove it he hired her and she did more than any of the men were at the time. Prime on her list of achievements was the discovery of the “Horsehead Nebula”. She was honoured

see “Mary Blagg” on page 13

Women Shatter the Glass Ceiling—In Rockets



ANDREA GHEZ AT KECK OBSERVATORY. In addition to research, teaching at UCLA, authoring a book and raising two boys, Andrea Ghez also lectures young women interested in science.

JOHN CROSSEN

FOR THE FIRST HALF of the 20th century we wasted half of our most powerful intellectual resources—the minds of women. The world of science and many other pursuits were men-only domains. To achieve success women had to climb a steeper set of stairs, all while outperforming their male counterparts. And they did just that.

By the 1950's public attitude was just beginning to change—at least a little.

Physics and advanced science programs became more open to female applicants. Some even offered PhDs to women!

Among those seeking her PhD in Physics was Jocelyn Bell a PhD candidate from Ireland. As a part of her doctorate program she worked at the Jodrell Bank Radio Observatory. It was here that she and her partner first encountered the Little Green Man.

The LGM as she called them were very regular bleeps from radio signals. Deeper analysis showed that they were rapidly spinning neutron stars whose rotation generated a radio beam. It swept past us like a lighthouse lamp's beam. Today we call them

pulsars. Jocelyn Bell was the first to discover such a rare phenomenon.

While Dr. Bell was working in radio astronomy, Valentina Tereshkova was flying high as Russia's first woman in space.

Tereshkova orbited the Earth 48 times in June of 1963. She then parachuted out just before the Vostok 6 space capsule smashed into the ground. It was risky, but that's how the early cosmonauts made their landings. Valentina earned the Order of Lenin Award and later won the United Nations Gold Medal for Peace.

Sally Ride later became America's first woman in space. Her career as an astronaut also led to duties aboard the International Space Station. She held a PhD in Physics which made her a valuable asset on space missions which called for her expertise. Upon retiring from NASA and life as an astronaut, Sally took up teaching positions and will be remembered for her working in helping to interest young girls in science careers.

See "Andrea Ghez" on page 13

New Mexico Adventures Part IV: New Mexico Museum of Space History (NMMSH), Alamogordo



FIGURE 1. New Mexico Museum of Space History. Photo by Rick Stankiewicz.

RICK STANKIEWICZ

UNTIL MY RECENT TRIP this past January to New Mexico, I had no idea there was a space history museum in Alamogordo. What a pleasant surprise for my wife and I. If you ever find yourself in this part of southern New Mexico plan to take at least a half day to do a tour and learn and see lots of interesting things “space” related. From early rocket exploration to more recent Shuttle missions, you are sure to find something to pique your interest.

Located on the northern edge of the city, at the base of the Sacramento Mountains, the NMMSH is easy to find and provides a nice view of the surrounding Tularosa Basin area. The cube design of the main exhibit building (Figure 1) is strikingly simple with its four stories of reflective windows. This

facility is over 40 years-old and it still looks state-of-the-art.

There are a number of attractions in the immediate area of the main exhibit building, including the “New Horizons Dome Theater and Planetarium” (Figure 2), which offers many big-screen experiences on space related themes. The movies we saw were IMAX quality and well worth the time and money.

A short walk across the parking lot and you can check out the “John P. Stapp Air and Space Park” (Figure 3). The rockets, missiles and engine parts allow you to get up close and personal for photo ops and to learn more about each item and their place in history. There are about 15 exhibits in this outside “park” next to the main building.

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FIGURE 2. New Horizons Dome Theatre and Planetarium. Photo by Rick Stankiewicz.



FIGURE 3. John P. Stapp Air and Space Park. Photo by Rick Stankiewicz.

They are all the real deal and come complete with all the scratches, dings and whammies of the stories they tell. It is pretty cool to walk among the exhibits and get a sense of the size and scale of these pieces of history.

Another interesting feature is the “Astronaut Memorial Garden” (Figure 4), dedicated to the memory of those who have perished in the name of space exploration. Specifically, there are plaques to the members of Apollo I, and the Space Shuttles Challenger and Columbia. Not far away is the final resting place of HAM, the first “Astrochimp” who paved the way for the first manned Mercury mission in 1961, but more about HAM later.

Another big outdoor exhibit is the “Daisy Track” (Figure 5), which was restored and relocated from nearby Holloman Air Force Base. As you can imagine during the early days of experimenting with the effects of G-forces on the human body, men were



FIGURE 4. Astronaut Memorial Garden. Photo by Rick Stankiewicz.



