

THE

LOWELL OBSERVER

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THE QUARTERLY NEWSLETTER OF LOWELL OBSERVATORY

HOME OF PLUTO

As Lowell's Deputy Director for Science, Michael West plays an active role in managing Lowell's scientific and outreach missions. He also enjoys sharing the excitement of the universe through his provocative writing, and will contribute a regular column to the *Observer* (see page 6).



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Four Questions with Michael West

How did you become interested in astronomy?

Carl Sagan's wonderful book, *The Cosmic Connection*, changed my life by inspiring me to become an astronomer. I've been a professional astronomer for three decades now, and feel blessed to earn a living doing what I love. It's been an incredible journey. As the great American mythologist, Joseph Campbell, said, "Follow your bliss and the universe will open doors for you where there were only walls."

Where were you before Lowell?

I did my PhD in astronomy at Yale University. Since then, I've lived on four continents, learned several languages, and given up tenure at two universities, all in pursuit of my dreams. Canada. Holland. Hawaii. The Gambia. Chile. Nantucket. It's a tale of wanderlust and wonder.

I'm delighted to be part of Lowell Observatory since August 2015, and believe that the observatory has a very bright future. It's been wonderful traveling the globe, but my family and I are happy to finally put down roots in Flagstaff.

What are your research interests?

I started out as a theoretical astrophysicist. My PhD dissertation at Yale explored how different types of dark matter – the invisible stuff that makes up most of the universe – might influence the distribution of galaxies in space. Over time, however, I moved into observational astronomy. Today, my research focuses on the birth and death of galaxies, the large-scale structure of the universe, and star clusters.

I'm using the Hubble Space Telescope and Lowell Observatory's Discovery Channel Telescope to study giant cannibal galaxies and the ghostly remains of their victims. I'm also trying to learn more about 'orphaned' star clusters that my collaborators and I

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Working as a Post-Doc at Lowell Observatory

By Alma Ruiz-Velasco

See page 11 for more!



DIRECTOR'S UPDATE

By Jeffrey Hall

Last week, I stopped by the solar telescope our educators set up every day outside our visitor center. A mom and her son of about seven came along, and our volunteer Marie Schimmelpenninck showed them the prominences that were visible around the Sun's limb and explained the Sun's behavior and physical characteristics to them. Our very young visitor was so excited he could barely stop asking questions and reciting what he knew about the Sun (almost all of it correct) to take a peek. His executive summary was that the Sun is "really cool."

Actually, the Sun is cool, being formally known as a "cool star," hotter than the low-mass stars Lisa Prato studies, but not nearly as hot as the heavyweights Phil Massey studies. Cool stars are the subject of wide-ranging

research, more than enough to merit their own biennial international conference – the most recent one having been organized by Gerard van Belle in 2014 right here in Flagstaff. It was a feather in the cap for both Lowell and the City.

But of course, the young man at the telescope was using the more colloquial meaning, one that I also think is perfectly applicable. I've had a number of interactions like this lately, indicative of the great job our outreach staff does in not only communicating good information, but in showing our visitors young and old that the cosmos is wondrous – and also incredibly cool.

If your plans bring you our way this year, come see us and let us show you. ☺



TRUSTEE'S UPDATE

By W. Lowell Putnam

Thomas Edison once said, "Everything comes to him who hustles while he waits." While the observatory is waiting for new instruments like IGRINS (from Texas/Korea), EXPRES (from Yale) and RIMAS (from Maryland) to come to the DCT, everyone is quite busy working on a myriad of other projects on Mars Hill and around the globe.

This issue is full of examples of the new and ongoing work that happens every day at Lowell. The potential of the "next new thing" is something we are always looking for, but it has to be balanced with (and not distract from) working with what we have and producing great results this week, this month, this year. I am always impressed with how well everyone at Lowell seems to carry both those activities out.

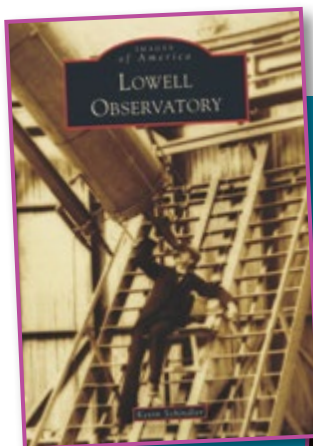
We had great success last year with both science and outreach. As you can read in these pages, there is a lot going on this year and tremendous potential for even more going forward.

