

THE

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# LOWELL OBSERVER

THE QUARTERLY NEWSLETTER OF LOWELL OBSERVATORY

HOME OF PLUTO

Lowell Observatory engineers Frank Cornelius and Ben Hardesty hoist the EXPRES vacuum enclosure.



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By Debra Fischer, Yale University

EXPRES is the EXtreme PREcision Spectrograph. Designed and built at Yale University, this will be the first spectrograph with the precision to detect analogs of our Earth around nearby stars. Lowell Observatory's Discovery Channel Telescope (DCT) is the perfect telescope for collecting the photons that EXPRES will use for exoplanet detection.

While work on the spectrograph continued in the Yale Exoplanet Lab this summer, the first stage of commissioning at the DCT was completed, with installation of the three-ton vacuum enclosure; the front end module; and critical software - the data-taking GUI for controlling EXPRES and for communicating with the telescope control system.

The DCT pointing exceeded expectations. Thanks to the extraordinary support from the DCT team and the excellent planning by the Yale instrument team, a star was acquired and commissioning tests began 30 minutes after going on-sky. Once the pointing offsets were determined for the guiding

and acquisition system, new targets always fell within a 10" radius of the fiber. David Sawyer, who was a system engineer at Yale before becoming Lowell's technical project manager, said this was the smoothest commissioning that he has seen in his 25-year career.

One of the most important efforts for extreme precision and the detectability of Earthlike planets is the ability to disentangle velocities that arise on the surface of stars from orbital velocities. We are making exciting progress with new statistical techniques using simulated data. The high fidelity data from EXPRES are critical to the successful application of the methods

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## Pluto Telescope and Dome Renovation Photos

See page 12 for more!



**DIRECTOR'S UPDATE**

By Jeffrey Hall

I'd like to wish everyone a very happy 2018, and thank you for your interest and support of Lowell Observatory.

Many good things happened in 2017: a number of new research grants obtained by the faculty, exciting new instruments arriving at our Discovery Channel Telescope, a smashing successful pair of events on Mars Hill and in Oregon for the Great American Eclipse, continued extremely strong attendance in the outreach programs, and steadily developing plans for a new and expanded visitor center to accommodate our growing visitation. Our recent announcement of the Giove Open Deck Observatory (GODO) is, I hope, just the first in a string of happy events that will, over the next 5-6

years, raise the breadth and reach of Lowell's scientific, technical, and outreach activities to yet another level.

This year will be a critical one in ensuring these plans continue toward fruition. We will arrive at a full vision for our scientific and technical future, we'll break ground on the GODO with hopes of opening it by sometime next fall, and we'll be defining and raising funds for the building and the detailed components of our new outreach center. We look forward to keeping all of you up to date as things move along, and we appreciate your continued interest.

Happy New Year to all! 🍷



**TRUSTEE'S UPDATE**

By W. Lowell Putnam

I don't thank people enough. As I read the articles that make up this issue of the *Observer*, I realize what a great job everybody on Mars Hill is doing and how fortunate I am to be a part of this organization. I also want to extend my thanks to all of you who support the

observatory and help all the good work in both science and outreach that continues to get done. As you can see from what is already going on we have a lot in front of us that will help create a very exciting and successful 2018. My best wishes to all of you and your families for the year ahead as well. 🍷



**From the LMI Gallery:  
The Ring Nebula**

The Ring Nebula (M57) is a planetary nebula located about 2,300 light years from Earth in the constellation Lyra. The Ring Nebula is easy to spot using binoculars or a small telescope because of its proximity to the bright star Vega.

*Credit: Sanborn/Hayslip/Excelsior84/Lowell Obs./NSF*

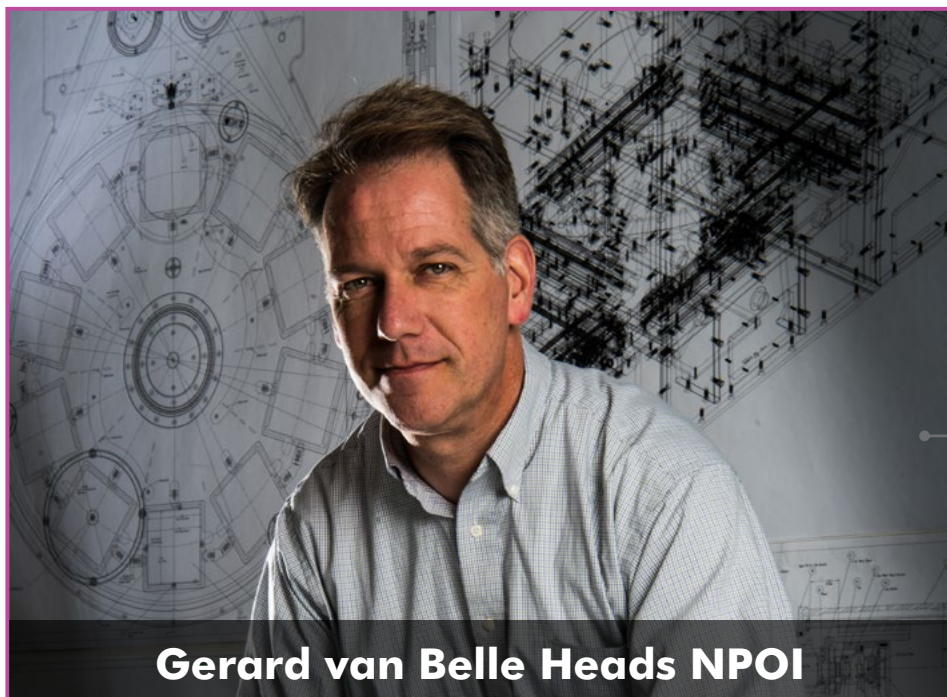


Alma Ruiz-Velasco stands in front of the Clark Telescope during a recent tour.

**Astronomy Liaison**

A generous donation from Advisory Board member Bob Ayers is supporting the new position of Astronomy Liaison at Lowell. Duties will focus on interacting with amateur astronomy communities, the media, and the public to relay general information about astronomy and planetary science and specific information about current research being conducted at Lowell Observatory.

The observatory has hired Alma Ruiz-Velasco, a familiar face around Lowell for several years, for the position. Alma earned her doctorate of sciences in astrophysics in 2012 from the University of Guanajuato in Mexico. She originally came to the observatory as a postdoc working with Gerard van Belle and for the past several months has served as an educator in the Public Program. In addition to giving tours and special programs, she has also partnered with a Navajo teacher as part of the Navajo-Hopi Astronomy Outreach program. Alma's dual background in both science and outreach make her an ideal fit for this position.



## Gerard van Belle Heads NPOI

By Kevin Schindler, Historian

In May, Lowell Observatory Astronomer Gerard van Belle was named the director of the Navy Precision Optical Interferometer (NPOI) in Flagstaff, Arizona. Van Belle has been on the Lowell faculty since August of 2011 and is a noted leader in astrophysical research and remote sensing utilizing telescope arrays such as NPOI.

NPOI is an advanced telescope array at Lowell's Anderson Mesa dark sky site, roughly 10 miles outside of Flagstaff, an International Dark Sky City. Lowell operates the facility in partnership with the Naval Research Lab (NRL) and the U.S. Naval Observatory (USNO). NPOI links multiple optical telescopes spread over a site many football fields in size to form a single, larger synthetic telescope. It is the largest such operational facility in the world, with potential telescope separations up to 432 meters and the only one expressly built for the challenge of visible light operations.

The directorship of NPOI has rotated between USNO, NRL, and Lowell over the lifetime of the facility. The previous director of NPOI, Donald J. Hutter, retired from his position at USNO on April 30. During his 13-year tenure as director, NPOI achieved a number of ground-breaking observations, including the first-ever direct


detection of stellar gravity darkening (a latitude-dependent brightness effect on the surface of rapidly-rotating stars), characterization of the disks around Be stars, and thousands of measurements of stellar diameters and binary star orbits.

Van Belle has a long history in the development of telescope instrumentation. Before working at Lowell, he served as the instrument scientist for the PRIMA and MATISSE instruments for the European Southern Observatory's VLTI facility (2007-2011) and an instrument architect for the Keck Interferometer (1996-2002). He has conducted scientific research on the IR Optical Telescope Array (IOTA), the Palomar Testbed Interferometer (PTI), and Georgia State University's Center for High Angular Resolution Astronomy (CHARA) Array.

Van Belle's pioneering stellar surface imaging work at PTI won him the inaugural Edward Stone

Gerard van Belle is one of Lowell's well-respected astronomers. While he has carried out diverse research through his career, he has focused on building and using the highest resolution optical telescopes available. He uses these to learn about the sizes, shapes, and surfaces of stars, as well as to look for planets orbiting those stars. Credit: Andrew Holt Frazier

research award at NASA's Jet Propulsion Laboratory in 2001, for the first-ever direct detection of stellar oblateness on rapidly rotating stars.

Van Belle is the principal investigator of the recently announced \$3.27M PALANTIR upgrade to NPOI. He said, "There's been some revolutionary new advances in optics and electronics, and by implementing those at NPOI—and capitalizing on the considerable existing infrastructure of the facility—we should be able to marry the high resolution of NPOI with faint-object sensitivity. We'll have the premier observatory of its kind for achieving some of the defining astronomical discoveries of the 21st century." 

Aerial view of NPOI. Instead of using a single telescope, this instrument combines the light from an array of up to six mirrors spaced tens of meters apart by precisely directing the beams of light from a star to a point. Each arm measures more than 800 feet long, giving NPOI the largest baseline of any single interferometer in the world.





## Giovale Open Deck Observatory

By Kevin Schindler, Historian

Lowell Observatory is now implementing the first phase of a long-range facility expansion plan with construction of the Giovale Open Deck Observatory (GODO). This new public observing plaza, to be located near the Pluto Walk at Lowell, is set to open in late 2018 and will help accommodate the observatory's ever-increasing crowd sizes.

The facility is named in honor of longtime Lowell supporters/advisors John and Ginger Giovale, who made a lead gift for the project. John Giovale said, "One of the things that prompted us to support this project is the vision being developed at Lowell Observatory for major revamping of the campus and the visitors experience. We saw this telescope plaza as a way in which momentum may be created towards that bigger objective, that bigger vision. And we were excited about that."


