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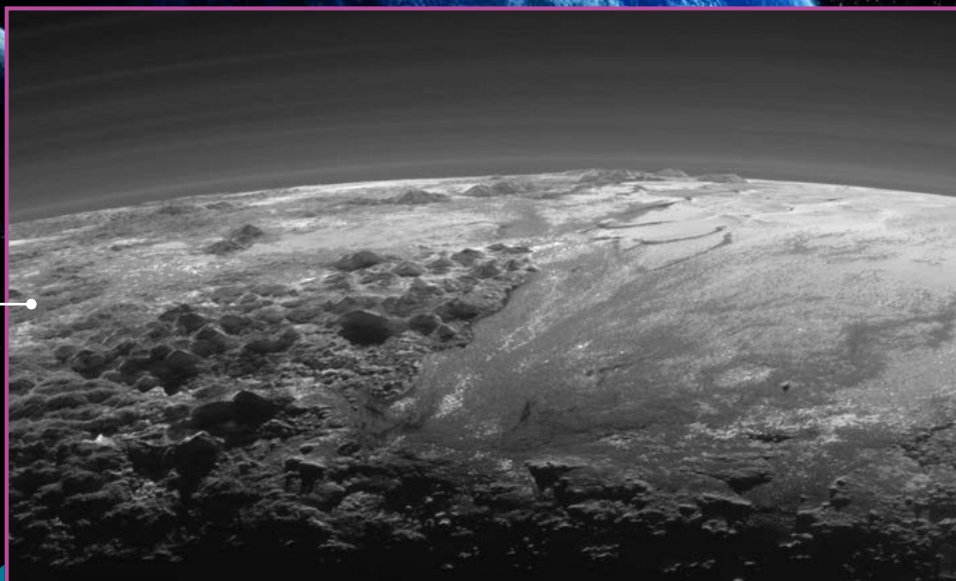
LOWELL OBSERVER

ISSUE 105 FALL 2015

THE QUARTERLY NEWSLETTER OF LOWELL OBSERVATORY

HOME OF PLUTO

Just 15 minutes after its closest approach to Pluto on July 14, 2015, NASA's *New Horizons* spacecraft looked back toward the Sun and captured a near-sunset view of the rugged, icy mountains and flat ice plains extending to Pluto's horizon. (NASA/JHUAPL/SwRI)



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New Horizons Unveils Pluto's Secrets

By Will Grundy

Astronomers can normally study distant objects only through their light, so a unique appeal of solar system science is the possibility to send spacecraft to study bodies in ways that could only be done up-close. Such spacecraft exploration isn't cheap, and competition is fierce over which missions should be flown. The opportunity to participate in one is a rare and cherished opportunity for a planetary scientist like myself. That's especially so for a first-ever encounter with a previously unexplored class of planet, as with *New Horizons'* spectacular Pluto system encounter in July.

And what a tremendous encounter it was! Millions across the globe were captivated by enigmatic Rorschach images that became progressively sharper as *New Horizons* approached, culminating in stunning and surreal imagery of Pluto's alien landscape, as in this edition's cover photo. Journalistic coverage was intense. NASA's web tracking soared way off the charts compared with anything they had ever previously seen. Social media crackled and buzzed with discussion, images, and

memes. Importantly, the focus remained almost entirely on the science, not hare-brained conspiracy theories or umbrage at off-the-cuff remarks of team members.

Pluto, the real star of the show, certainly rose to the occasion, revealing incredible complexities and stark beauty. But much about the encounter was attributable to the hard-working team who delivered Pluto to the world. How was this done, and what was it like being involved? The key was practice. During the years leading up to the encounter, we rehearsed just about everything you could imagine, from data-handling, to emergency decision making, to expressing

continued on page 4



See page 5 for more!

SPECIAL PLUTO SECTION



DIRECTOR'S UPDATE

By Jeffrey Hall

As part of the flyby of Pluto, NASA created the clever concept of Pluto Time, the time of day at a given location when the illumination equals that of midday on Pluto. You can explore this yourself at NASA's Pluto Time web page at <http://solarsystem.nasa.gov/plutotime/>.

Last July 13, I went down at Pluto Time to the overlook at the eastern edge of Mars Hill. It was a restless monsoon night, with purplish clouds and lightning in the distance and the amber, dark-sky-conscious lights of Flagstaff below. I tried to cast my mind three billion miles across space

to what was transpiring: at that very moment, a piano-sized spacecraft was zipping toward a world discovered right on the hill where I was standing, the field view of its instruments filled with vistas we all would soon see for the first time.

It gave me goosebumps. I felt tremendously proud of the Lowell team, which was playing a key role in the mission and doing an outstanding job of sharing the excitement with the thousands of guests visiting us that week. I also felt privileged, for surely Lowell Observatory was the most appropriate place in the world to see Pluto's secrets for the first time and to wait for the beep that all was well.