So we await the future, but we are quite busy as it approaches. ☺

Stay in the Loop with AstroAlerts

Written by Dr. Michael West, this issue's cover story subject and Lowell Observatory's Deputy Director for Science, *AstroAlerts* provide breaking news stories from the world of astronomy, as well as information about upcoming meteor showers, eclipses, International Space Station sightings, and other astronomical events straight to your inbox. Sign up at:

www.lowell.edu/astroalerts



Both *The Far End of the Journey* and *Lowell Observatory* are available at Lowell's Starry Skies Shop. They may also be ordered by contacting Starry Skies Shop manager Kelsey Banister at kbanister@lowell.edu



Clark Telescope Coffee Table Book and Images of America Book Released

These two new books highlight the rich legacy of Lowell Observatory — its scientists, their groundbreaking research, and the tools they used to both advance the field of astronomy and popularize the excitement of space to the general public. *The Far End of the Journey: Lowell Observatory's 24-inch Clark Telescope* is a lavishly illustrated coffee table book written by Kevin Schindler, with a chapter about the recent Clark renovation written by Peter Rosenthal. *Lowell Observatory*, also written by Schindler, consists of more than 200 pictures and captions and is part of Arcadia Publishing's Images of America series.



Like observatory founder Percival Lowell, Rick and Mary Ann Woods have committed long-term financial support to the observatory by including it in their estate planning. With the addition of Rick and Mary Ann, the Percival Lowell Society now includes about 70 individual members.



**LMI Image -
"Pillars of Creation"**

Joe Llama captured this image in 2015 using the Large Monolithic Imager (LMI) on Lowell Observatory's Discovery Channel Telescope.

Shown here, the "Pillars of Creation" is an area of the Eagle Nebula, in the constellation Serpens. The Pillars is a region of star formation located about 7,000 light years away and featuring columns of interstellar gas and dust. The Eagle Nebula is also known by its catalog numbers M16 and NGC 6611.

Credit: Joe Llama/Lowell Obs./NSF

Rick and Mary Ann Woods Join Percival Lowell Society

By Antoinette Beiser

The Percival Lowell Society recognizes the generous Friends of Lowell who plan to leave a legacy through their will, IRA, charitable gift annuity, or other arrangements. Support from our Friends through bequests are especially important during these times of reduced government grants and will continue to sustain the observatory for our next 100 years.

Rick Woods has had a lifetime fascination with the planet Mars, which naturally led him to Lowell Observatory. Percival Lowell is an inspiration to Rick and he hopes to observe his and Lowell's favorite planet through the newly restored Clark Telescope in 2016. He's visited the observatory's library several times over the years to make use of the wonderful Mars collections here for his own research. He

and his wife Mary Ann, a former farrier and cowboy action shooter, have been members of our Friends program for 10 years. They enjoy hiking, camping, and gardening in retirement and Rick also plays in a few musical groups. Their planned gift to Lowell Observatory is earmarked to support historic preservation, something near and dear to their hearts.

Please consider supporting Lowell Observatory with an estate gift to the Lowell Observatory Foundation. Your gift will ensure that astronomical discovery, educational programming, and preservation activities continue at the observatory. For more information please contact Antoinette Beiser at asb@lowell.edu or (928) 864-9527.

Introducing the New Lunar Membership Level



We are proud to announce a new \$150 Lunar membership level in the Friends of Lowell Observatory. Lunar members receive all the benefits of the Planetary level membership plus invitations to our quarterly "Ask an Astronomer" webinars. The first webinar was held on February 20, 2016. Becoming a member at our Lunar level is easy and can be done at lowell.edu/donate/renew-membership. You can use our monthly payment program with installments of only \$13 a month! As a Friend of Lowell Observatory, you not only will be able to visit Lowell Observatory and other science centers for free, but you'll also receive regular updates from our team about our scientific discoveries and educational programming. — Mica Gratton



Throughout the AAS meeting in Kissimmee, Florida, the Lowell booth served as a convenient meeting point for observatory staff, past and present. Pictured here (left to right): Research Assistant Laura Flagg, Communication Manager Josh Bangle, Astronomer Gerard van Belle, Adjunct Astronomer Evgenya Shkolnik, Predoctoral Fellow Victor Garcia, and former Postdoctoral Associate Joe Llana.

AAS Meeting is Key Gathering for Astronomers

By Gerard van Belle

The field of astronomy is a surprisingly tight-knit community, if one stops to ponder the rather thin geographic distribution of professional astronomers world-wide. There are only about 10,000 of us on the entire planet. However, the shared experiences, similar career arcs, and in many cases, overlapping academic paths mean that many of us are not just colleagues but close personal friends. Unfortunately, we only get to see these friends infrequently.

This is one of the aspects of the annual American Astronomical Society (AAS) winter meeting that makes it one of the 'must-not-miss' events of the year for me — it is an opportunity to catch up with those long-lost friends, most of whom regularly attend the meeting as well. The AAS winter meeting is held every year during the first full week of January, and moves around the United States. Cities that frequently host the AAS meeting include Seattle, Orlando, Los Angeles, and the ever-popular D.C. That latter venue ranks high on the list, as the opportunity to trek up Capitol Hill and discuss matters with your congressional representatives is one not to be missed. In turn, many staffers and even legislative members will take the opportunity to visit the meeting to learn about how grant support through NASA and NSF is reaping a scientific bounty.