GODO will consist of a 5,000-square-foot, elevated plaza along with a roll-off-roof building that houses a suite of telescopes. These will be used for direct observing through eyepieces, as well as for projection of images and spectra onto monitors. Director Jeff Hall said, "Our strategic plan demands that our guests have an experience here they can't get anywhere else, so we're going to make sure this is a premier facility from stem to stern."

An early supporter of the new facility was Lowell Observatory Advisory Board member Michael Beckage, who with his wife Bridget kicked off fundraising for the facility with a gift. Fellow board member Pam Ross and her husband Charlie

followed that up with their own gift, inspiring more support. With the Giovale's gift, the observatory has more than 70% of the funding needed and will begin constructing the facility.

Giovale said, "We were excited that this project started with the Advisory Board meeting, in which we had a number of our Advisory Board members step forward and spontaneously make a pledge for this facility. That got us thinking about pledging to the project. And of course there were also the relentless efforts by (Deputy Director for Development) Lisa Actor, (Director) Jeff Hall, and (Sole Trustee) Lowell Putnam, as well as other faculty and staff. Their enthusiasm and excitement was so important to us. They not only created this vision, but are actively working to make it happen."

While 75% of construction costs are now committed, Lowell's development staff, led by Actor, is seeking additional funding for the telescopes and related equipment that will be housed in the structure. This will come to approximately \$270,000. Lowell staff and supporters believe this is well within reach. Giovale said, "Lisa has been incredibly important in helping us all realize that we have this gem that we can raise money for. It is out there, it is possible, and it is probable that we can make this vision happen."

*If you would like to contribute to the Giovale Open Deck Observatory, contact Lisa Actor (email [lactor@lowell.edu](mailto:lactor@lowell.edu), phone (928) 255-5047) or Bruce Kosaveach (email [bkosaveach@lowell.edu](mailto:bkosaveach@lowell.edu), phone (602) 501-9876). *

GODO will be located near Lowell's Pluto Walk and Pluto dome. To make room for it, the two large water tanks in that area will be removed and replaced by a single, more modern tank elsewhere on campus. This expansion of public observing facilities will allow staff to spread out the evening stargazing and telescope viewing experience, lessening congestion around the Rotunda and Clark Telescope areas.

### Telescope Wishlist for GODO

**32-inch, f/3.0 StarStructure Horizon Series Reflector, with optics by Lockwood Custom Optics.** This will be the largest telescope on Mars Hill and ideal for deep-sky objects such as galaxies, planetary nebulae, globular clusters, and emission nebulae.

**8-inch, f/12 Victorian Style Refracting Telescope by MoonRaker Telescopes, with optics by APM Germany and mount by Astro-Physics.** To ensure clearance of this long refractor with the roll-off building, an adjustable-height pier will be utilized. This will be the primary telescope used for viewing the Moon, planets, double stars, and star clusters.

**17-inch PlaneWave CDK Telescope, with mount by Astro-Physics.** This will be outfitted with a Shelyak spectrometer that has already been donated to Lowell Observatory. This will allow us to display stellar spectra on a monitor. With the optional eyepiece kit, the telescope may also be used visually.

**14-inch PlaneWave CDK Telescope, with mount by Astro-Physics.** It will be fitted with a MallinCam video camera—already donated to Lowell. With this system, we will show live, imaged objects on a monitor. With the optional eyepiece kit, the telescope could be used visually.

**16-inch Meade Ritchey-Chrétien Telescope, with mount by Astro-Physics.** This telescope has already been donated to Lowell but we may look to upgrade certain components. It will be ideal for a variety of visual observations.

## New “Junior Astronomer” Program

By Angela Trnka, former Public Program Supervisor



Last summer, Lowell launched a new activity-based Junior Astronomer program geared toward youth. This is modeled after the National Park Service’s “Junior Ranger” program. During my career traveling and working around the country, I saw how this program not only enriched my own experience in learning about a new place, but enhanced that of the visitors, whether they be five or 95 years old. Coming from a teaching background, I set out to see which activities were the most appealing to participants and why. I participated and earned many patches and badges myself throughout my life, which I gratefully referenced as well.

activities nearly anyone can find fun while learning along the way. Thus, since my first day at Lowell Observatory, I wondered and dreamed about creating a program where visitors of all ages, especially youth, could become a “Junior Astronomer”, actively learning and earning a stellar patch. I envisioned and implemented diverse learning activities such as comparing and contrasting deep space objects; creating constellations and related stories; learning astronomy-related terminology through a word find; exploring the rich history of Lowell through a scavenger hunt; a matching game; and a fill-in-the-blank

This program is another way to experience a ‘place’, through a variety of

The Junior Astronomer Program is Lowell’s latest effort to bring exciting, hands-on astronomy activities to our younger visitors. Since the Public Program instituted the program earlier this year, it has been wildly popular among youth and their parents.

activity of some of the really cool stuff that has occurred here. And yes indeed, some really cool stuff has definitely occurred here which I wanted to share in a more youth-friendly, accessible and fun, activity-based way.

How it works: for just \$3, a participant receives a booklet of 17 activities plus a customized pencil with a mini-crayon set. Participants earn a stellar patch by completing required activities. The \$3 goes directly back to our educational efforts in the Public Program.

We are grateful for the in-kind donation of printing the first 2,000 booklets from APS. We also thank Public Program volunteer Jon Petrescu for a donation to help make this program available for financially strapped families. We are grateful to John and Cathy Matthews as supporters of the project. They provided a financial gift that allowed us to plan and design the brochure. We hope this is just the beginning, with enhanced versions in our future to offer visitors yet another way to explore, learn, and experience this wonderful place full of science and history that is Lowell Observatory. 🌟

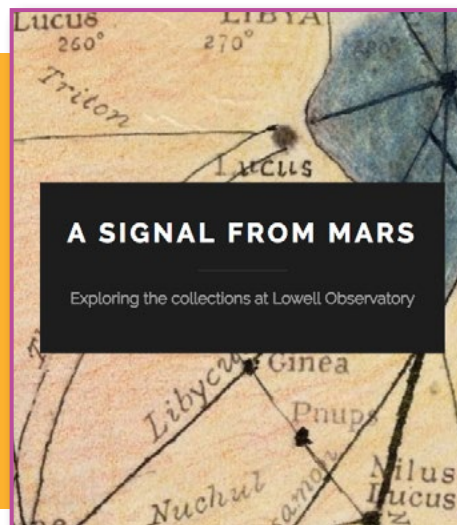
Visit our website for more information:

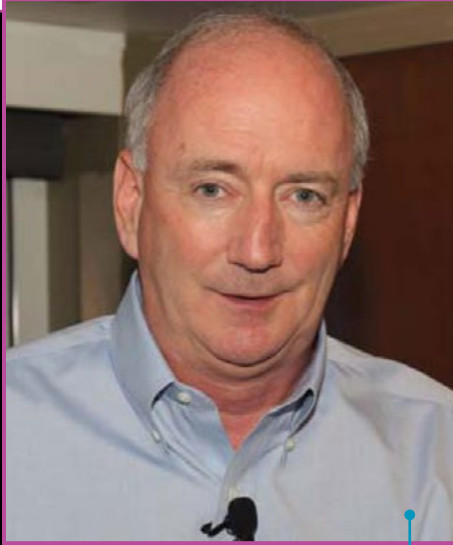
[www.lowell.edu/outreach/things-to-do/junior-astronomer](http://www.lowell.edu/outreach/things-to-do/junior-astronomer)

### A Signal from Mars Blog Highlights Historic Collections

Earlier this year Lowell launched *A Signal from Mars*, a blog highlighting interesting and unusual materials housed in the Putnam Collection Center. Many people know Lowell Observatory because of Clyde Tombaugh’s discovery of Pluto or Percival Lowell’s sensational Mars studies. In fact, the inspiration for our blog’s title came from a 1901 song written by E.T. Paull at the height of the Mars craze. While our collections are rich with materials documenting these two aspects of our history (and we will certainly post some of them) we have so much more to share. Our goal is to explore some of these hidden treasures that the public may not otherwise see.

[www.asignalfrommars.wordpress.com](http://www.asignalfrommars.wordpress.com)





Lowell Putnam spends much of his time as the observatory's Sole Trustee speaking to astronomy clubs, potential donors, and other groups about the exciting legacy of astronomical research at the observatory.

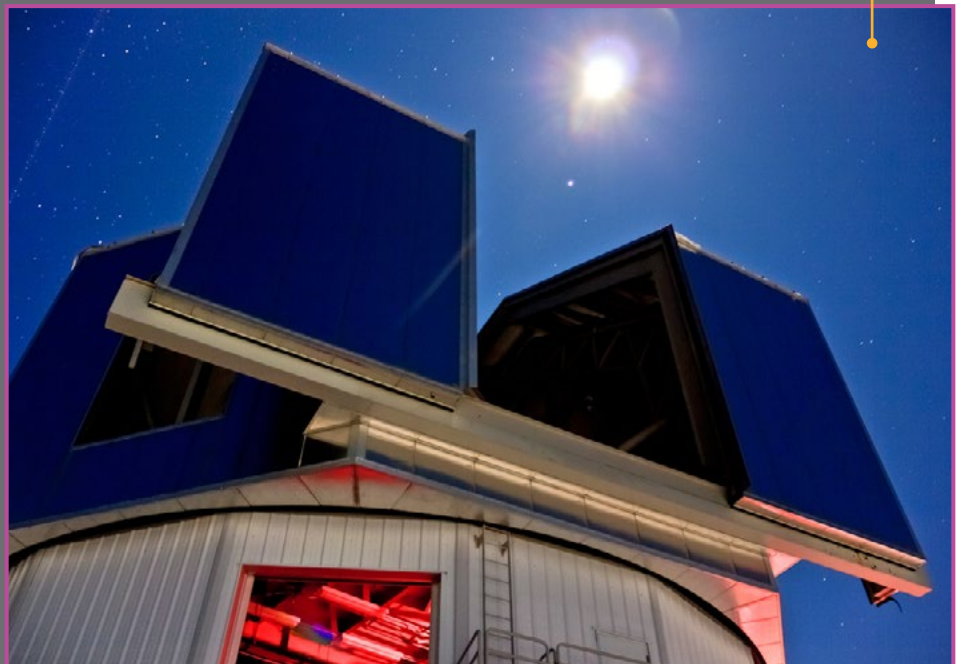
## Lowell Putnam Speaks in Boston

Trustee W. Lowell Putnam has been busy speaking to groups about the work of the observatory. In June he was the featured speaker for the Amateur Telescope Makers of Boston's annual meeting at the Harvard Smithsonian Center for Astrophysics in Cambridge, Massachusetts. In his presentation, "Exploring the Universe at Lowell Observatory", he started with a brief biography of his great-granduncle, Percival Lowell, and culminated with a look at current research projects.