And assuming NASA extends the mission, we'll get a repeat on January 1, 2019, when we get our first close-up look at a Kuiper Belt Object.

New Horizons has done Lowell, science, and humanity proud. Sail on, you magnificent ship! 🐾



TRUSTEE'S UPDATE

By W. Lowell Putnam

As you can see in this issue, it has been a very busy year at the observatory! With the huge interest in Pluto, there has been a lot of coverage on Lowell about our history and current science around that planet. Lowell astronomers were involved with *New Horizons* and with other programs, as written here. Meanwhile our science staff was also continuing their

work in many other areas of astronomy, and you can look forward to hearing about it in future issues.

With the interest generated by the flyby and the hard work by the public program staff, we have had an incredible number of visitors up on Mars Hill. The re-opening of the Clark and the growth of programs like LOCKs will continue to see an increase in visitors and, hopefully, more of them will become Friends of the Observatory.

We have a mission from our founder to do good science and to support it over the years. This year has shown the worth of that approach as Lowell is the only institution that was there at the discovery of Pluto and at the first mission to that world. We also have a mission to describe all of this to people in a way that engages and excites them. I want to thank the staff for being so good at both and continuing this commitment into the future. 🐾

Pluto: Brighter Than You Think
<http://solarsystem.nasa.gov/plutotime/>



Join the Percival Lowell Society

When Percival Lowell died in 1916, he set aside funds from his estate to help support the observatory's operating expenses. In these times of reduced government grants for science and preservation, support from our Friends through bequests will continue to sustain the observatory for our next 100 years. In support of our founder's vision and foresight, we created the Percival Lowell Society in 2002 to recognize individuals who make planned gifts to Lowell Observatory. By including Lowell in your estate plans, you help ensure that our mission of astronomical discovery, education and outreach continues in perpetuity. The Percival Lowell Society recognizes those generous Friends who plan to leave a legacy through their will, IRA, Charitable Gift Annuity, and other arrangements. Please let us know if you're already a PLS member or if you'd like to become one! Call Antoinette Beiser at (928) 255-0186.

Drew Barringer and Clare Schneider, long-time supporters of Lowell Observatory, recently became members of the Percival Lowell Society. Drew is president of the Barringer Crater Company and serves on the executive committee of Lowell's advisory board. Clare is employed by Magnitude Software in London where she, Drew and their loyal pup, Hotshot, have resided for the past 3 years. Their planned gift ensures our continuing success! Thank you!



Paranal Observatory, shown here in 1999, is located on the mountains of Cerro Paranal in the Atacama Desert of northern Chile at an altitude of 2,635 meters. Far from city lights, high above sea level, with more than 350 cloudless days each year, Atacama Desert is an ideal location for ground-based astronomy. (ESO)

Bound for Chile!

By Lisa Actor


Director Jeff Hall invites Director's Opportunity Network (DON) members to tour the Paranal Observatory above the Atacama Desert of Chile in Fall 2016. Deputy Director for Science, Dr. Michael West, will lead the excursion to the facility operated by the European Southern Observatory (ESO), where he served as Head of Science for seven years.

ESO is a consortium of 15 European nations plus Brazil and Chile. Paranal Observatory operates ESO's flagship instrument, the Very Large Telescope (VLT), which consists of four separate telescopes, each with a mirror eight meters in diameter.

"The trip to Paranal Observatory will be the first of many Lowell Observatory excursions to foreign observatories," said Dr. Hall.

DON members contribute at least \$10,000 annually to Dr. Hall to support a variety of opportunities that arise at Lowell Observatory. In Summer 2015, DON dollars funded a graduate intern to assist Dr. Lisa Prato's studies of very young binary stars. The research experience offered a promising NAU astronomy graduate the opportunity to expand her academic portfolio for graduate school admission.

"I expect to use DON funds for a wide range of efforts in support of our mission, including research, technology, education, and outreach," said Dr. Hall.

For more information about DON membership or the 2016 Chile trip, contact Lisa Actor at lactor@lowell.edu or (928) 255-5047. 



Volunteer Highlight

Anne Robison has been a valuable asset since she started volunteering for the development department in July.

Anne aids our efforts by mailing membership cards, packaging donor perks, and much more. Meeting new people was on the top of Anne's list when asked why she likes volunteering. When she isn't helping out at Lowell, she rides motorcycles and works on her art. She has been a freelance artist her entire life, making art out of recycled items such as glass and old albums. We're lucky to have her on our team!