Annual attendance is roughly 3,000 — a substantial fraction of all the world's astronomers; it has been remarked by the AAS executive director that, "every

time we have a winter meeting in DC, it's the new record-holder for the largest gathering of astronomers, ever." A typical meeting day opens up with one or two plenary talks, pitched at the community in general, usually a presentation associated with winning one of the many society prizes awarded to our more accomplished astronomers. This then runs into general sessions, when roughly a dozen parallel sub-sections delve into arcane sub-specialties of the field — all the information you can convey to your audience with the bounty of a five-minute speaking slot. Lunch time provides a breather, which itself is typically pre-empted by the many 'town hall' meetings of funding agencies, such as NASA, or national observatories, such as Gemini or SOFIA. The afternoon is back to business with more parallel sub-sections, with further plenary talks as well at the end of the day.

Simultaneous to all of this, the meeting always has an expansive exhibit hall. Aisles and aisles of exhibitor booths proffer information on telescope manufacturers, funding agencies, instrumentation providers, publishing houses, and even observatories — including, in particular, Lowell Observatory. Populating the space between those aisles are literally hundreds of 40

inch by 40 inch posters, tacked up on posterboards. For those individuals who don't find the meager five-minute speaking slots of the oral sessions worthwhile, a poster slot gives you one whole day to talk the ear off any and all who find your poster. My own preferred technique is to get a poster, rather than oral, spot — only one per attendee per meeting allowed — and take my chances on poster location. A winning spot is by the exhibit hall entrance — lots of foot traffic means lots of visibility for your poster — but luck of the draw can also mean you're in the back of the hall amongst the cobwebs of science ideas full of merit but low on visibility.

The Lowell booth for me is always a delightful oasis amidst the chaos where I can sit for a moment, meet & greet passers-by and chat up the observatory, and a useful lightning rod for gathering those friends and colleagues for coffee, or launching off to dinner at the end of a not-quite-finished day. For much of the truly interesting business of the AAS occurs not during a science session, or scanning one of hundreds posters on a given day, but after hours over a usually overpriced meal. New collaborations are formed, ideas are hashed over, and much of a year's road map for science endeavors can be hammered out.

At the end of the meeting week, I am typically worn out from the non-stop pace of the event, the futile attempt to drink from its fire hose of astronomical energy — but I am also re-invigorated from the camaraderie and the kernels of new ideas that will blossom into new insights about our universe. I always return from the AAS with the certainty that it's going to be another exciting year in astronomy. ☺



Public Program Supervisor Emily Bevins (second from left) performed science demonstrations for several groups of k-12 students at the January AAS meeting. Here, Bevins holds a Pluto globe while discussing results from the New Horizons mission.

SUPPORT THE NEXT 100 YEARS of discovery and outreach at Lowell Observatory! Visit foundation.lowell.edu to learn how.

By Lisa Actor

The time will come when diligent research over long periods will bring to light things which now lie hidden. A single lifetime, even though entirely devoted to the sky, would not be enough for the investigation of so vast a subject...

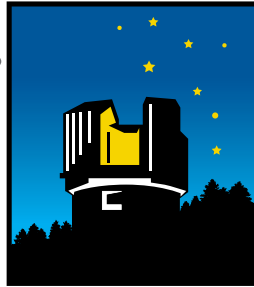
- Seneca, *Natural Questions*, Book 7

Seneca, a Roman philosopher and statesman, knew the study of the sky was a long-term project. Percival Lowell understood this, too. When Lowell died in 1916, he left his trust to support the sustained study of the universe. In the past one hundred years discoveries funded by his trust have unveiled evidence of the expanding universe, identified the rings of Uranus, and discovered Pluto. What will Lowell Observatory astronomers discover in the next 100 years?

The cost of sustaining modern, long-term astronomical research has surpassed the support of Percival Lowell's trust. Increasingly, private donations will support our future discoveries. We created the Lowell Observatory Foundation to manage these donated funds.

"Our strength in the past has been our ability to give our researchers sustained access to the best equipment possible, along with support for long-term research," said observatory Sole Trustee Lowell Putnam. "The Lowell Observatory Foundation provides a vehicle for our supporters to endow the future of the observatory with the confidence that their investments will be managed for the long term."