## Potential Contact Binary Detected

Among the strangest small bodies in our Solar System are contact binaries, which are made up of two objects that are touching or in contact with each other, resulting in a peanut-shaped object. Last year, Postdoctoral Associate Audrey Thirouin led a team that used Lowell's Discovery Channel Telescope to detect only the third-known contact binary in the outer solar system. This new find will help shed light on how these mysterious objects formed. With the low number of expected objects in the current trans-Neptunian belt, these contact binaries are unlikely to form today. The population of objects had to be 100 times or more populous in the past to create contact binaries from two objects passing near each other. The other possibility is that the contact binaries are a natural outcome of planetesimal formation. A collection of pebble-sized particles could coalesce directly into a larger object and with the right angular momentum, the pebbles could separate into two components, creating the contact binary.

The detection of this contact binary again proves the value of Lowell's Discovery Channel Telescope and its use in cutting-edge research.



## Samantha Gorney Takes on New Position

As part of Lowell's plan to significantly expand our visitor facilities, Samantha Gorney has been promoted to the new position of Deputy Director for Education. For the past several years Samantha served as Outreach Manager and in 2016 was recognized as the Employee of the Year for her outstanding leadership in the day-to-day operations of our education and outreach efforts. In her new position, she will take the lead in planning and implementing the observatory's long-range education plans.

Samantha Gorney started at Lowell as an educator giving tours and is now leading the future development and growth of all education and outreach efforts.





## Expanding the LOCKs Program

By Vickilyn Hussey, Cave Creek Unified School District

Lowell Observatory's outreach program is collaborating with the Cave Creek Unified School District (CCUSD) on the expansion of the observatory's activity-based, hands-on science program, the Lowell Observatory Curriculum for Kids (LOCKs).

Lowell Advisory Board member Tom Ensign played a key role in developing the relationship. He said, "The vision was to expand the program, to provide more children access to LOCKs, because not everyone can come to Mars Hill. And, expand it in a way that didn't require bricks and mortar."

Ensign worked with Gina Durbin, Director of Education & Community Services (ECS) with CCUSD. She facilitated the use of LOCKs kits with teacher Kathy Grandprey at the ECS Play Preschool site at Horseshoe Trails Elementary School (HTES) in Phoenix. Grandprey collaborated with Samantha Flagg, then the Lowell Observatory Education Coordinator and developer of the LOCKs program, to integrate the Lowell curriculum into the more traditional preschool curriculum. Deputy Director for Education Samantha Gorney and current Education Coordinator Kelly Ferguson continued development of the

program after Flagg relocated to Tucson in the fall of 2016.

"We had a wonderful teacher in Kathy Grandprey," said Ensign. "For example, for the curriculum on Newton's Law, she introduced coloring books with Newton sitting under an apple tree. So while the students were learning, we learned a new way to use the curriculum."


Lowell provides all the required material to perform the scientific investigations and experiments. Each lesson plan takes a week to cover. With their teachers' close guidance and supervision, students perform scientific testing (investigating and modeling), conducting experiments and guided investigations in life, physical, and earth and space sciences. "Providing this kind of learning early in a child's life builds skills and interests that serve children throughout their school years, and later in life," explained Durbin.

During a LOCKs event at Lowell, young visitors demonstrate that learning about science is a fun experience not limited to older kids or adults.

"We certainly need more individuals choosing science, technology, and engineering as a career."

Learning to recognize constellations by using toothpicks and marshmallows, essentially training the mind to see images created by alignment of the stars, was one of the students' favorite activities. "Hands-on investigation, singing songs about science, and making art encourages interest in and retention of the lessons," said Grandprey. She continued, "It's important to instill a love of learning as early as you can. I hope by exploring our world, it makes them hungry for more."

"CCUSD starts our youngest learners with quality learning programs like LOCKs," noted Dr. Debbi Burdick, Superintendent of the Cave Creek Unified School District. "We are fortunate to have our preschool students engaged in this interactive and engaging program as they start to formalize STEM (Science Technology Engineering Math) concepts for future learning and interests."

Funding for development of the LOCKs program at Lowell Observatory comes from the Flagstaff Community Foundation, scholarships, private donations, Lowell Observatory, and ECS, which pays for the LOCKs lesson plan kits. Ensign believes that the LOCKs program will continue to grow and eventually support itself financially. 



When the LOCKs program was originally established, Lowell educators gave classes one Saturday a month at Lowell. The expansion of LOCKs into the Cave Creek Unified School District is the first step in the program reaching regional and, eventually, national audiences.



## Stephen Riggs Joins Lowell Staff

By Kevin Schindler, Historian

In recent years, Lowell's Development department has expanded in proportion to the increased fundraising needs required to ensure long term excellence on both scientific and education fronts. The most recent addition to the development team is Stephen Riggs, who is filling the new position of Development Manager.

Stephen will oversee the annual giving and membership efforts, as well as helping with planned giving and major gifts. He said, "When this opportunity came up I jumped. It's a good cause to fundraise; Lowell has what I would call a mature fundraising staff, particularly for Flagstaff; and the vision that Jeff (Hall) has for the organization is really surprisingly broad."

Originally from Tennessee, Stephen spent his early career in the arts, following

a course of study at the University of Memphis that resulted in a BFA in Theatre Arts. He began fundraising in 1995 and has been in this field since. From 1995 to 2006 he was Membership and Marketing Director, and later Director of Annual Giving, at the University of Wyoming. He then moved to Flagstaff, where he served as Director of the NAU Fund at Northern Arizona University, Development Director at the Guidance Center, and, most recently, Director of Development at the Museum of Northern Arizona.

Stephen's wife, Melissa, is the National and International Fellowships and Scholarships Coordinator at Northern Arizona University. The couple has no children but a cat that rules the house. ☺

Stephen Riggs will play an integral role in helping Lowell raise the funds necessary to meet our ambitious goals of campus expansion necessary for our scientists to continue their world-class research, as well as our educators to offer a premier learning experience for our ever-growing base of guests.



## Molly Baker Joins Tourism Committee

Communication Manager Molly Baker was recently named to the Flagstaff Tourism Commission. The mission of this group is to develop, promote, and maintain Flagstaff as a year-round destination with professional visitor services that will benefit the community economically, environmentally, and socially. This position will help Molly keep the observatory connected to the broader tourism market of Flagstaff and northern Arizona, as well as continue Lowell staff's long tradition of taking leadership roles in community affairs.

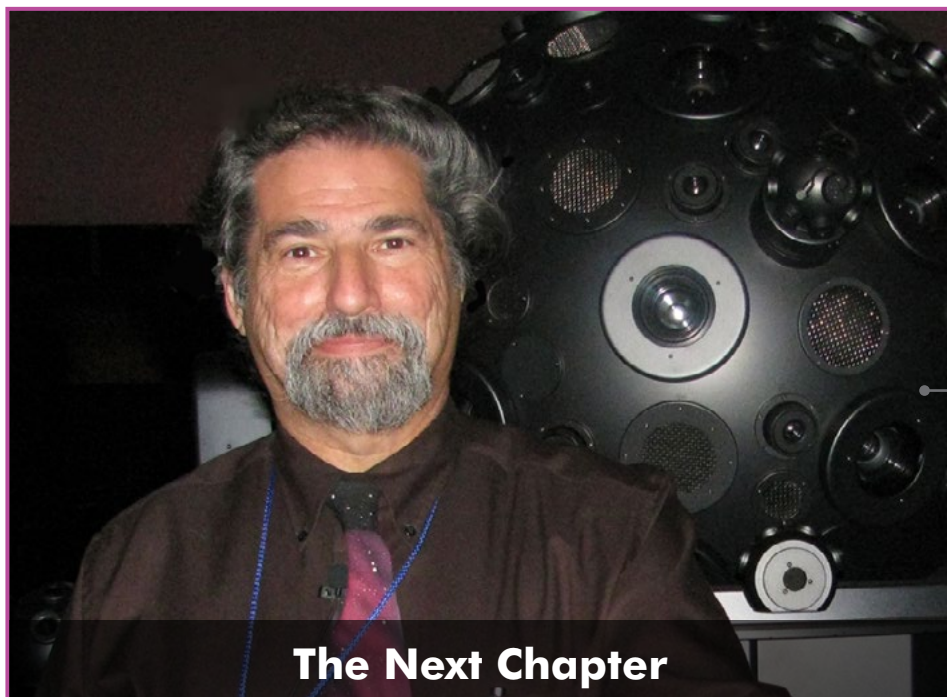


## Plants of Mars Hill Guide

As long, cold Flagstaff winters give way to the windy warmth of spring, mountain residents look forward to the return of color to the landscape—luminescent green leaves dot aspen and oak trees, and an eye-catching mix of colorful flowers reappears in local gardens and on the observatory campus. Thanks to the support of Lowell members Ken and Chris Dahl, a new guide, *Plants of Mars Hill*, will be available for sale in the Starry Skies Shop beginning next spring. Several new signs identifying flowers and trees will also be placed on the campus.

Volunteers Amanda Blanco and Marie Schimmelpenninck created this guide identifying the flowers and trees of Mars Hill visitors most often ask about.





## The Next Chapter

By Sam Storch, longtime Lowell supporter

I'm finally becoming "my own part" of the Lowell Observatory story!

As a child, I often read by a dim flashlight while hiding under the covers after my "official bedtime." Feelings of wonder and mystery enveloped me as grainy, black and white images found in astronomy books gave me my first views of the Moon, Mars, Saturn, and Pluto (the "planet with the arrow"). Nebulae and galaxies were even more mysterious. The images of the telescopes at Palomar and Mount Wilson showed the sort of laboratory perfection I somehow expected to find at a modern observatory.

Many of my books contained the well-known image of Percival Lowell perched on the observing ladder at the Clark telescope. Another photo showed the unusual shape of the dome housing that telescope; it reminded me of a large cake.