— Shannon Gonzales

Pluto Circle Members Celebrate Flyby

On July 14, 2015 Lowell Observatory's members at the Pluto level and above gathered for a champagne reception to celebrate NASA's *New Horizons* as it flew by Pluto. Guests at the Trustee's residence eagerly listened for *New Horizons*' "phone home" beep. It was a great moment in the history of Lowell Observatory as we watched, with the world, the excitement unfold. Thornager's Catering served appetizers with beverages donated by Nackard Distributors. Lowell Observatory events for the Year of Pluto were made possible by APS. — Mica Gratton

While Will Grundy and several other staff members at the *New Horizons* mission control center in Maryland waited for confirmation that the spacecraft reached Pluto, other staff and VIPs shared the same exhilaration just 100 yards from where Pluto was discovered at Lowell.



NEW HORIZONS UNVEILS PLUTO'S SECRETS
continued from page 1



ELLIOT SEVERN / AMERICASPACE

Will Grundy (right) and *New Horizons* principal investigator Alan Stern (left) celebrate *New Horizons*' arrival at Pluto by holding a poster of the 1991 U.S. postage stamp of Pluto, with the words "not yet" crossed out. (Elliot Severn/AmericaSpace)

scientific results in press release prose. We even brought in a specialist to teach the team about sleep physiology. Good thing, too! The hours were extreme, with meetings starting as early as 6 a.m. and running through 11 p.m., even on weekends. Our base during June and July was the Applied Physics Laboratory in Maryland. We were organized into four science theme teams, focusing on the space environment, atmospheres, geology and geophysics, and surface compositions. I led the composition team. After so many years of preparation, everyone was eager to do their part. We had to pace ourselves to stay sharp, planning ahead who would do what as each new data set arrived. This

inevitably produced moments of regret when an interview or planning meeting put me elsewhere right when my team was making exciting new discoveries. What mattered was processing the data and communicating results. I couldn't be happier about how the composition team performed.

Now, months after the encounter, you'd think things would be tapering off. Not yet! Team members are all busy as ever giving public talks, writing papers, and preparing presentations for scientific conferences. The spacecraft's memory banks are packed with precious data that will take an entire year to downlink. Naturally, top priority observations get transmitted first. Gems like the cover image keep arriving, feeding numerous discoveries and a weekly press release cycle that has been almost as intense for the team as the encounter itself had been. **E**

Education On Board SOFIA

Lowell curator Samantha Thompson recently flew aboard NASA's airborne telescope, SOFIA (Stratospheric Observatory for Infrared Astronomy) and she plans to incorporate what she learned into a new STEM-themed exhibit for display at Lowell and other locations in Northern Arizona.

Thompson teamed with Flagstaff teacher Rich Krueger as part of NASA's Airborne Astronomy Ambassador program, an effort to increase scientific literacy. Each year, a select group of educator teams are chosen to help fulfill this mission; in 2015, the Thompson/Krueger team was one of only 14 selected out of some six dozen applicants.

To fulfill an ambassador program requirement of engaging the public, Thompson and Krueger plan to build a replica of SOFIA that will include a full-scale mock-up of the main cabin, with stations for each of the main areas of operations (science, telescope operations, mission control, and education).

— Kevin Schindler

Rich Krueger of the Flagstaff Arts and Leadership Academy and Lowell's Samantha Thompson sit at the educator console aboard SOFIA on August 31.



Talking Historic Telescopes

In October, Ralph Nye and Kevin Schindler attended the Antique Telescope Society's annual meeting at Lick Observatory in California. Nye, shown here, presented programs about the renovation of the Clark Telescope and his own 9-inch Brashear instrument. Schindler spoke about the history of the Clark and also discussed Lowell's legacy of instrument building, including a tribute to Nye's 40 years of contributions at Lowell.





Lowell Scientists Observe Pluto Occultation

By Amanda Bosh

On June 29, astronomers from Lowell Observatory, MIT, UCLA, and the University of Stuttgart watched an occultation of Pluto from an altitude of 39,000 feet in the skies south of New Zealand using SOFIA (the Stratospheric Observatory for Infrared Astronomy). At the same time, other astronomers observed the event from sites across New Zealand and Australia. Our mission was to gather data to get a better understanding of how Pluto's atmosphere changes as it gets further from the Sun.

Getting an airborne observatory into the exact center of Pluto's shadow required a lot of teamwork. For the week before the occultation event, in a room in Lowell's Slipher Building temporarily appropriated and renamed "Pluto Occultation Mission Control" (fittingly, just across the hall from

what was Clyde Tombaugh's office), Carlos Zuluaga (MIT) and I worked late into the night analyzing data taken by colleagues and students at Lowell's Hall and Discovery Channel telescopes, the Naval Observatory's 1.55-meter Strand Telescope, and the 24-inch SARA telescope on Cerro Tololo, Chile. We turned these critical data into updated prediction paths and relayed this information to SOFIA flight planners who were already in Christchurch, New Zealand and refining nightly mission plans.