The Lowell Observatory Foundation is a 501(c)(3) non-profit organization



**LOWELL
OBSERVATORY
FOUNDATION**



Supporting
the Mission of
Lowell Observatory

The Lowell Observatory Foundation

dedicated solely to supporting the observatory's mission. Directed by an independent board of seven trustees, it has nearly \$2 million under management. These endowments generate approximately \$80,000 per year in support of Lowell Observatory's dual mission of discovery and outreach.

"The Lowell Observatory Foundation board feels strongly that donors should have absolute confidence in the oversight and stewardship of any and all endowment-type gifts," said Foundation Chair David Connell. "We recently completed the development and adoption of all of the policies necessary for the Foundation's stewardship over the gifts entrusted to it. Those policies will provide assurance and comfort to our donors who, through their gifts to the Foundation, wish to be a part of future discoveries and public outreach at Lowell Observatory."

The Lowell Observatory Foundation is here to help donors achieve long-term

endowment goals or manage short-term targeted donations. The Foundation is especially adept at receiving and investing assets to support Lowell Observatory's mission in perpetuity.

"As the Estate of Percival Lowell supported the observatory in its first century, the Lowell Observatory Foundation is a vital part of supporting the next 100 years," said Director Jeff Hall. "Our sincere gratitude goes to all who join our calling through their support. We'll be thrilled to keep making discoveries great and small for decades to come."

By studying the secrets of the universe, we discover the essence of ourselves. Please join us in our journeys of discovery. Visit foundation.lowell.edu. For more information, contact Lisa Actor, Executive Director of the Lowell Observatory Foundation at lactor@lowell.edu or (928) 255-5047. ☎

Thank You for Funding the Navajo-Hopi Program

Lowell would like to thank the following generous donors who gave to the Navajo-Hopi Astronomy Outreach Program for the 2015-16 School Year: Philip Massey, Helmut Wolf, Mary Miller Stair, Diana and Anthony Visdas, Michael Saks and Roselle Wissler, and Craig Jansen. Their support, along with grants from APS, Richard F. Caris, O.P. and W.E. Edwards, and John F. Long Foundations has helped us to fully fund the program for the school year! We are thrilled to continue sharing our passion for science with underserved Navajo and Hopi students. — Hannah Graves

In addition to leading hands-on classroom activities at partner schools, Lowell scientists and educators set up telescopes for evening star parties that are typically open to the entire local community.





On April 23, 1972, astronauts Charles Duke and John Young explored the moon's Descartes Highlands. Before setting up a solar wind collector, Duke left his family photograph on the lunar surface and then photographed it with a Hasselblad camera as it rested on the dusty surface. Credit: NASA

Love and Litter: An Epitaph for the Human Race

By Michael West

On the surface of the Moon there is no wind, no rain, only endless time. The footprints of the 12 astronauts who walked there between 1969 and 1972 remain undisturbed nearly half a century later, and will for eons.

We humans have left a lot of other things on the Moon too – nearly 400,000 pounds of abandoned spacecraft, rovers, cameras, boots and even containers of urine, feces, and vomit strewn across the pristine lunar landscape.

But it's the personal items left behind by astronauts that are most fascinating.

Apollo 14 commander Alan Shepard hit two golf balls that went for miles in the Moon's low gravity. Astronaut Dave Scott left a Bible. James Irwin left a four-leaf clover. There's even a small sculpture titled

"Fallen Astronaut" that was placed on the Moon along with a list of American and Soviet astronauts who gave their lives in the quest to explore space. It'll be a treasure trove for future archaeologists and souvenir hunters.

Yet perhaps the most remarkable thing left on the Moon was a simple photograph.

Before returning to Earth, Apollo 16 astronaut Charles Duke gently placed a family portrait of himself, his wife Dottie and their two young sons, Charles and Tom, in the gray lunar soil near a crater named Descartes. The picture shows a happy family of four smiling for the camera. On the back they inscribed the words "This is the family of Astronaut Duke from Planet Earth. Landed on the Moon, April 1972."

Sadly, the photo is one of the few things left on the Moon that probably hasn't survived. With no atmosphere to shield the Moon from the Sun's intense rays or to retain heat after sunset, temperatures on the surface careen from a sweltering 250 degrees Fahrenheit during the two-week-long days to 400 degrees below zero during the equally long nights. It probably didn't take long for the Duke family photo to fade completely in the brutal sunlight before eventually crumbling. Nothing lasts forever, not even on the Moon.

Yet by its brief existence on the Moon, that photo says more about our species than all the books ever written could.

When the last stars burn out and the universe grows dark in the far distant future, all that remains will be a faint whisper of love that once flourished on a rocky planet orbiting an average star in an unremarkable part of the Milky Way galaxy.

"For small creatures such as we the vastness is bearable only through love," wrote Carl Sagan.