I thought about the places in these photos—how much courage was needed to build an observatory in "the middle of nowhere?" My impression was that Lowell Observatory was a special place, more intimate, and different from the other storied observatories with their famously large telescopes.

Through my school years I did a lot of observing through various telescopes, both bought and proudly assembled. My resulting career spanned more than forty years bringing astronomy to planetarium audiences and to astronomy classes,

especially for undergraduate non-science majors. Here and there I encouraged a suitably gullible amateur to try finding Pluto using a large telescope by looking for the arrow. My experience and observing skills helped me with my presentations and with understanding why research at any observatory amounts to a mighty labor, squeezing the secrets of the universe from the tiny amount of light the sky gives us every night. I reminded my students that we all receive the same starlight that's showered down on every observatory, and that included Lowell Observatory!

A good way to communicate the enthusiasm for a subject is to "become part of it," and tell the story as if it had happened to you. I tried hard to bring the flavor of "being present at the time" to my audiences. Now that I'm retired, I confess to describing how I enjoyed supper with Galileo (some in my audiences likely thought I was old enough) and to using an entire hour's lecture romantically telling the story of Percival Lowell and his quest to uncover the secrets of Mars. In solar system astronomy courses I told how a young Clyde Tombaugh managed to discover Pluto through unwavering dedication to a demanding schedule of photography and blinking of plates in what is best described as the "brute force" of one quiet man. In stellar and galactic astronomy I enjoyed describing how V. M. Slipher's discovery of the red shifts in "spiral nebulae" eventually

led to an understanding of our model of the evolutionary universe.

Sam Storch has devoted much of his life to observing space and sharing his excitement for this with others. He's traveled the world to chase eclipses, run planetarium shows for students of all ages, and spoken about astronomy to anyone who shows the least interest in the subject (and many who don't, though they usually become fascinated after listening to Sam).

led to an understanding of our model of the evolutionary universe.

The "stuff" of the stories was enriched over the years as new books were published and a video of Clyde Tombaugh himself describing how he discovered Pluto was released. My "tool chest" of stories and anecdotes grew. In 1988, Tombaugh himself attended the annual Stellafane Conference for amateur telescope makers in Vermont. His quiet yet intense mind was revealed in his eyes, his broad, sincere smile, and the firmest of handshakes. You didn't want to wash your hand for a while...

The stories also changed physically—first, with 2x2 slides, my stories of Lowell Observatory were told in a totally dark hall. Later, color printers and overhead transparencies found me showing the same images in a partly lit room; now I could look directly at my listeners. Nowadays a laptop and projector replaces all of that technology, and the images are even more compelling.

More than four decades of telling my Lowell Observatory stories passed before my retirement. In the spring of 2016 a trip to Lowell Observatory allowed me to enjoy two personal experiences best described as "religious."

A wonderful night at the eyepiece of the Clark Telescope placed me literally at the same end of the telescope as Lowell had

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## The Lowell Family's Love of Plants

By Kevin Schindler, Historian

The lovely array of plant life on Mars Hill (see Flower Guide story on Page 8) was not lost on Percival Lowell. He was an amateur botanist who collected all sorts of plant specimens and even has a tree named in his honor. Percival was not alone in his family with this love for plants; other Lowells through the generations maintained an active interest.

John Lowell (one of many John Lowells; within the family he was known as "The Old Judge") was a well-regarded lawyer and federal judge. He also was a founding member of the Massachusetts Society for Promoting Agriculture and its second president. John's son (also John and known in the family as Rebel) was also active in this group, eventually himself serving as president of the organization as well as editor of the publication *The Massachusetts*

*Agricultural Repository and Journal*. He later helped establish the Massachusetts Horticultural Society.

The Rebel's son, John Amory Lowell, was an industrialist but had a lifelong interest in botany. For years he collected books about plants with the hope of one day devoting his time to botanical studies. He had to abandon this idea in 1857 because of financial issues and ended up giving many of his books to his friend Asa Gray (they eventually became part of Harvard University's Gray Herbarium library). Others went to the Boston Society of Natural History.

One of John Amory's grandsons was Percival Lowell, a man with many interests beyond astronomy. For years he kept a vegetable garden at the observatory, just

Percival Lowell's garden on Mars Hill, just below the Clark dome and Baronial Mansion.

down the hill from the 24-inch Clark Telescope dome and Baronial Mansion.

In 1910, he began corresponding with Charles Sprague Sargent at Harvard University's Arnold Arboretum, sending specimens of plants he collected on Mars Hill and other nearby locations such as Oak Creek Canyon. These included a new species of ash that Sargent named *Fraxinus lowellii* (Lowell's ash tree, named in honor of Percival).

In an obituary about Lowell, Sargent wrote that Percival was especially interested in juniper trees and was planning to write a monograph on species of the southwest. While Lowell didn't live long enough to carry out this project, he did publish a paper in the *Bulletin of the American Geographic Society*, "The Plateau of the San Francisco Peaks in its Effect on Tree Life".

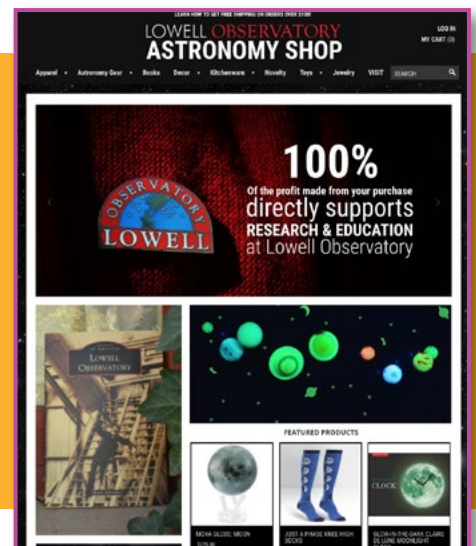
Sargent said that in November 1916 he received a package of willow specimens from Lowell. As fate would have it, this was one of the last packages of any kind that Lowell sent, as he died just a few days later.

While Lowell's contributions to astronomy are well documented at his observatory, his passion for botany is also represented. Between Lowell's mausoleum and his beloved 24-inch Clark Telescope dome lives a specimen of the tree that he discovered, the Lowell ash tree. 🌳

## Online Gift Shop

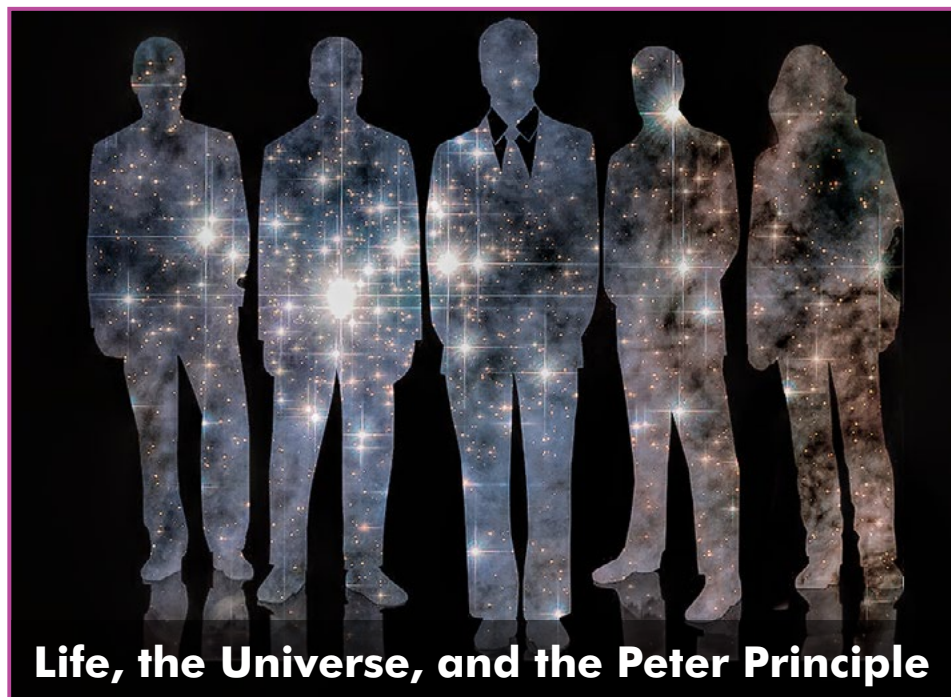
With our online Astronomy Shop, buying Lowell gifts has never been easier. We offer quite a range of clothes, books, toys, astronomy gear, jewelry, kitchenware, décor, and novelty items. Within each category are groupings of products by price level, which makes it easy for you to search for items based on how much money you want to spend. This is a great place to find that perfect astronomy or Lowell gift, as well as support the observatory—100% of the profit from sales directly supports our research and education efforts.

[www.myastronomyshop.org](http://www.myastronomyshop.org)



# DISPATCHES FROM THE UNIVERSE

By Michael West, Deputy Director for Science



## Life, the Universe, and the Peter Principle

These are heady days for astronomers. Discoveries of ancient Martian lakes and planets around distant stars have raised hopes of finding life elsewhere in the universe, maybe even intelligent life.

But if Laurence Peter was right, we might want to lower our expectations a bit.

In 1969, Peter stumbled on one of those universal truths that seems so obvious now you wonder why it wasn't discovered before. The Peter Principle, as it's known, says this: In any hierarchy, individuals tend to rise to their level of incompetence.

The idea is simple. An employee who excels at his or her job is likely to be rewarded with a promotion. Success in the new position may bring another promotion, and so on.

Eventually, however, the employee gets promoted to a position whose demands exceed his or her abilities. They end up marooned there, with no prospect of further advancement and little likelihood of demotion. At best they become mostly harmless, at worst they impede progress.

Peter's wry observation is key to understanding how organizations work. "In time, every post tends to be occupied by an employee who is incompetent," he concluded. Like cataract surgery for your inner cynic, the Peter Principle brings the world into sharper focus.

But what if, like gravity, the Peter Principle is one of those fundamental laws that govern the universe?

For four billion years, life on Earth has worked its way up the evolutionary ladder of complexity. Simple self-replicating

molecules in our planet's oceans, life's entry-level position, combined to make the first single-celled organisms. Multi-celled organisms then arose. Squishy invertebrates gave way to creatures with skeletons. Rudimentary nervous systems evolved into brains. Eventually a few enterprising sea creatures dragged themselves onto land.