Aboard SOFIA, Michael Person (MIT) coordinated with the three instrument teams who would be collecting data during the event. Lowell's Ted Dunham, Tom Bida, and Peter Collins were all aboard to ensure that one of these instruments, HIPO (a dual channel, high-speed occultation camera built at Lowell) performed well during this event.

Part of the Pluto occultation team, front row (left to right): Stephen Levine (Lowell), Thanawuth Thanathibodee (MIT), Luke Weisenbach (MIT), Hugh Harris (NOFS), Peter Collins (Lowell); back row (left to right): Amanda Bosh (MIT/Lowell), Steph Sallum (Steward Observatory), Ted Dunham (Lowell), Carlos Zuluaga (MIT)

While SOFIA was flying above the clouds, many teams—including Lowell astronomers—were on the ground in New Zealand and Australia, hoping for a clearing of the weather so they could observe this event. Stephen Levine was in New Zealand at the Mt. John University Observatory, using a special infrared camera lent by Henry Roe. Larry Wasserman was also in New Zealand to observe this event.

About five hours before the occultation time, while SOFIA was already in the air, we made last-minute calculations to conclude that SOFIA needed to change course by more than 300 kilometers (185 miles). We emailed this information to the SOFIA flight crew and they modified the course accordingly. The result of this maneuvering was our observation of the central flash, a temporary brightening of the star when it is still behind the planet, due to focusing of the starlight by the planet's atmosphere. Central flashes are sought after by occultation observers because they reveal the structure of the lower atmosphere that is normally not seen during an occultation.

Our analysis of these data is continuing, but we have already learned a great deal about Pluto's atmosphere as a result of this expedition. 📍



Pluto at 85: From Discovery to New Horizons

After a wonderful six months with the NASA-loaned Science on a Sphere on display, its departure has provided room to showcase more items from Lowell Observatory's extensive Pluto collection. Come visit the Pluto at 85 exhibit, made possible with a major gift from Exodyne, Inc. and the support of others. Learn how our view of Pluto has changed over time, see various name suggestions that reveal how Pluto became a symbol of optimism amidst the global economic uncertainty of the 1930s, and examine items collected by Dr. Will Grundy during flyby week at New Horizons mission headquarters in Maryland. — *Samantha Thompson*

Artist Keith Boulger created this Pluto globe with the first close-up images released by New Horizons. More recent images are also on display in the newly updated Pluto at 85 exhibit. (*Gerald Lamb/Lowell Obs.*)

Lowell educators demonstrating the "Pluto Salute" (nine fingers indicates the classic nine planets) in the Pluto dome. Left to right (back row): Samantha Flagg, Jim Cole, Emily Bevins; (middle group): Kelly Ferguson, Justin Ringle, Kelsey Banister; (front): Kevin White.

By Kelly Ferguson

July 14, 2015. 5:53 p.m. – Arizona time. It's when NASA's *New Horizons* mission was to send a signal back to Earth, after closest approach, to confirm the safety and future of the little spacecraft that could. And it was late.

The entire month of July was an exciting time for anyone in the know about Pluto. From July 11 - 20, Lowell Observatory hosted Pluto Palooza, a nine day extravaganza full of fun and frivolity celebrating our planet. That first day was a bit chaotic and nobody was ready for the sheer number of people about to pour through the front doors. Despite this, the educators in the public program were extremely excited to share their love of Pluto.

Skipping ahead to the morning of July 14: *New Horizons* had already reached closest approach and all we could do was wait to hear back. Guests were lining up at the front gate well before we opened and you could feel excitement and anticipation in the air. Despite this, the morning was uneventful; aside from the fact we had record numbers in attendance. However, by 5 p.m., everyone was restless again. Activities and telescopes were left abandoned as nearly a thousand people gathered around televisions and radios



Lowell Hosts Pluto Palooza

all over the observatory. I sat quietly with friends and colleagues as the seconds ticked closer. Minutes before the signal, fellow educators Haley DeLong and Shy Dustrud grabbed both my hands and squeezed tight. The scheduled time came and went without a peep and we began to nervously wonder what could possibly delay such a moment. Before any of us could voice our concern, the Mission Operations Manager confirmed the spacecraft had flown within 7,800 miles of Pluto and survived. Cheers exploded from the over-capacity audience in the Giclas Lecture Hall while embraces were shared between friends and strangers alike. Misty-eyed and grinning ear to ear, I walked out of the building silently congratulating myself for not weeping in front of everyone. However, another

educator, and my best friend, Justin Ringle, had something else in mind. He made a beeline to where I was standing and hugged me tight while chanting "We did it! We did it!" On any day besides this one, a scene like that would have looked strange. But this day, it was happening all across the observatory. When he finally let go, both of us were wiping away tears as the news really sunk in. We did it.