It would make a fitting epitaph for the human race: we loved. ☺

Lowell Highlighted in Magazines

Lowell Observatory is featured in the March issues of *Sky & Telescope* and *Astronomy* magazines. For *Sky & Telescope*, Docent Klaus Brasch and Director of Technical Services Ralph Nye contributed an article about the recently completed Clark Telescope renovation. For *Astronomy*, Historian Kevin Schindler and Archivist Lauren Amundson wrote a story about how Pluto got its name. This is based on a collection of letters and telegrams with naming suggestions that the observatory received in 1930. These documents are now stored in the Putnam Collection Center.

Sky & Telescope and *Astronomy* are magazines about the science and hobby of astronomy. They are available in both print and digital formats.



Elizabeth Williams, shown here in 1923, worked off and on at Lowell Observatory for years. She eventually married Lowell Mars researcher George Hamilton and the couple then moved to Harvard Observatory's station in Jamaica.

By Phyllis Schiller

Elizabeth Langdon Williams was a brilliant mathematician and one of the first women to attend the Massachusetts Institute of Technology, graduating with honors in 1903. Percival Lowell hired her in 1905 to assist him in his calculations to determine the location of his theoretical Planet X. In 1918, Williams moved from Lowell's Boston office to Flagstaff, where she had the eclectic job of handling the observatory's correspondence. This ranged from such mundane tasks as ordering paper stock to corresponding with people as far away as Turkey.

Having spent the fall months of 2015 archiving the letters of Williams, I came away with a picture of a woman who essentially ran the daily operations of the observatory and who did it with grace, compassion, and utmost patience. The following correspondence illustrates these qualities.

On June 30, 1920, Williams received a letter from M. Gemil of Constantinople, Turkey. Gemil was a military officer and high school teacher. He requested a list of English books and sellers of astronomy books and she answered by sending him



Where's the Lute?

a list of American booksellers he could contact. Thus began an exchange between the two that would continue throughout the following year. He wrote her about the dearth of astronomy texts in Turkish public libraries, pointing out that what did exist was mostly religious in Arabic/Persian language. She suggested that he learn English by using a series of self-teach books, although she acknowledged that most of these were in European languages, not Turkish. When he replied that he had an old Turkish-English dictionary, circa

1890, she then wrote that she had found a Turkish Conversation/Grammar book for English speakers, but "not the other way around".

The last letter, from M. Gemil and dated 05/27/21, was a note expressing his gratitude for all her help. Enclosed was a Turkish lute with translated description and biographical sketch of its maker. The letter was placed in the Lowell archives and remains there today as a reminder of Williams and the role she played in early observatory history. 📧



One of the most important characteristics of Lowell's DCT is its ability to utilize multiple instruments at one time. The instrument cube, for example, can hold five instruments.

New Spectrograph for Lowell's DCT

Lowell Observatory has the opportunity to install what is perhaps the world's most sophisticated spectrometer on our Discovery Channel Telescope (DCT). IGRINS, the Immersion GRating INfrared Spectrometer, was developed by the University of Texas at Austin and the Korea Astronomy and Space Science Institute (KASI). IGRINS is unique because it uses new technology to capture a large portion of the infrared bandpass in a single exposure. Using IGRINS, astronomers expect to determine the properties of young stars which impact the planet-forming potential of stellar systems, detect the presence and characteristics of planets around other stars, and measure the temperatures and compositions of planetary atmospheres in our own solar system. Lowell Observatory must raise \$1.2 million to install IGRINS and pay for its use on the DCT. Our goal is to install IGRINS by fall 2016. A generous donor has offered to match up to \$200,000 for gifts toward this project. If you are interested in contributing to this important project, please contact Lisa Actor (lactor@lowell.edu) or Antoinette Beiser (asb@lowell.edu) to discuss how your gift can make a difference.

Lowell outreach staff excite visitors about space in a variety of ways, from telescope viewing and stargazing to in-depth lectures and multimedia presentations. Educators also employ a number of kid-friendly techniques to inspire youth. Here, Justin Toller paints a rainbow on the arm of a happy young girl.



Sharing the Wonder of Space with our Guests

By Justin Toller

On a recent winter night working with the public, I was reminded of the impact our outreach efforts have on our visitors. On this particularly cold evening, I was operating a portable telescope in front of the Rotunda when a family of three children, their parents, and grandmother stopped by. Despite the bone-chilling cold, they each went up to the telescope and took their turns peering through, except for the grandmother, who politely declined because she was in a wheelchair.


Since they were the only folks out there, we got to move the telescope quite a bit to different highlights of the winter sky, and even some of the more off-beat, deep-sky objects. The children asked clever questions about everything from supernova remnants and red giants to binary stars and nebulae. Somewhere amidst all of this, I became aware that I wasn't so cold anymore, and as we all warmed up with conversation and wonder, a depth of exchange followed that was truly remarkable.