Then, about four million years ago, a group of primates with the ability to walk upright appeared on the plains of Africa and immediately began searching for the nearest Starbucks. And that's when the problems began.

Maybe smart ape-like creatures with a fondness for café lattes and chattering on cell phones was one promotion too many up the evolutionary ladder. The same intelligence that has helped our species survive for 200,000 years has also given us tools capable of destroying civilization as we know it, such as nuclear weapons, global warming and the Kardashians.

Is it possible that life on Earth has finally reached its level of incompetence with *homo sapiens*?

Worse still, we might be unable to judge. As psychologists David Dunning and Justin Kruger discovered more than a decade ago, the least competent are usually the most clueless about their own shortcomings, prone to overestimating their talents as, say, the self-appointed stewards of a planet.

SETI, the search for extraterrestrial intelligence, is driven by the belief that alien civilizations are likely to be as common as pork chop sideburns in a

roomful of Elvis impersonators. We only need to listen patiently for their messages, SETI enthusiasts tell us, and our efforts will be rewarded someday. If we're lucky we might even be invited to join an exclusive "galactic club" of advanced civilizations with whom we can share bon mots and swap recipes.

But the Peter Principle suggests that life on every planet might eventually reach a level of incompetence. If so, then there may be nobody out there to talk to—or worth talking to. ☹



Deputy Director for Science  
Michael West



## PLUTO TELESCOPE AND DOME RENOVATION

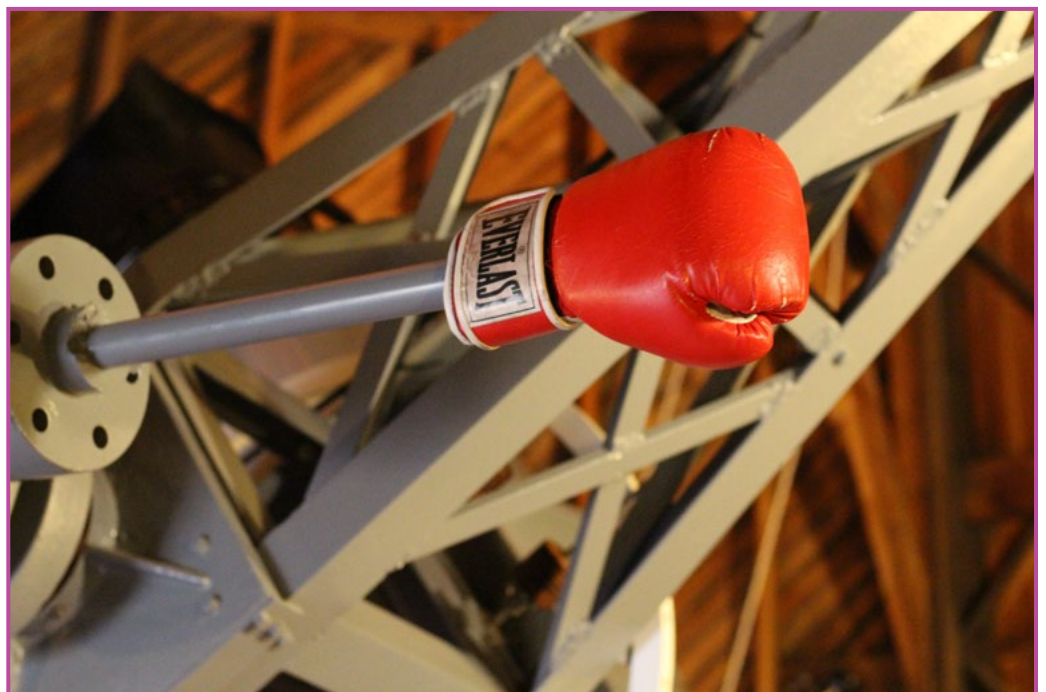
**Top left:** Refinished wooden plate holder used by Clyde Tombaugh.

**Top right:** Dave Shuck (foreground) and Ralph Nye reattach one of the dome's top shutters.

**Middle left:** Glen Hill (left) and Peter Rosenthal stand in front of one of the dome shutters being transported to the shop.

**Middle right:** The setting circles are legible again!

**Bottom:** The renovation would not be complete without one of Ralph Nye's boxing gloves.



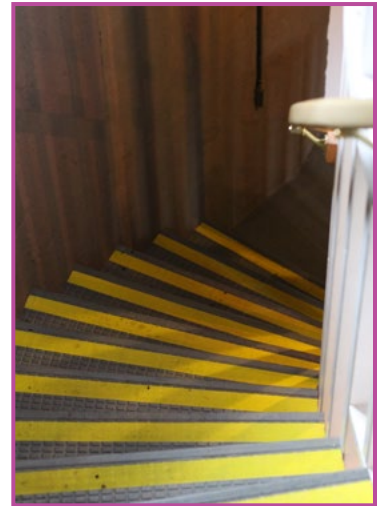


**Top left:** The finished Pluto Discovery Telescope.

**Top right:** The dome stairs are lined with anti-slip strips.

**Bottom left:** Glen Hill rebuilt all of the windows.

**Bottom right:** Peter Rosenthal did much of the fine instrument and wood work for the renovation.





## Percival Lowell Society Members Stan and Dawn Sutherland

By Mattie Harrington, Executive Assistant

Stan and Dawn Sutherland retired to Flagstaff, via Cottonwood, from their home in Wisconsin. Initially the Sutherlands thought living in Cottonwood would be nice, but soon found the heat index a little too high for comfort. Northern Arizona has proven to be a place of solace for both of them, perfect for Stan's passion for astronomy and Dawn's love of the arts. Stan was able to volunteer his time here at Lowell Observatory, where he enjoyed combining his love of teaching and interacting with astronomers. Dawn, still a farm girl at heart as well as an artist, wakes up every day at 4:50 a.m. and goes out to admire the wonders of the sky.


Stan and Dawn's parents aspired to live in Flagstaff but never got the chance to do so. Dawn's father was on his way to Flagstaff when a stop in Nebraska and a persuasive uncle rerouted them back to the farm in Wisconsin. Despite their parents never making it to Flagstaff they now call it home. Fortunately for us here at Lowell Observatory, they are here and have a love for astronomy and the arts and want to share that love with others. Stan says he is a strong believer in founder Percival Lowell's philosophy of making astronomy accessible to all, which is what Stan did for several years as a teacher of physics before becoming an attorney. He was inspired by a teacher, Jim Corrigan, who taught drama, and his enthusiasm sparked Stan's interests and made him think 'I want to be like

him'. In return for the 'spark' Jim provided Stan, Stan started the Jim Corrigan Scholarship in remembrance of his friend, and just received a note from this year's scholarship recipient. "That's why I do it", Stan smiled, "to help someone be able to continue their education." He added, "If it were not for scholarships I would not have been able to go to school because my parents would not have been able to send me."

Stan and Dawn have made arrangements to include Lowell Observatory in their estate plans in support of Percival's philosophy and as a way to continue Lowell's efforts to make astronomy accessible to everyone. After all, Stan recalls, it was physics that saved his life. Back in 1968, Stan graduated *cum laude* from the University of Illinois with a degree in physics. He was offered a scholarship for graduate school, but stuck to his plan of teaching physics at the high school level. He

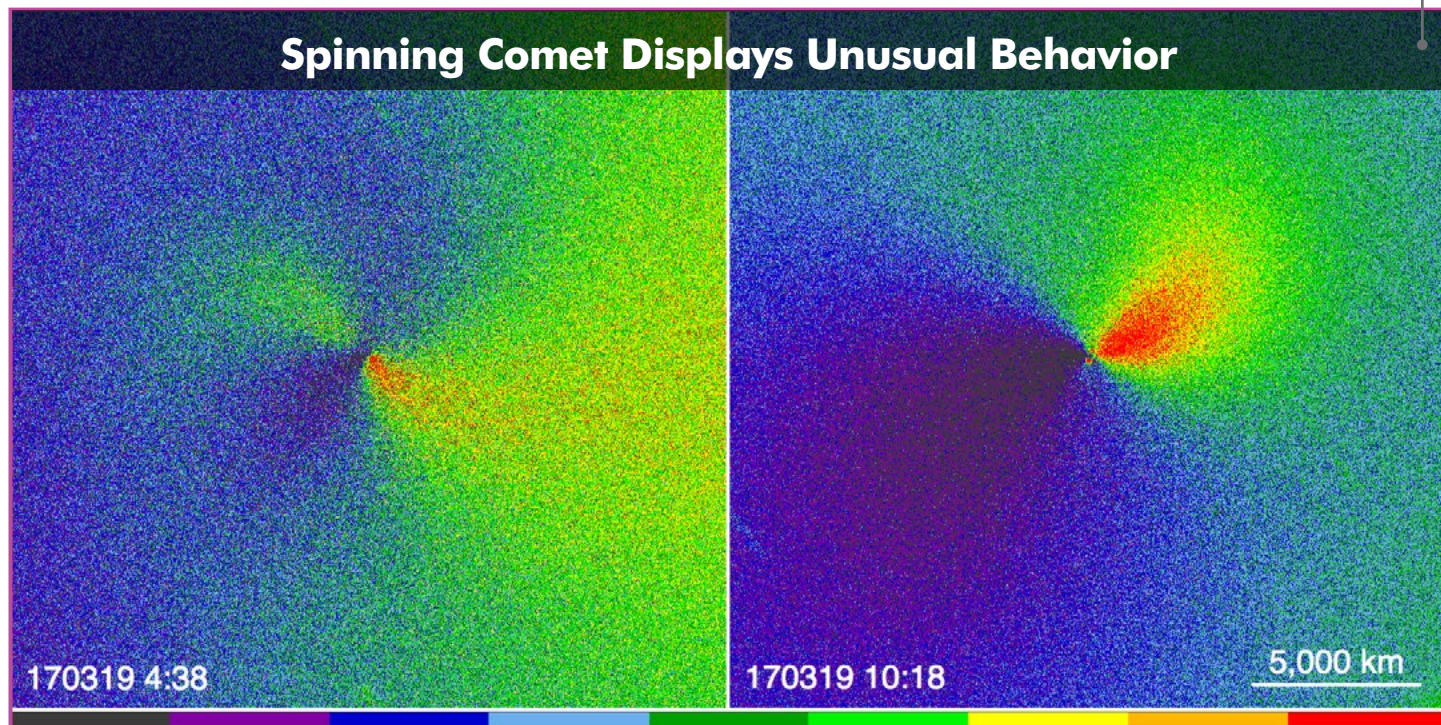
In March 2016, Stan Sutherland manned a Lowell information table during a community volunteer event at the Coconino Center for the Arts.

received a 2A Deferment from the Army because at that time science education had been deemed a national security priority. The deferment saved Stan from being drafted and serving in Vietnam. "It saved my life," he said.