The *New Horizons* mission was the capstone of almost half a century of planetary reconnaissance. We all are looking forward to the coming adventures in which we as humans and scientists are charged with asking the next greatest questions about our universe, our solar system, and, ultimately ourselves. Next stop, 2014 MU₆₉! 🍷

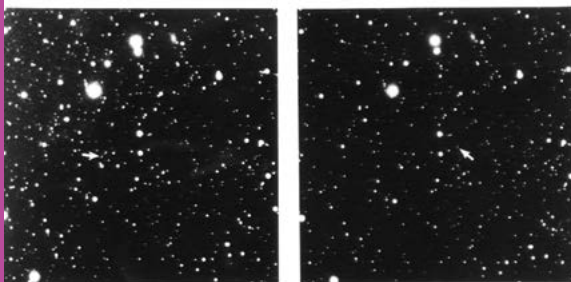
Pluto Through the Years - The evolving view of Pluto after its discovery at Lowell Observatory 85 years ago.

Jan 29, 1930: Clyde Tombaugh discovers Pluto at Lowell Observatory. (*Lowell Obs. Archives*)

June 22, 1978: Jim Christy discovers Pluto's first moon, Charon, while looking for binary stars at the U.S. Naval Observatory in Flagstaff, AZ (*USNO*)

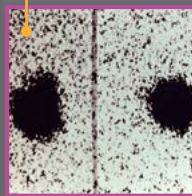
March 11, 1996: The first photo of Pluto based on direct images from the Hubble Space Telescope. (*A. Stern (SwRI)/M. Buie (Lowell Obs.)/NASA/ESA*)

DISCOVERY OF THE PLANET PLUTO

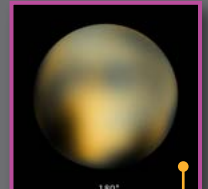
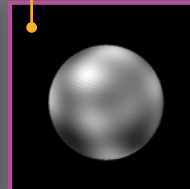
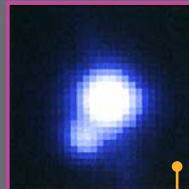


January 23, 1930

January 29, 1930



1990: The best ground-based image of Pluto and Charon taken with the Canada-France-Hawaii Telescope. (*CFHT*)



2002-2003: The first color photo of Pluto constructed from multiple images taken by the Hubble Space Telescope. (*NASA/ESA/M. Buie (SwRI)*)



Will Grundy is shown on a video screen as he answers a question during a July 15 press conference at the Applied Physics Laboratory in Maryland.

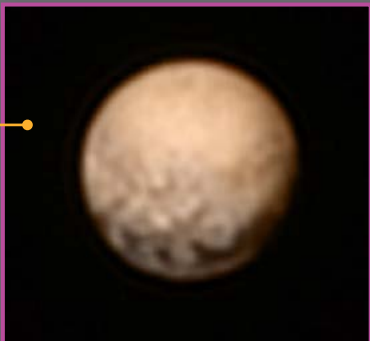


The Giclas Lecture Hall was packed in anticipation for the signal that *New Horizons* had survived its journey to Pluto. Visitors and observatory staff members alike shared in the excitement.



New Horizons captured this high-resolution enhanced color view of Pluto's moon Charon just before closest approach. (NASA/JHUAPL/SwRI)

July 3, 2015: With *New Horizons* only 7,800,000 miles away from Pluto, the spacecraft's Long Range Reconnaissance Imager (LORRI) captured this image. (NASA/JHUAPL/SwRI)



July 14, 2015: *New Horizons* became the first spacecraft to visit Pluto when it flew just 12,500 kilometers (roughly 8,000 miles) above its surface. New images revealing a detailed landscape provide a view of Pluto most people could never have imagined. (NASA/JHUAPL/SwRI)

Lowell Well Represented at Pluto Flyby Headquarters

Donning Pluto hats during a July 14 press interview at the Applied Physics Laboratory are (left to right): Lowell Observatory Sole Trustee Lowell Putnam, former Lowell astronomer Marc Buie, former Lowell post-doc Simon Porter, former Lowell astronomer Cathy Olkin and current Lowell scientist Will Grundy.

By Kevin Schindler

Lowell Observatory—past, present and future—was prominent at the July Pluto flyby festivities at the Applied Physics Laboratory (APL) in Laurel, Maryland. Current Lowell planetary scientist Will Grundy was front and center as the leader of the *New Horizons* surface composition team, and he was joined by many other people with Lowell ties that date back to founder Percival Lowell. This strong representation was a great reminder of the observatory's bond with Pluto, one whose length and breadth continues to justify the sentiment that Pluto is Lowell Observatory's planet.