The grandmother had been mostly quiet during the experience, listening intently to the concepts of physics and astronomy that we danced around. Finally, when there was a brief lapse in conversation, she asked, "So looking

through that telescope you can see two entire galaxies (M81 and M82) that are full of stars, planets orbiting those stars, and untold wonders on those planets?"

"That's right," I replied with a smile.

"I hate to be a bother but could you help me up to see?" She smiled with a mix of embarrassment and hope. I looked to the mother and father, who agreed that together we could all help her up the ladder. Supporting her under each arm we made our way up the telescope ladder. Finally at the top, she leaned her eye into the telescope and I watched as a gasp slowly turned into a broad, ear-to-ear smile. When she took her eye away and looked at me, I was surprised to see a single tear escape her eye as she whispered a thank-you. I wasn't sure what to say, but had the feeling that this moment was of real significance to her, and potentially her worldview.

It's easy to forget what an amazing thing the night sky can be when it's your job to look at it every night, and countless moments like this remind me just how incredible it really is. On behalf of the entire Public Program staff, I am thankful for guests like this grandmother for not only reminding us, but for inspiring and teaching us, what a gift it is that we share. 

Lowell Welcomes Record Number of Visitors in 2015

Like other attractions in Northern Arizona, Lowell saw its best attendance ever in 2015, with a total visitation of 97,591. This marked a 21% increase over the previous high water mark of 80,595, reached in 2008. Communication Manager Josh Bangle attributed these numbers to several factors, particularly the Pluto flyby, which brought 7,000 visitors during flyby week alone. Bangle said other reasons for Lowell's healthy attendance included the Clark Telescope coming back on line and expanded hours that were standardized to consistent times throughout the year. He also cited the efforts of the Flagstaff Convention and Visitors Bureau. "I believe in the City of Flagstaff and what the visitors bureau is doing to promote all the businesses in Flagstaff as a destination town. Flagstaff is no longer just a stop along the way to the Grand Canyon, but a destination itself."

During periods of heavy visitation, Lowell astronomers often pitch in to talk with the public or give media interviews. Here, Larry Wasserman discusses Pluto with *Arizona Daily Sun* reporter Emery Cowan.



Lowell Hosts First Flagstaff Astro Symposium



By Phil Massey

I came back very jazzed from the Steward Internal Symposium last February, and David Trilling and I decided we would together organize the first Flagstaff Astro Symposium among NAU, Lowell, USGS, and USNO. Our director Jeff Hall was kind enough to agree to host the event up here at Lowell, as we needed a pleasant space that was large enough to accommodate the 60-65 attendees we estimated. We planned from the beginning that this would be a low-key affair, with

five-minute talks, and the goal was to have astronomy and planetary researchers within Flagstaff meet each other and hear about the very cool work that is going on here in town. We agreed at the beginning that this would be an excellent opportunity for the younger researchers (postdocs, grad students, and undergrads), as well as more senior people, to present.

Due to teaching commitments of our NAU colleagues, we decided to hold this in a single afternoon. With five-minute talks, two minutes

Phil Massey not only helped organize the Flagstaff Astro Forum, but also gave one of the presentations. Here, he stands at the front of the Giclas Lecture Hall of Lowell's Steele Visitor Center, speaking to scientists from Lowell, Northern Arizona University, the United States Geological Survey, United States Naval Observatory, and elsewhere.

for questions, and a couple of breaks, we would have 30 slots. We did a rough BOTE (back of the envelope calculation) and concluded that we probably would have about 25 people wanting to speak. As it was, we filled 31 speaking slots by running a bit longer than 5 p.m. A key element of the success we had, if I do say so myself, was not grouping the talks by topic, but rather following a planetary science talk with a stellar astrophysics talk followed by an extragalactic talk, followed by a planetary science talk, etc.

The whole thing went smashingly well, and all the comments we've received have been incredibly positive. There really is no way David and I can get out of doing this again next year.

I think what we want to do is pretty much a repeat of this past year. The feedback we've gotten for improvements have basically been "do the same thing again," and that's what we currently are planning. 🍷

Discovery Circle Members to See DCT Re-Coating

After six years our DCT primary mirror will be removed for re-aluminization, a painstaking process that will last approximately four weeks. Our Discovery Circle members will have the opportunity to observe this critical step in keeping the DCT in top condition. It's not too late to get in on this once-every-six-year event! Discovery Circle members are also invited to attend our annual dinner hosted by Deputy Director of Science Dr. Michael West, in addition to receiving quarterly notes from Michael of "what's happening in Science at Lowell".

You can sign up for our Discovery Circle membership at www.lowell.edu/donate/renew-membership or contact Mica Gratton at (928) 255-0229.