FIGURE 5. Daisy Track. Photo by Rick Stankiewicz.

strapped in to a “sled” and shot along this track and then stopped just as suddenly. On the one track, you could test the effects of acceleration and deceleration at the same time. It doesn’t take too much imagination figure out how this contraption works and how it helped research into seatbelt safety.

Before entering the main exhibit building of the NMMSH, I had to try climbing into the life-sized scale model of the Mercury Capsule (Figure 6). I had a hard time getting in and out and this was without a spacesuit. It must have been a challenge even going into suborbital space in a spacecraft that restric-

See “Alamogordo” on page 12

M46 Open Star Cluster with a (Dying Star) Planetary Nebula NGC-2438



Hi everyone,

A Cheerio in the sky! M46 open cluster is located at 5,400 light years from Earth in the direction of the Constellation of Puppis. There is approximately 500 stars involved in the cluster and is about 300 million years-old.

The little Cheerio looking nebula ring shaped NGC-2438 planetary nebula is a dying star blowing off its outer atmosphere, it is not at the same distance as the cluster, it simply is in front of the cluster via chance alignment as seen from Earth.

Another quick test shot from the city. C6 Newtonian scope and ZWO ASI174MM cooled CMOS camera from my backyard observatory in Dayton, Ohio. Three minute exposure.

Best Regards,

John Chumack www.galacticimages.com

Caldwell 20 (Part of Pelican Nebula)



This image is part of my continuing mosaic of the North American Nebula in Cygnus (Mosaic portion 3). It is part of the Pelican Nebula (centre) and another piece of the North American Nebula.

Again, this is a hi resolution image at 8K , so zooming is allowed.

Tech data: An Ha+LL+RGB using a modified Astrograph 300 at $f/4.9$. A G4EC 160000 Moravian with all Astrodon weighted filters.

Acquisition time about 5 hours. Conditions were typical late November haziness (poor seeing).

Brian McGaffney

Galactic smack down — Andromeda vs. the Milky Way



ANDROMEDA AND MILKY WAY. They call it a galactic collision, but it's more like a merge in slow motion. Our two galaxies will begin to merge in about 3.7 billion years and the whole process will require another billion years.

JOHN CROSSEN

GALAXIES ARE HUGE collections of stars held together by gravity and that mysterious stuff called Dark Matter. By huge I mean galaxies are light years across. In case you were beset by a case of attention deficiency syndrome in astronomy 101, here's the math.

A single light year is the distance a beam of light travels in a year. Light is no slow poke. It whistles through space at 300,000 kilometres per second. That's right, 300,000 kilometres per second. Add all those seconds up and you've got nearly 10 billion kilometres on your odometer at the end of a year. But a light year is just a short hop when you're talking galaxies.

According to a 2016 study our Milky Way Galaxy is now calculated as being 160,000 light years across. That's just average when you're sizing up galaxies. Our neighbour, the Andromeda Galaxy is just as large, and... it's on a collision course with the Milky Way.

But don't stop working on those kitchen renovations. You've got plenty of time before main event — like maybe 4 billion years. Nonetheless, it will happen. The Andromeda Galaxy is streaking towards us at nearly 402 kilometres per hour. But relax and have a beer, Andromeda is still around 2.5 million light years away. So what will happen when our two galactic gladiators meet?

For starters the two will engage in a sort of cosmic taffy pull in which they will distort each other via gravitational tug. If you have visions of stars colliding, you've been reading too many Hollywood scripts.

The truth of the matter is stars are separated by huge distances. For instance the nearest star to our Sun is 4.3 light years away. To bring that down to human size, it would be like placing two ping-pong balls on the ground 3.2 kilometers apart from each other. There's lots of room to zoom in between.

see "Galactic Collision" on page 13

Increase Your Photo Ops!



Lightning storm on April 27, 2017. Photo by Rick Stankiewicz.

RICK STANKIEWICZ

THE NEXT TIME THERE IS a thunder and lightning storm threatening to wipe out your evening observing session, make the best of it and try for a unique photo op. Try and capture some shots of lightning instead of stars. This is not for the faint of heart, but some basic safety precautions can keep you safe and not turn into a human lightning rod.

This past week I watched as a lightning and thunder storm swept toward the Peterborough area from the west. It was not overly violent, but quite active and short lived as it moved east. First, pick a location outside that is protected by an overhang, like a covered deck or garage. You do not want to be out in the open and the tallest structure in your surroundings.