*If, like Stan and Dawn Sutherland, you would like to help continue Percival Lowell's philosophy of making astronomy accessible to everyone, and would like to support the research of Lowell astronomers, consider a gift for Lowell Observatory in your estate plan, trust, IRA or charitable gift annuity. Please contact Stephen Riggs at [sriggs@lowell.edu](mailto:sriggs@lowell.edu) or (928) 255-0186. *



Images of the comet 41P/Tuttle-Giacobini-Kresak obtained on March 19, 2017 using Lowell's Discovery Channel Telescope. Most of the emission from the coma was artificially removed to show the structure of the jets. There is a difference of six hours between the two images and both jets are rotating clockwise. The faint jet on the left image increases in strength as sunlight hits the region, while the other jet nearly shuts off as its source on the nucleus moves into night. The comet rotation period was 24 hours



By Alma Ruiz-Velasco, Astronomy Liaison

Astronomers at Lowell Observatory observed Comet 41P/Tuttle-Giacobini-Kresak last spring and noticed that the speed of its rotation was quickly slowing down. A research team led by David Schleicher studied the comet while it was closer to Earth than it had ever been since its discovery. The comet's rotational period became twice as long, going from 24 to more than 48 hours within six weeks, a far greater change than ever observed before in a comet. If it continues to slow down, it might stop completely and then begin rotating in the opposite direction.

Comet 41P/Tuttle-Giacobini-Kresak is a short period comet that now completes an orbit around the Sun every 5.4 years. Astronomers had a hard time studying this comet in detail until early 2017 when it passed within 13 million miles from Earth, the closest since its discovery. With a relatively inactive nucleus estimated to be less than one mile in size, this comet was finally sufficiently bright for an extensive observing campaign.

During eight weeks between March and May of last year, the comet remained at a distance of less than 18 million miles from Earth. In comparison, the distance between the Sun and Earth is 93 million miles.

These conditions allowed astronomers to study it in great detail.

Remnants from the formation of the solar system, comets have changed very little during the past 4.5 billion years. As a comet gets closer to the Sun and the ice on its surface vaporizes, it develops gas and dust jets thousands of miles in length that ultimately create the coma or head, and the tail that distinguishes comets from asteroids and other celestial bodies. One of the most common gases found in comets is the cyanogen radical, a molecule composed of one carbon atom and one nitrogen atom.

Schleicher and his collaborators used Lowell Observatory's Discovery Channel Telescope, together with the Hall Telescope on Anderson Mesa. They found and measured the motion of two cyanogen jets coming from comet 41P/Tuttle-Giacobini-Kresak. From these jets, they determined that the rotation period changed from 24 hours in March to 48 hours in late April, slowing down to less than half the rotation speed by the end of the observing campaign in May.

This result also implies that the comet has a very elongated shape, a low density, and that the jets are located near the very

end of its body, providing the torque needed to produce the observed change in rotation.

Looking to the past brings another possible scenario. If the comet behaved similarly on previous orbits, it could have been rotating so fast that the nucleus might have broken, allowing more gas to escape and causing an increase in brightness for a short period of time. Such an outburst was observed in 2001.

The full comet team consists of Lowell's Schleicher and Audrey Thirouin, Nora Eisner from the University of Sheffield, and Matthew Knight from the University of Maryland.

This research was supported by NASA's Planetary Astronomy Program and the Marcus Cometary Research Fund. ☺



The heart-shaped Tombaugh Regio.  
Credit: NASA/Johns Hopkins University Applied  
Physics Laboratory/Southwest Research Institute

## IAU Adopts Names for Pluto Features

By Kevin Schindler, Historian

The New Horizons mission revealed scores of surface features on Pluto in 2015, and now many of those craters, mountains, and other topographic treasures possess official names. This is the first set of Pluto place names officially adopted by the International Astronomical Union (IAU), with more forthcoming. As with most things Pluto, some of the designations, as well as the naming process itself, feature Flagstaff ties.

The 14 names honor people and spacecraft that impacted scientists' study of Pluto and its neighbors, as well as a variety of mythological stories from cultures around the world. Scientists have been informally using many of the names for the past two years, with Tombaugh Regio probably the most well-known. This iconic, heart-shaped region is named after Clyde

Tombaugh, who discovered Pluto in 1930 from Lowell Observatory.

A second name with a Flagstaff connection is Elliot Crater, named for Jim Elliot. He was an astronomer at the Massachusetts Institute of Technology (MIT) who pioneered the use of stellar occultations and also established a summer internship program at Lowell in which MIT students traveled to Flagstaff to work with astronomers at Lowell, Northern Arizona University, the U.S. Naval Observatory Flagstaff Station, and U.S. Geological Survey.

Another name familiar to many who know the story of Pluto's discovery is Burney Crater. This celebrates Venetia Burney, who is credited with first suggesting the name Pluto in 1930.

This process of submitting a name to a governing body for official recognition is still followed today. In the case of the new Pluto names, a group of New Horizons team members assembled a list of candidates, many suggested by the general public. This nomenclature working group consisted of nine people, including Lowell's Will Grundy and former Lowell researchers Cathy Olkin and Amanda Zangari. They submitted the list to the IAU, which officially approves names of astronomical bodies and their surface features.

A committee of the IAU—the Working Group on Solar System Nomenclature—then evaluated the list. This group of astronomers and space experts includes Flagstaff's Rose Hayward of the USGS and astronomy historian Bill Sheehan. They debated the merits of the names and submitted their recommendations to the IAU.

Other new names recognized people including Virgil Fossae (depressions on Pluto's surface honoring the Roman poet Virgil) and Al-Idrisi Montes (mountains recognizing 12th-century Arab mapmaker and geographer Ash-Sharif al-Idrisi). Then there are Hillary Montes and Tenzing Montes, after Sir Edmund Halley and his Indian/Nepali Sherpa guide who first climbed to the summit of Mt. Everest.

Continued on page 23

## Elizabeth Roemer Archives Intern

When astronomer Elizabeth Roemer passed away in 2016, she left 50 linear feet of her personal and professional papers and 3000 glass plate negatives to the Lowell Observatory Archives. With a portion of her final monetary gift, the observatory hired Stacey Christen as the Elizabeth Roemer Archives Intern. Since May, Stacey has been processing Dr. Roemer's papers, which consists of inventorying, weeding, organizing, and re-housing in archival enclosures. Upon completion of processing, Stacey will create a finding aid for the papers and an online exhibit highlighting Dr. Roemer's life and research.

Stacey Christen processes Elizabeth Roemer's papers in the Putnam Collection Center. Stacey is organizing and preserving the collection and making it accessible for researchers and historians.







## Observing an Occultation of Triton

By Kevin Schindler, Historian

In early October, scientists using NASA's flying astronomical observatory, SOFIA, observed the wispy atmosphere of Neptune's moon Triton in order to better characterize moon atmospheres in our solar system. Thanks to critical contributions from both Lowell Observatory and the Naval Observatory Flagstaff Station (NOFS), the mission was successful and is expected to reveal important results.

The study centered around a stellar occultation, an event occurring when an object, such as a planet or, in this case Triton, passes between Earth and a more distant body such as a star. As the distant object is blocked (occulted) from view, its light dims and creates a shadow with the shape and size of the occulting body. Lowell's Ted Dunham, Tom Bida, and Georgi Mandushev joined other scientists in riding on board SOFIA (which stands for Stratospheric Observatory For Infrared Astronomy) to observe the occultation. They flew over Florida, the Atlantic Ocean and the Caribbean Sea for the event.

SOFIA is a modified Boeing 747SP aircraft carrying a telescope with a 100-inch-diameter, 1940-pound primary mirror. Like other (usually ground-based)


telescopes, SOFIA is outfitted with a variety of cameras and other instruments for gathering data. One of these is called the High-speed Imaging Photometer for Occultations (HIPO), which was designed and built at Lowell. It is used primarily to observe such stellar occultations.

Positioning a moving observing platform to capture a fleeting shadow is not an easy task. It's all about being in the right place at the right time, and predicting these parameters is an exercise in precision and planning. Ideally, scientists want to capture not only the shadow, but the so-called central flash, a bright spot in the center of the shadow that is caused by focusing of the starlight by the atmosphere of the occulting body.

This is where NOFS and its magnificent Kaj Strand Telescope come into play. With a primary mirror measuring 61 inches across, this is the largest telescope in the

HIPO sits in front of SOFIA prior to installation.

U.S. Naval Observatory's arsenal. Its dome is the one visible from the Arboretum and Interstate 40 (while traveling east from Belmont). It began operations in 1964 and was used to photograph the Moon in support of the Apollo manned missions, discover Pluto's moon Charon in 1977, and help refine the flight path of New Horizons for its historic 2015 flight past Pluto.

In support of the SOFIA flight, astronomers used this telescope to precisely measure the positions of the bodies ahead of the event. These observations were supplemented by others, including some made with Lowell's Discovery Channel Telescope. Astronomers including Lowell's Stephen Levine and Lowell adjunct Amanda Bosh then evaluated these results to plot what proved to be a highly accurate occultation path—so accurate that the resulting observations captured the sought-for central flash. The astronomers are now analyzing the SOFIA data, as well as observations of the event made by numerous astronomers using ground-based telescopes, including Lowell's Larry Wasserman in Georgia and Levine in the Canary Islands. They expect to learn much about Triton's atmosphere and, by extension, the atmospheres of other planetary moons. The effort demonstrates the value of collaboration in such scientific pursuits. 