The DCT primary mirror has only been aluminized once, during the telescope's construction. This process requires strict attention to detail in removing the mirror from the telescope, moving it to the coating annex, removing the old surface, adding the new coating, and moving the mirror back into the telescope.

Clark Restoration Crew Named Team of the Year

Each year at our end-of-year holiday party, Sole Trustee Lowell Putnam announces the Team and Employee of the Year. Speaking on Mr. Putnam's behalf, Director Jeffrey Hall awarded the 2015 Team of the Year to the Clark Telescope restoration crew. While several groups and individuals made the restoration possible, it was this core of five staff that did the brunt of the cleaning, rebuilding, painting, and other tasks involved. The team included Ralph Nye (Director of Technical Services), Peter Rosenthal (Archival Restoration Specialist), Jeff Gehring (Machinist), Glenn Hill (Facilities, Grounds, and Maintenance Assistant), and Dave Shuck (Facilities, Grounds, and Maintenance Manager). Percival Lowell's venerable refractor is now truly better than new, a national treasure that will reveal the cosmos to millions more pairs of eyes over the upcoming decades.

The renovation crew, left to right, Peter Rosenthal (mechanics), Dave Shuck (dome structure), Glenn Hill (paint and woodwork), Ralph Nye (project oversight, mechanics), Jeff Gehring (machining and mechanics), and observatory dog Lucky.



In 2012, Stephen Levine helped host astronaut Neil Armstrong on a tour of the Discovery Channel Telescope. Here, Levine operates the telescope as Armstrong peers through a specially fitted eyepiece.

Stephen Levine Named Employee of the Year

Stephen Levine was named the 2015 Employee of the Year. Stephen has given the observatory five years of tireless effort leading the commissioning of Lowell's Discovery Channel Telescope and bringing the facility to full science operations. Our goal for 2015 was to deliver 300 science nights; in fact, we delivered 297 and now have a fully operational telescope!

Recent Publications



Keep up with our astronomers' research by reading their recent publications. Below is just one example of their work. See our website for more.

Stern, S. A. ; Bagenal, F. ; Ennico, K. ; Gladstone, G. R. ; **Grundy, W. M.** ; McKinnon, W. B. ; Moore, J. M. ; Olkin, C. B. ; Spencer, J. R. ; Weaver, H. A. ; and 141 coauthors (2015). The Pluto system: Initial results from its exploration by New Horizons. *Science*, Volume 350, Issue 6258

Image: Neugent/Massey/Lowell Obs./NSF

See our website:
[www.lowell.edu/
research/recent-
publications](http://www.lowell.edu/research/recent-publications)
for more publications

Space Guard

Coming later this year, Lowell Observatory proudly presents a new exhibit: *Space Guard Academy*. Mind-blowing digital interactives will put you on the frontline of asteroid detection, classification, and more! Brought to life through stunning artwork from artist Andrew Bosley, *Space Guard Academy* is where science-fiction meets science fact!

FOUR QUESTIONS WITH MICHAEL WEST
continued from page 1

discovered wandering the space between galaxies. And I'm using quasars as beacons to search for distant clusters of galaxies — the urban centers of the cosmos.

I've also done, and continue to do, research on offbeat topics such as whether whales navigate by the stars, how the language of science evolves over time, and quantifying the readability of astronomical writing.

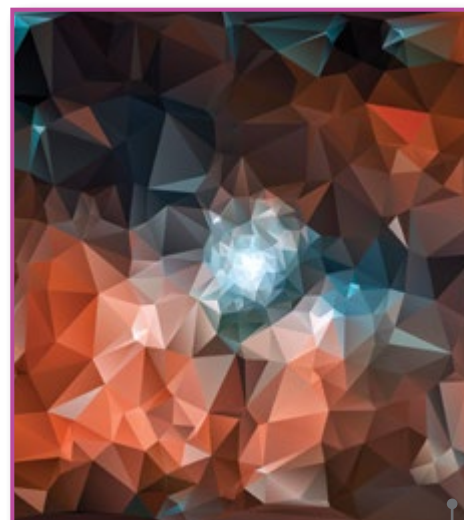
You write a lot; why?

Sharing the wonders of the universe with others has always been my passion. For six years, I chaired the International Astronomical Union's working group on New Ways of Communicating Astronomy with the Public. I also served as chief content developer for the 'Imiloa Astronomy Center of Hawaii, a \$28 million NASA-funded science center that

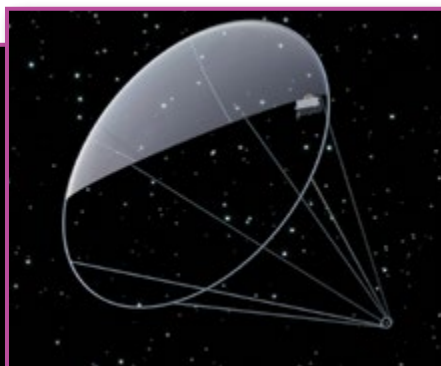
weaves together astronomy and Hawaiian culture into a compelling story of human exploration.