Often the lightning portion of the storm will be on the leading edge or “front”, so you need to set-up and get your photos early as the main body of a storm will usually have high winds and heavy rain following it, and you don’t want to get caught in this.

The image shown here is the best of about a half dozen images captured on the night of April 27th. I set-up a tripod mount-

ed DSLR camera and wide angle lens to frame the advancing storm. Then focus on infinite, set the camera on “manual” and the following setting will let you capture images similar to what you see here. ISO 200, *f*/8-11 and start taking a series of 15 second exposures, one after the other. With a proper set-up, persistence and lots of luck, you can turn one kind of observing session into another and have a unique photo record of what you saw. No two lightning strikes are alike and with any luck, you will record multiple strikes as I did here and this is without having to stack or Photoshop your images.

Next time your planned observing session is clouded out by a storm, turn this lemon into lemonade.

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Alamogordo



FIGURE 6. Mercury Capsule. Photo by Rick Stankiewicz.

tive. It sure gave me a better appreciation for what those space pioneers put up with.

Once inside the main building, there were lots of exhibits, artifacts and displays to read and marvel at. Throughout the four floors is the “International Space Hall of Fame”. All the great contributors to space exploration are immortalized there, from Yuri Gagarin to Marc Garneau, to name just a few.

Each floor of the main building focuses on a different aspect of space history and exploration. It is explained why there is a museum in the first place and you soon understand why it makes sense to be in Alamogordo. Due to its proximity to the Holloman Air Force Base and White Sands Missile Range and given the history of the State with advancing and exploring our knowledge of space, it totally makes sense for this museum to be where it is. Remember, it was at White Sands that the German

V-2 rockets were tested. One actually crash landed not far from the site of this museum.

There are exhibits on the “Icons of Exploration”, where you find an actual “moon rock” along with replicas of the first man-made satellites (Sputnik and Explorer). There is the “Living and Working in Space” section, that deals with issues like eating in space and space toilets and everything in between. I tried the Shuttle Lander Simulator and crashed it every time. It is harder than it looks. The rocketry section was one of my favorites though. This is where the rubber hits the road or the fuel burns the launch pad, so to speak. I particularly liked the Rocket Rumbler, which simulated the vibration of a rocket launch.

There is an exhibit of HAM’s spacesuit and capsule that this famous chimpanzee was subjected to during his lead up to his famous launch into space on January 31st, 1961

See “HAM” on page 15

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Earth Facts

from east to west at the equator than when measured from north to south around the poles. So will Mother Earth still fit into her bikini this summer?

If you think your kids have short memories, be glad they're not goldfish. The estimated memory span for these gilded little sea creatures is just 3 seconds. Makes me wonder how many times my wife has caught and released the same bass during the same hour, on the same day, on the same fishing trip.

Here's good news for snail dentists everywhere. If your patients are one of a certain species of snail, they'll have nearly 20,000 teeth. A visit to your office would rival Donald Trump's annual income from just one country.

Turning the tables, let's put the bite on the dentist. With 20,000 teeth to examine, how would she or he know the difference between a molar, a bicuspid or a canine? And imagine the cost of a full set of plastic clackers!

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Galactic Collision

In fact any star that had planets orbiting it, like our Sun and its solar system would likely be totally unaffected. We will however wind up in a different corner of our new galactic home thanks to the gravitational tug-of-war taking place.

It will take about 1 billion years to reach the final count. The end result will be a huge elliptical galaxy with a supermassive black hole at its core. All the constellations will be new, thanks again to the gravitational stretch. So the horoscope floggers will have to make up some new myths.

Earth will have survived, though it will be uninhabitable because our Sun will have grown into a red giant and anything on Earth's surface will be roasted crisp. Still I'd love to be on some planet in that new galaxy just so I could look up and see twice as many stars.

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Mary Blagg

to become the first woman member of the Royal Astronomical Society of London among other accolades.

Another turn-of-the-century woman astronomer was Mary Blagg. You can credit her with systemizing the manner in which lunar craters are named. Naturally, there is a Blagg Crater in her honour.

Jumping ahead a few years brings us to such luminaries as the late Vera Rubins who discovered dark matter and was the first woman to use the Mt. Palomar Observatory. Not surprising for the era, Mt. Palomar didn't have a ladies room. Vera changed that with a piece of paper and scissors. She cut out a skirt shape and taped it in the appropriate position over the image of the man on the door. Presto, instant ladies room!

Over the next few articles I'll cover more on women in astronomy—from astronomers to astronauts and educators. It's a terrible waste when half of the population is denied an education or the right to work at anything other than menial tasks.