Back in 1905 Percival Lowell began a search for a theoretical ninth planet that culminated 25 years later with Clyde Tombaugh's discovery of Pluto at Lowell's observatory. One hundred and ten years after that search began, Lowell's great grandnephew (Sole Trustee Lowell Putnam) and great-great-grandniece (Flynn Vickowski) headed to Laurel to represent the Lowell family and his observatory. Meanwhile, Tombaugh's two children, Annette and Alden, traveled from New Mexico to take part in the festivities.

They enjoyed watching the observatory's modern era of Plutophiles play a prominent



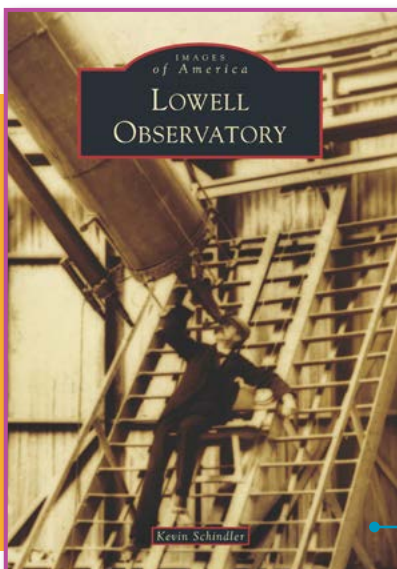
role in turning the dot discovered by Tombaugh into a real world. Former observatory astronomers John Spencer, Cathy Olkin, and Marc Buie, along with recent Lowell post-doc Simon Porter—all now working at the Southwest Research Institute in Boulder—added to the distinctive Lowell identity, as did the presence of current Deputy Director for Technology Stephen Levine and adjunct astronomer Amanda Bosh. Advisory Board member John Menke and his wife, Meg, even participated.

Then, of course, there was Grundy, who balanced his time during this frenetic week between analyzing incoming data and explaining mission highlights to the two hundred media representatives who flocked to the mission's operations center at APL.

As *New Horizons* gathered so-called fail-safe data just before closest approach (in the event the spacecraft was destroyed by

impacting a previously undetected moon while approaching Pluto, the mission wouldn't have been a total loss), Grundy could really start looking at some exciting data, though this would serve merely as a warm-up for the closest approach data that will stream back to Earth over the next year and a half. From this fail-safe data, Grundy and his team created preliminary but nonetheless breathtaking false-color images of Pluto and Charon showcasing variations in surface material and features of each body.

Grundy spent a lot of time during flyby week speaking with reporters from around the world, explaining mission activities and interpreting incoming data. While he will continue to handle some number of interviews, he has since been able to turn most of his focus back to data analysis, continuing to build the legacy of "Lowell Observatory's planet." 📧



Images of America Book Coming in 2016

Pluto will be featured in a new Images of America book, *Lowell Observatory*. Published by Arcadia Press, the Images of America series celebrates the history of towns, neighborhoods, and other places of interest. With more than 200 pictures from Lowell archives and other sources, this new book highlights several important themes from Lowell's past, including the Lowell and Putnam families, the 1894 Site Testing Expedition to Arizona, Pluto and other significant research, and much more. Publication is set for February, 2016 and copies will be available in Lowell's Starry Skies Shop.

The cover of this new book features an image of Percival Lowell observing through the Clark Telescope while the instrument was in Mexico.



First Day Jitters

By Marie Schimmelpenninck

As the *New Horizons* Pluto flyby approached in July, I was looking back at my thirteen years as a daytime volunteer leading tours of Lowell's historic campus, sharing views of the Sun with visitors and remembering the many fun interactions I have had with people who have come from all over the world to learn about Lowell history and current research.

My initial presentation is memorable—first day jitters took hold. My husband and mother-in-law were among the interested audience, eager to learn about Percival Lowell's observations of the Martian surface, such as the linear features (*canali*) and polar ice-caps.

Explaining Lowell's idea that life might have been possible on Mars got the audience excited, but I needed to tell them the scientific truth! Risking traumatizing children and adults, I took a deep breath and announced: "Well, we all know now that there is no life on EARTH." A lot of nodding heads. Smiling faces, some laughter. No crying children. I held my breath.

"What did I say?" I asked.

Then we all laughed, and headed off on our tour, walking in the footsteps of Percival Lowell and Clyde Tombaugh and learning about the fascinating research that is going on today at Lowell Observatory. ☺

Marie Schimmelpenninck has been volunteering at Lowell for more than a dozen years, leading daytime campus tours and showing visitors the Sun through our specially filtered solar telescopes. She has welcomed thousands of guests during her time at Lowell and her tours are quite popular and well attended.



Latest DCT Image

Recent Lowell post-doc Joe Llama captured this picture of the Crab Nebula (M1) in early October using the Large Monolithic Imager on Lowell's Discovery Channel Telescope.