The intersection of astronomy, art and culture fascinates me. As Maria Mitchell, America's first woman astronomer, said, "We especially need imagination in science. It is not all mathematics nor all logic, but it is somewhat beauty and poetry."

I'm especially passionate about writing. I've written astronomy-themed essays for *The Wall Street Journal*, *USA Today*, *The Washington Post*, *Scientific American*, and other publications. My second book, *A Sky Wonderful with Stars*, was published by University of Hawaii Press in July 2015, and includes a foreword by 2011 Nobel Laureate Brian Schmidt, one of the discoverers of the accelerating expansion of the universe. I'm currently working on two new books when I can find time. ☺



Artwork by Michael West of a star cluster within the giant nebula NGC 3603. Located about 20,000 light years away in the constellation Carina, this is one of the most massive young star clusters in the Milky Way.



Ask an Astronomer

Members at the Lunar level and above of the Friends of Lowell Observatory are eligible to participate in quarterly webinars with our astronomers.

Dr. Gerard van Belle led the most recent webinar, on February 20. He discussed a proposal for developing an advanced space telescope technology which is aimed at a quantum leap in the scope of space-based observatories. The idea leverages some of the recent, rapid advances in additive manufacturing, know more colloquially as "3D Printing". The underlying astrophysics potentially enabled by this many-orders-of-magnitude improvement is revolutionary.

Working as a Post-Doc at Lowell Observatory

I was born in Aguascalientes, Mexico. After obtaining my PhD degree from the University of Guanajuato, I came to Lowell in December, 2014 to take my first postdoctoral position. I study Mira variable stars using a technique called interferometry, where the light from two or more telescopes is combined in order to obtain higher resolution, and hence, discern the sizes of the dust envelopes around aged stars. The Navy Precision Optical Interferometer (NPOI) at Lowell Observatory can reach resolutions of a few milli-arc seconds, enough to directly measure the diameter of giant stars or resolve binary stars that otherwise will look like a single point in the sky when using conventional telescopes. One of the things I like most about working at Lowell Observatory is that this is one of the few observatories in the world that is completely open to the public. I enjoy taking breaks to go outside, see the Sun through the solar telescope, and talk to the people that are visiting the campus.

— Alma Ruiz-Velasco

At the January AAS meeting in Kissimmee, Florida, Alma Ruiz-Velasco (shown here speaking with a meeting attendee) presented a poster with Gerard van Belle and other colleagues highlighting their research of Mira variables, a class of pulsating variable stars.





RECURRING EVENTS

2nd Friday Science Night | **MARCH 11** (*Electromagnetic Spectrum: Radio through Infrared*), **APRIL 8** (*Electromagnetic Spectrum: Visible light through Gamma Rays*), **MAY 13** (*Chemistry I*) | Shows at 6, 7, and 8 p.m.

Stars on Mars Hill | **MARCH 30** (*Kevin Schindler - Topic: The Clark Telescope*), **MAY 25** (*TBA*) | 6 p.m. | Steele Visitor Center Giclas Lecture Hall

Meteor Showers | **APRIL 21** (*Lyrid*), **MAY 5** (*Eta Aquarid*)
(6 p.m.) *Activities to teach visitors about the cause of meteor showers*
(7 p.m.) *Viewing tips and lecture*

MARCH

SAT 12 - SUN 13 | **Mustache Salute to Percival Lowell**

MON 14 | **Pi Day**

SAT 26 | **Lights Out Flagstaff**

(5-10 p.m.) *Free admission and activities after 5 p.m.*

APRIL

SAT 2 | **Clark Book Signing Event**

(7 p.m.) *Talk and Clark book signing by Kevin Schindler*

FRI 22 | **Earth Day**

MAY

FRI 6 | **Space Day**

MON 9 | **Mercury Transit**

(8 a.m.) *Lowell will open early to view the Mercury Transit*

SAT 14 | **Astronomy Day**

FRI 20 | **Space Guard Academy Exhibit Opening**

SUN 22 | **Pluto Presentation**

Dr. Will Grundy at the Pacific Science Center in Seattle, WA

SUN 29 | **Holiday Star Fest - Hours Extended until 10 p.m.**

(7-8 p.m.) *Special Guest Lecture: Kent Colbath*

MON 30 | **School is Out and Kids are Free**

(10 a.m. - 5 p.m.) *Special activities featuring moons of our solar system*

For more special event information visit:
www.lowell.edu/outreach/special-events



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For comments about the newsletter, contact
Historian Kevin Schindler: kevin@lowell.edu | 928.233.3210
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