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Andrea Ghez

In my opinion the next two women are tied for first place among the many women now enjoying productive careers in modern astronomy.

If you've ever been mesmerized by the images of Saturn taken by the Cassini Spacecraft, you've seen Carolyn Porco's work. Remember the famous image of Earth taken from Saturn? It's named 'The Pale Blue Dot' and is also attributed to Dr. Porco.

Next up is Professor Andrea Ghez. She's the lady responsible for proving that there is a supermassive black hole at the centre of our galaxy. While her work is now thought to apply to all galaxies, she is also deeply involved in helping young women become astronomers. She has written a book titled *You Can Be a Woman Astronomer*.



Peterborough Local 590

The Sky this Month

Mercury is well placed in the morning sky all month and is at greatest elongation west (26°) on the 17th. Moves within 2° of crescent Moon on the 24th.

Venus is prominent in the dawn sky during the month. Within 2° of crescent Moon on the 22nd.

Mars is in Taurus the entire month. Comes within 6° of Aldebaran on the 7th.

Jupiter well placed in central Virgo during the month. Moon passes 2° north on the 7th. Multiple series of double shadow transits can be seen this month.

Saturn travels in retrograde motion in morning during the month and moves westward from Sagittarius into Ophiucus mid-month. By mid-month it rises before midnight.

η -Aquariid Meteors peak at 9 PM on the 4th.

Moon Phases

First Quarter	10:47 AM	May 2
Full Moon	5:42 PM	May 10
Last Quarter	8:33 PM	May 18
New Moon	3:44 PM	May 25

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HAM



FIGURE 7. HAM Space suit and capsule. Photo by Rick Stankiewicz.

(Figure 7). I guess the Russians had their dogs and the Americans had their chimps. The fiberglass capsule would have been mounted inside the Mercury spacecraft, where an astronaut would later be seated. It must have worked because humans followed HAM into space and he lived until 1983 and is buried on the NMMSH grounds. HAM, stands for Holloman Aerospace Medical Center, where he was prepared for his historic flight.

When we were here there was a temporary exhibit dedicated to Gene Rodden-



FIGURE 8. Enterprise Transport Deck. Photo by Rick Stankiewicz.

berry, of *Star Trek* fame and it made for a cool departure from the other history and science that surrounded us. This exhibit was complete with a Transporter deck from the Starship “Enterprise” (Figure 8). My wife tried to get home quicker this way, but it did not materialize.

If you appreciate history and want to learn about it, as it relates to space, this is a place to visit. I was sure glad I took the time to explore yet another corner of New Mexico while on our tour of the Land of Enchantment.



**Ontario Telescope
and Accessories**



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and in time over every location on Earth's surface. This can help us understand how UV light penetrates the various layers of Earth's atmosphere.

- The Clouds and the Earth's Radiant System (CERES) instrument will quantify the effect of clouds on Earth's energy balance, measuring solar reflectance and Earth's radiance. It will greatly reduce one of the largest sources of uncertainty in climate modeling.

The information from this satellite will be important for emergency responders, airline pilots, cargo ships, farmers and coastal residents, and many others. Long and short term weather monitoring will be greatly enhanced by JPSS-1 and the rest of the upcoming satellites in the JPSS system.

Want to teach kids about polar and geostationary orbits? Go to the NASA Space Place: <https://spaceplace.nasa.gov/geo-orbits/>

This article is provided by NASA Space Place.

With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology.

Visit spaceplace.nasa.gov to explore space and Earth science!



KW Telescope
PERCEPTOR

Articles

Submissions for *The Reflector* must be received by the date listed below. E-mail submissions are preferred (Microsoft Word, OpenDoc, ASCII and most common graphic formats are acceptable). If your article contains photos or graphics, please provide a separate file for each. Typed or hand-written submissions are acceptable provided they are legible (and not too long.) Copyrighted materials will not be published without written permission from the copyright holder. Submissions may be edited for grammar, brevity, or clarity. Submissions will be published at the editor's sole discretion. Depending on the volume of submissions, some articles may be published at a later date. Please submit any articles, thoughts, or ideas to:

phillip.chee@gmail.com

**Next submission deadline:
May 28, 2017**



Meetings

The Peterborough Astronomical Association meets every first Friday of each month, except July and August, at the **Peterborough Zoo Guest Services and Rotary Education Centre** (inside the main entrance at the north end of the Zoo) at 7 p.m. P.A.A. general announcements will begin each meeting with the guest speaker starting at 7:30 p.m.