M1 is a supernova remnant in the constellation Taurus and located at a distance of about 6,500 light years from Earth. It was first recorded in 1731 but corresponds to a supernova observed by Chinese sky watchers in 1054. (Joe Llama/Lowell Observatory/NSF)



Volunteers Play Critical Role in Archives

Volunteers Katy Harding (pictured), Winston Fredrickson, John and Linda Spahn, and Lori Lombardi spent the summer assisting with the move to the Putnam Collection Center (PCC) by preparing materials for the freezer and shelving them in the repository. In addition to moving the papers of former Director Robert Millis from the Slipper Building basement to the PCC, we hauled several dozen sets of *Annals of the Lowell Observatory* and other books and publications. We are making great progress on the move with the assistance of our dedicated volunteers. — Lauren Amundson

Lowell's volunteers support observatory operations in a variety of ways. If you would like to join the Lowell team as a volunteer, please contact Mary DeMuth at demuth@lowell.edu.

The Season of Giving

At this time of year we ask for your support to continue Percival Lowell's legacy of discovery and outreach.

Thank you to all of our members and donors who have given past gifts to sustain this unique and special place. Your contributions truly make a difference!

Annual Fund donations support STEM-based camps for kids and other outreach efforts that inspire future generations of scientists. Your donations to Lowell Observatory also support our innovative exhibitions that educate, entertain, and inspire more than 80,000 visitors each year, including 12,000 school children.

Donations also fund cutting-edge astronomical discoveries using our world-class 4.3-meter telescope. Just like the farm boy from Illinois named Clyde Tombaugh who discovered Pluto at Lowell Observatory in 1930, Lowell astronomers continue to make new discoveries.

2015 has been an amazing year for Lowell Observatory, and with your help 2016 can be just as exciting. Please support our Annual Fund.

Thank you for your generous gifts!



Lowell Observatory Camps for Kids (LOCKS) is one of the many programs funded with your donations.

We now accept recurring monthly gifts through our website. Recurring donations are the best way to give steady support throughout the year.

Giving Options

Mail Payment To:

Lowell Observatory
Attn: Mica Gratton
1400 West Mars Hill Road
Flagstaff, AZ 86001

Call:

Mica Gratton
(928) 255-0229

Or Visit Our Website:

www.lowell.edu/donate

Recent Publications



See our website:
www.lowell.edu/research/recent-publications

for more 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.

Massey, Philip; Neugent, Kathryn F.; Morrell, Nidia (2015). A Modern Search for Wolf-Rayet Stars in the Magellanic Clouds. II. A Second Year of Discoveries. *The Astrophysical Journal*, Volume 807, Issue 1, article id. 81

Image: Neugent/Massey/Lowell Obs./NSF



Lowell Awarded Art & Science Fund Grant

In July, the Flagstaff Arts Council announced recipients of its 2015-16 Art & Science Fund grant program. Total monies awarded added up to \$248,700, split among thirty-three Flagstaff non-profit organizations that produce arts, culture and/or science programs. Lowell led all recipients with an award of \$29,000, which will be used to support general operations in the public program. Art & Science Fund grants are funded entirely through a portion of the City of Flagstaff's Bed, Board and Beverage (BBB) revenues.



LOWELL OBSERVATORY Camps for Kids (LOCKS)

In last month's issue of the *Lowell Observer*, we reviewed this summer's successful Lowell Observatory Camps for Kids (LOCKS) programs. Major donors to this program in 2015 are: W. L. Gore & Associates, the Leo & Rhea Fay Fruhman Foundation, the Arizona Community Foundation, the Geofund, Don Paul, and Tom Ensign.



Clark Telescope Renovation is Completed

By Kevin Schindler

Lowell Observatory's iconic Clark Telescope has returned to action after a 20-month renovation project. Staff reopened the facility for daytime tours in September and evening viewing in October.

The Clark has been a mainstay of the visitor experience to Lowell for decades, but the continual heavy use wore out its parts. By 2013, the instrument was in danger of permanent damage if corrective measures weren't taken, so the observatory began a fundraising campaign to support a complete renovation of the telescope and the dome.

Led by major donations from philanthropists Joe Orr and the Toomey Foundation for the Natural Sciences, an online crowdfunding effort, support from the City of Flagstaff and Flagstaff Arts Council, and contributions from a variety

of groups and individuals, the observatory raised nearly \$300,000 to complete the work.

Lowell's Director of Technical Services, Ralph Nye, led a renovation team that included Peter Rosenthal, Glen Hill, Jeff Gehring, and Dave Shuck. Their goal was two-fold: return the facility to proper working order and turn both the telescope and dome into stunning showpieces.