Ted Dunham (left) and Georgi Mandushev stand at computer console aboard SOFIA. Hanging from the monitor between them is a witch doctor bone that Jim Elliot bought at a tourist trap in Lesotho in the early 1970's. Somewhere along the line it started accompanying the scientists on occultation runs as a sort of good luck charm or tradition. Ted Dunham recalls that it probably flew on every airborne occultation observation made with the KAO and subsequently, after Elliot's death, on SOFIA.



## Changes in Native Outreach Program

Last year a group of teachers from the Navajo Reservation met with Lowell Observatory staff to brainstorm ways that Lowell's 20-year-old Navajo-Hopi Astronomy Outreach Program could make an even deeper impact with students. The solution was to introduce "Project-Based" curriculum developed by Todd Gonzales that would help meet the many other standards besides science that the schools are faced with on the reservations.

Working with Verna Tallsalt, a Navajo teacher at Jeehdeez'a Academy and longtime collaborator with the Navajo-Hopi Program, Gonzales interwove scientific principles with the cultural aspects of Native life. The resulting week-long unit is more holistic than the previous programming and is intended to be more meaningful and relevant to students. The culmination of the effort has students creating posters that they present to the Lowell astronomers during their spring field trip to the observatory.

Poster made by a 5th grader at Jeehdeez'a Academy and displayed at Lowell Observatory in May 2017.



Kelsey with her award certificate at the Wellness Council Award luncheon.

## Wellness Award

Congrats to Kelsey Banister, who in September was recognized as Champion of Worksite Wellness at the Arizona Wellness Council Awards during a ceremony in Phoenix. This event recognized individuals committed to advancing wellness personally and professionally. Kelsey has led Lowell's social committee, organizing staff celebrations, exercise and self-defense classes, massages, and other activities intended to improve the physical and mental health of staff. Kelsey has since left Lowell to take a position at Northern Arizona University, but we will continue the wellness programs she helped start.

## Bird Feeders

Lowell Observatory opens our eyes to what's "out there" during warm summer days as well as stary nights. On a casual stroll through the Mars Hill campus this past June, at least 20 bird species were spotted within an hour. Former Public Program Supervisor Angela Trnka recognized this avian treasure, and her love of birds and nature on Mars Hill resulted in the placement of several bird feeders on campus to bring the local species closer for visitor and staff viewing. Volunteer Jeff Pickens worked with Angela on the project and now serves as the unofficial keeper of the feeders.

Volunteer Jeff Pickens helped install and maintains several bird feeders on the Lowell campus. Birds bring color, song, and cheer to the observatory grounds.





## Mars and Beyond

By Kevin Schindler, Historian

The Science Channel’s coverage of Lowell’s Solar Eclipse event in August was the latest example of our scientists and research being highlighted on educational television programming. The list includes such classic shows as the original *Cosmos* series with Carl Sagan, *Bill Nye the Science Guy*, and a Walt Disney production that represents one of television’s earliest educational programs.

In 1956, the Disney studio began developing a Mars-themed show that would feature rocket scientists Wernher von Braun and Ernst Stuhlinger talking about potential travel to the Red Planet. To discuss general features of that world, the studio contacted an institution long known for its research about Mars—Lowell Observatory. In mid-March, producer Ward Kimball sent observatory director Albert Wilson a script and story board for the show, pointing out that the text was kept

simple “so that the average viewer won’t switch stations to ‘Liberace’ and his piano.”

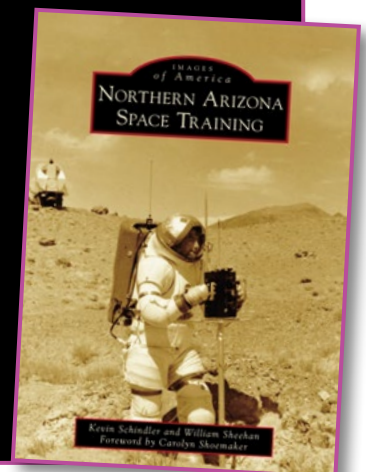
E.C. Slipher, then one of the world’s leading Mars experts, would host the segment. Disney filmed at Lowell in April, paying \$1350 in rental fees and costs to cover observatory staff salaries. In May, Slipher flew to the Disney studio in California for filming of his narration piece. Kimball later noted, “Dr. Slipher did very well before the cameras. We put horn-rimmed glasses on him and everybody who has seen the footage comments that he looks like a typical astronomer.”

The program, eventually called “Mars and Beyond,” was released on December 4, 1957. In the approximately eight-minute segment featuring Lowell Observatory and Slipher, colleagues V.M. Slipher (E.C.’s brother) and Henry Giclas also made short appearances. The show aired on *Disneyland* on December 1957, and today is considered by many a classic Disney production. 📺

E.C. Slipher—wearing fake glasses—explains the physical features of Mars during a segment of the “Mars and Beyond” show. The program may be viewed online on YouTube.

## Northern Arizona Space Training

Nearly a half-century after humankind visited the Moon, Kevin Schindler and William Sheehan have written a new book that captures Northern Arizona’s role in preparing for these missions. *Images of America: Northern Arizona Space Training* tells the tales of astronaut training, lunar mapping, and instrument development and testing. Pat Bridges and Jay Inge helped create detailed lunar maps at Lowell, Neil Armstrong and his fellow astronauts studied geology at Meteor Crater and the Grand Canyon, scientists with the U.S. Geological Survey exploded cinder fields near Sunset Crater to create a simulated lunar surface, and engineers built lunar buggies that were tested at the cinder fields of Flagstaff and beyond.



## Mount Cuba Support



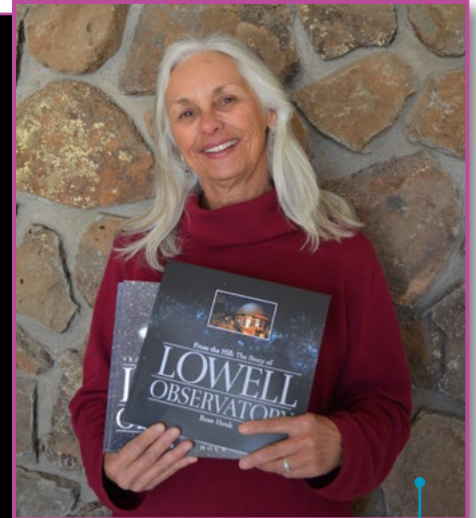
The Mount Cuba Astronomical Foundation has been supporting Lowell research for more than ten years. Astronomers apply to the foundation for grants primarily to fund the purchase of equipment to further their research. This year, Nick Moskovitz and Phil Massey received grants from the foundation totaling \$56,775. The resulting purchase of a new corrector lens and dichroic mirror will keep the Discovery Channel Telescope operating with exquisite capability.

## Market Conditions Perfect for Gifts of Stock

Were you amazed by the Dow's meteoric rise in the last seven months? When the market is riding high, many Lowell supporters donate stock instead of cash. Stocks, mutual funds, bonds, and other securities given to Lowell Observatory can provide considerable savings in capital gains taxes.

Let us know if you're interested in transferring stock. It's easy to make arrangements for the gift between your broker and the observatory. Contact Lisa Actor at [lactor@lowell.edu](mailto:lactor@lowell.edu) for more information.

Interactive daily chart illustrating the performance of the Dow Jones Industrial Average market index over the last ten years.



Rose Houk holds all three editions of *From the Hill: The Story of Lowell Observatory*. This book gives a great overview of Lowell and is a popular item in our gift shop.

## From the Hill Updated

Flagstaff author Rose Houk has updated her book, *From the Hill: The Story of Lowell Observatory*. This marks the third edition of this popular publication, first released in 1991. It highlights important research at Lowell, from the days of Percival Lowell to the modern-day Discovery Channel Telescope era. Production of this latest edition, which numbers 50 pages, was made possible by a generous donation from Lowell astronomer Dave Schleicher.



## Mark Your Calendar for Pluto Dome Reopening

On March 10, 2018 Lowell Observatory will celebrate the grand reopening of the Abbott Lawrence Lowell Telescope, known by most people as the Pluto discovery telescope. The telescope has been closed for the past year as our renovation team has repaired or replaced critical aspects of the telescope and its dome. We will share more details of this exciting event in the coming months.

Archival Restoration Specialist Peter Rosenthal stands next to the Pluto discovery telescope in late November, 2017, as renovation work was winding down.

## Kids Zone at NAU

The Communication Department has entered into a partnership with NAU Athletics to bring science demonstrations and crafts to the Kids Zone at men's football and basketball games. The goal of this effort is to give families a taste of the Lowell Observatory Kids Camps. Look for us in the Skydome next year!

## Giving to Lowell

Congress' tax reform has triggered uncertainty about the charitable gift deduction for 2018. Lowell supporters are asking all the ways to donate.

We're grateful for your support. Here are ways you can enable astronomy discoveries and STEM education at Lowell.

### Personal Check

Sending a check made out to Lowell Observatory is always a great way to give.

### Credit Card

You may make a gift to Lowell Observatory on your credit card, or charge a monthly donation. Donate online at: [www.lowell.edu/donate](http://www.lowell.edu/donate) or call Shannon Gonzales with your credit card number at (928) 255-5059.

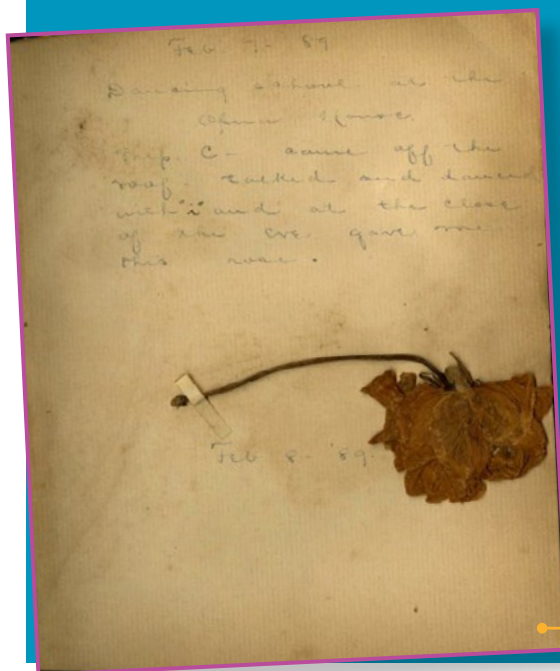
### Stocks & Securities

Stocks, mutual funds, bonds, and other securities given to Lowell Observatory may provide a considerable savings in capital gains taxes. Arrangements for your gift can be made between your broker and Lowell Observatory. Contact Mica Gratton at (928) 255-0229 or [mica@lowell.edu](mailto:mica@lowell.edu) for more information.