They closed the Clark in January 2014 and would ultimately examine every part of the telescope and dome, from the largest mount element to the smallest screw. The team removed the entire telescope and mount, in segments, through the shutters in the dome's roof. They repaired or replaced components as needed, and reassembled the instrument in the dome. The most significant work involved

Longtime Lowell docent Richard Bohner took this picture of the Clark Telescope as the renovation project neared completion. The resurfaced and polished Clark and associated telescopes shine brightly against the backdrop of the dome ceiling, which was reinforced to ensure its long-term stability.

replacing the telescope's main bearing, which supports the weight of the entire instrument and enables it to move.

Observatory founder Percival Lowell commissioned the eminent optician and telescope maker, Alvan G. Clark, to build the Clark in 1896. The final product cost Lowell \$20,000 and has been declared by astronomers as one of the best refracting telescopes ever made.

For decades, the telescope was used for major research projects, including Percival Lowell's controversial studies of Mars, V.M. Slipher's first detection of the expanding nature of the universe, and mapping of the moon for the Apollo program by teams of artists and scientists. It played a secondary role in the discovery of Pluto and was used by astronauts as they trained for their moon missions.

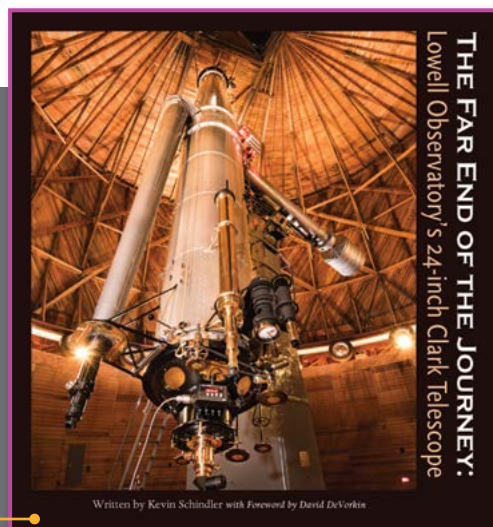
In recent decades, the Clark had been used for the observatory's public programs, allowing some 80,000 guests each year to tour it during the day and view through it at night.

To celebrate the Clark's return to operation, the observatory hired filmmaker Ed George to create a documentary about the renovation project. Lowell is also preparing a coffee table book highlighting the telescope's history and significance (see more about this below). Both book and film are expected to be finished in December. 📺

The Far End of the Journey

To celebrate the renovation and reopening of the Clark Telescope, we are releasing a new coffee table book about this venerable old instrument. Packed with more than 300 images, this book highlights the illustrious history of the Clark, from its construction and early use in Mexico to important research projects such as V.M. Slipher's recessional velocity work, Percival Lowell's Mars studies, and moon mapping in the 1960s. The final chapter covers the recently completed, 20-month-long renovation project that has the telescope working—and looking—better than ever. This book was made possible by a generous donation from Susanne Durling.

Release of this new book is scheduled for December and copies will be available in Lowell's Starry Skies Shop. The cover image was taken by Flagstaff photographer Dawn Kish.



THE FAR END OF THE JOURNEY:
Lowell Observatory's 24-inch Clark Telescope

Written by Kevin Schindler with Foreword by David DeVorkin

ISSUE 105 FALL 2015

THE LOWELL OBSERVER

UPCOMING SPECIAL EVENTS

OPEN YEAR-ROUND

Monday - Saturday: 10:00 a.m. - 10:00 pm.
Sunday: 10:00 a.m. - 5:00 p.m.

Holiday Hours: Closed after 5 p.m. November 25,
 Open until 10 p.m. January 17
Closed: November 26, December 24-25, January 1

RECURRING EVENTS

2nd Friday Science Night | **NOV 13** (*Air Pressure and Fluid Dynamics*),
DEC 11 (*Energy and Thermodynamics*), **JAN 8** (*Mechanics*)
 Shows at 6, 7, and 8 p.m.

School is Out and Kids are Free | **WED NOV 11, MON JAN 18** | 10 a.m.- 5 p.m. | *Free admission for kids 17 and under until 5 p.m.*

NOVEMBER

TUE 17 | Leonid Meteor Shower
 (6 and 8 p.m.) *Family-friendly meteor shower activities*
 (7 p.m.) *Lecture about the source of the meteor shower and viewing tips*

SAT 21 | Coconino Astronomical Society Monthly Meeting
 (6:45 - 8 p.m.) *Dr. Will Grundy (Lowell Observatory) - Early Results from the New Horizons Pluto Encounter* | **FREE**

DECEMBER

1-5, 7-10, 14-19, 21-23 | Star of Bethlehem Program
 (7 p.m. Daily) *Program explores various astronomical interpretations of the Star of Bethlehem.*

SAT 12 | Geminid Meteor Shower
 (6 and 8 p.m.) *Family-friendly meteor shower activities*
 (7 p.m.) *Lecture about the source of the meteor shower and viewing tips*

JANUARY

SAT 2 | Quadrantid Meteor Shower
 (6 and 8 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

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