### IRA Gifts

Wishing you didn't have to take your Required Minimum Distribution (RMD) in 2018? Most people can donate from their IRA without triggering a taxable event. Contact Lisa Actor at (928) 255-5047 or [lactor@lowell.edu](mailto:lactor@lowell.edu) for details.

## Wrexie Leonard's Scrapbook



We are currently digitizing the scrapbooks of Wrexie Louise Leonard, Percival Lowell's secretary. There are three albums: the first contains birth, marriage, and death announcements. The second is filled with handwritten accounts and mementos from Wrexie's personal life. The third is a combination of poems, photographs, and cartoons. Many of the cartoons feature cats and children, perhaps a 19th-century version of cute animals and kids on the internet.

A rose saved from a night of dancing at the opera house, February 1889.

EXPRES  
Continued from page 1

that are beginning to emerge from this new work.

EXPRES was installed on the DCT in November and saw first light on the evening of December 10. Once the commissioning phase is over, astronomers will begin the search for 100 Earths!

### Vacuum chamber

The vacuum chamber was fabricated by Dynavac and trucked from Massachusetts to the DCT in May 2017. The chamber was pumped down and the pressure and temperature are monitored from a web-based GUI. The vacuum is holding beautifully!

### Front end module

The front end module (FEM) is mounted to the instrument cube behind the primary mirror. It includes a fast tip/tilt mirror that runs at speeds of up to 600 Hz to keep the image of the star fixed on the fiber; the atmospheric dispersion compensator; the fiber mirror mount; and the guiding and acquisition camera.

### What makes EXPRES unique?

The extreme environmental stability is a new standard for all precision radial velocity spectrographs. However, EXPRES



The Yale Team (Ryan Blackman, Colby Jurgenson, Tyler McCracken) in front of the vacuum enclosure with installed optical bench, just before closing it up. November 20, 2017.

is truly unique in ways that will improve the fidelity of the data:

- Spectral resolution: 150,000 - important for disentangling velocities from the surface of the star and orbital velocities
- The 4.3-m Discovery Channel Telescope with flexible scheduling
- Unique extended fiber system for 2-d flat-fielding and a 25-LED flat-fielding lamp with voltages tuned to an inverse spectral response of the instrument
- Interferometric measurement of the CCD pixel positions coupled with a laser frequency comb will provide wavelength calibration that is accurate to  $\sim 1$  cm/s
- Chromatic sampling for the exposure meter for precise barycentric corrections

THE NEXT CHAPTER  
Continued from page 9


been! Ably assisted by two educators and researcher Brian Skiff, my small group first reveled in the superb physical restoration of the telescope and then enjoyed thrilling views of globular star clusters and galaxies, double stars, nebulae and planets. We thrilled to glorious Saturn, but I was unprepared for the experience of viewing Mars.

Truthfully, I'd observed Mars many times over the decades through telescopes both larger and smaller than the Clark, but I had never looked at Mars and felt my skin turn to gooseflesh. I finally "connected" with the minds and hearts of Lowell, of the Slipher brothers, and all those who had patiently labored to know Mars through that telescope. Flashing through my mind were the images of Lowell himself over the years, of E. C. Slipher explaining

the opposition of Mars in the 1956 Walt Disney film "Mars and Beyond," of modern research finally uncovering what Lowell had actually seen that led to the excitement about Martian surface markings. I thought about the irony in the first images of Mars from the early Mariner spacecraft. It was a deeply personal experience. A friend noticed a lump in my throat and a tear in my eye as I stood at the eyepiece silently for a few minutes, looking into the glass but seeing much more than the crisp yet shimmering image of a ruddy planet. I was finally there in the story!

The next day dawned bright and clear and gave me my chance to stand in the dome of the Pluto discovery telescope and know a similar feeling. Standing in the very place with the modest instrument that accomplished so much in the patient and dedicated hands of Clyde Tombaugh, I marveled at how so much was done with

technology now considered primitive as compared with today's methods. Again I was part of the story I had told so often, of how Tombaugh invested his entire mind and body in the glorious work of finding "Mr. Lowell's planet." Again, after so many years of telling the story as if I was there, I really was there!

This past summer added a chapter to my story—a chance came to contribute toward the restoration of the historic Pluto telescope. The Lowell story will continue through dedication to preservation and research at the observatory, and in my own way I have now become a part of the place. I have literally stood in the footsteps of the same giants whose commitment and resolve came to make Lowell Observatory a uniquely personal place in the world of astronomy and in my own world, too. I will continue my work to keep the story going! 

## Astronomy Comedy

by Jury Judge  
(Retail Associate Briana Jameyson)



IAU NAMES PLUTO FEATURES  
Continued from page 16

Spacecraft were honored with Sputnik Planitia (a large plain named after the Soviet Union's Sputnik, the first space satellite), Voyager Terra (a large land mass honoring NASA's Voyager spacecraft, which carried out the first close-up survey of the giant planets Jupiter, Saturn, Uranus, and Neptune), and Hayabusa Terra, after the Japanese spacecraft that in the early 2000s performed the first asteroid sample return.

From mythology comes Sleipnir Fossa (after the Norse eight-legged horse), Adlivun Cavus (a deep depression named in honor of the Inuit underworld), Tartarus Dorsa (a ridge honoring the deepest pit of the underworld in Greek mythology), and Djanggawul Fossae (after the trio of Australian beings that created the landscape). 📧

# LOWELL42

Connecting You to Life,  
the Universe, and Everything

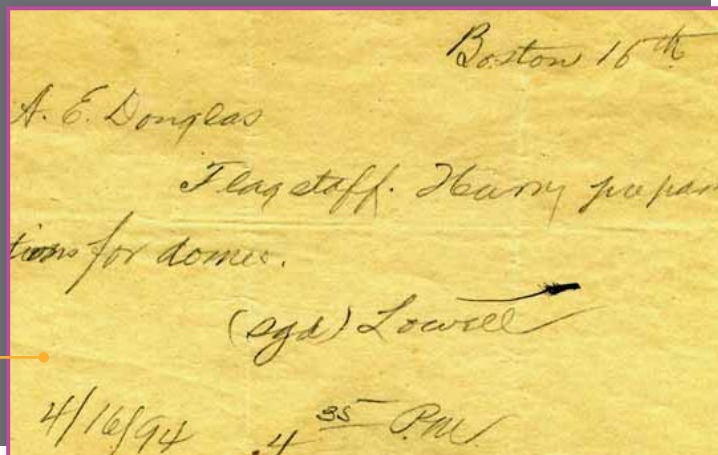
Science, art and culture come together in Lowell42, a new semi-monthly program that brings a cosmic perspective to some of life's biggest questions. Can we ever know everything? Are science and religion irreconcilable? How would the discovery of extraterrestrial life impact society? These are just some of the many thought-provoking topics addressed by Lowell42. The program takes its name from Douglas Adams' humorous science fiction series, *The Hitchhiker's Guide to the Galaxy*, in which a supercomputer concludes that the answer to "the Ultimate Question of Life, The Universe, and Everything" is, surprisingly, 42. "Astronomy compels the soul to look upwards and leads us from this world to another," Plato said. Join us as we explore the Big Questions that transcend space and time to better understand our place in the universe.

## Volunteers Digitize the Archives

Archives volunteers Rich Cornick, Helen Horstman, and Karen Kitt have been digitizing photos and documents for our digital collections. Rich digitized all of the letters between Percival Lowell and Andrew Douglass from 1894-1906, which includes Douglass' trip to the Arizona Territory to find a suitable site for an observatory. Rich is now creating metadata for the letters, and we will soon upload them to the Arizona Memory Project. Helen has digitized more than 5,000 photos of Lowell Observatory staff, buildings, telescopes, and events from the 1960s to the 2000s. Subjects include holiday parties, staff meetings, the Discovery Channel Telescope, the Steele Visitor Center, Percival Lowell's car, and more. Finally, Karen has digitized more than 1,000 of Carl Lampland's letters (see *The Lowell Observer* Issue 108). She is currently cataloging them for our website, and we will eventually add them to the Arizona Memory Project.

Our digital collections are available at <http://www2.lowell.edu/Research/library> and <http://azmemory.azlibrary.gov/cdm/lo>

This telegram from Percival Lowell to Andrew Douglass, dated April 16, 1894, is one of the many documents and photographs that archives volunteers have digitized for our online collections.



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

## 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.

**West, Michael J.; de Propriis, Roberto; Bremer, Malcolm N.; Phillipps, Steven (2017).** Ten billion years of brightest cluster galaxy alignments. *Nature Astronomy*, Volume 1, id. 0157.

Image: Neugent/Massey/Lowell Obs./NSF



## RECURRING EVENTS

**LOCKS Preschool** | **FEB 3 and Feb 17** (*Constellations: Constellations Change*) | **MAR 3 and MAR 17** (*Matter: Density*) | **APR 7 and APR 21** (*Earth: Seasons*) | 10:30 a.m. - Noon

**Meet an Astronomer** | **FEB 3, 10, 17, 24** | **MAR 3, 10, 17, 24, 31** | **APRIL 7, 14, 21, 28** | 7 - 10 p.m.

## FEBRUARY

### SAT 10 | Lowell42

(7 - 8 p.m.) "Your Brain on Astronomy" - Dr. Bill Sheehan

### WED 14 | Written in the Stars

(5 - 10 p.m.) Celebrate Valentine's Day at Lowell Observatory

## MARCH

### MON 5 | Community STEM Night

(5:30 - 7:30 p.m.) The 4th Annual Flagstaff Community STEM Celebration. Held at the NAU Skydome.

### SAT 10 | Pluto Telescope Grand Reopening

(1 - 3 p.m.) Members Only | (3 - 5 p.m.) Public Event

## APRIL

### SUN 22 | Lyrid Meteor Shower

(6 p.m.) Family-friendly meteor shower activities

(7 p.m.) Lecture about the source of the meteor shower and viewing tips

For more special event information visit:

[www.lowell.edu/outreach/special-events](http://www.lowell.edu/outreach/special-events)



Scan to go to [www.lowell.edu](http://www.lowell.edu)

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