

THE LOWELL OBSERVER

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THE QUARTERLY NEWSLETTER OF LOWELL OBSERVATORY

CELEBRATING 125 YEARS

COVID-19 STATUS

As of June 2020, the Lowell Observatory visitor program remains closed to deter the spread of coronavirus (COVID-19). For updates see lowell.edu/coronavirus or follow us on social media.

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New Agreement with Discovery, Inc.

By Kevin Schindler, Historian

As part of a new agreement between Lowell Observatory and Discovery, Inc., the 4.3-meter Discovery Channel Telescope at Lowell Observatory has been renamed the Lowell Discovery Telescope. The agreement also calls for renewed collaboration in science programming and publicity between the two organizations to highlight the astronomical research and public outreach undertaken at Lowell.

Lowell Observatory first entered into an agreement in 2003 with what was then Discovery Communications. At that time, Discovery donated a \$10 million capital gift for building what was initially named the Discovery Channel Telescope at Lowell Observatory. Construction of this instrument

began in 2004 and was completed in 2012 at a total cost of \$53 million. As part of that agreement, Discovery would create educational programming, such as its 2012 documentary called *Scanning the Skies*, which highlights the telescope's development from site selection to first observations.

After this initial agreement expired in 2017, Lowell and Discovery worked together to create a new agreement, one in which the two organizations committed to collaboratively communicate astronomy and planetary science to the public. Lowell Observatory Director Jeff Hall said, "Discovery and Lowell have a powerful opportunity to combine rigorously

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Dimming of Betelgeuse Likely Due to Dust

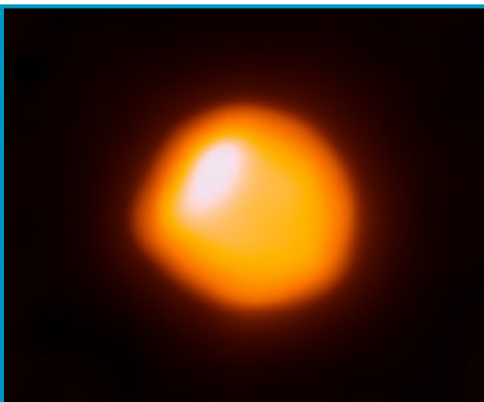
By James Urton, University of Washington

Late last year, news broke that the star Betelgeuse was fading significantly, ultimately dropping to around 40% of its usual brightness. The activity fueled popular speculation that the red supergiant would soon explode as a massive supernova. But astronomers have more benign theories to explain the star's dimming behavior. And scientists at the University of Washington and

Lowell Observatory believe they have support for one of them: Betelgeuse isn't dimming because it's about to explode—it's just dusty.

In a paper just published in the *Astrophysical Journal Letters*, Emily Levesque, a UW associate professor of astronomy, and Lowell Observatory's Phil Massey report that observations of Betelgeuse taken February 14

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DIRECTOR'S UPDATE

By Jeffrey Hall

A cursory glance at the Mars Hill campus would have you think everything came crashing to a halt on Percival Lowell's birthday, March 13, when we closed our outreach programs and sent the staff home ahead of the looming pandemic. A closer look reveals a different picture. We've seen a steady stream of papers and new grants from the research faculty, working effectively from their home offices. We've transitioned our outreach programs into a much more vigorous online effort—something we'd long intended to do but never gotten around to until the enforced reset. After initial shutdowns, the Lowell Discovery Telescope,

the Navy Precision Optical Interferometer, and our other telescopes at Anderson Mesa are up and running. Exhibit content for the Astronomy Discovery Center has proceeded apace, as has a fair amount of outdoor construction prep for the ADC and on other parts of campus. As you see in the picture below, the fantastic new Brian Dyer 24" PlaneWave telescope is ready to provide spectacular views of the Universe. The bills have been paid, generous gifts have continued to stream in from our wonderful supporters, and the grounds team has kept Mars Hill looking beautiful. And we've been developing a whole new set of program plans for when we can welcome visitors back to campus.

All this is thanks to the resilience, dedication, and creativity of our staff, who have done a superb job making the best of a ghastly situation. Thanks to them, when we emerge from the present chaos, we'll be up and running stronger than ever. 🍷



TRUSTEE'S UPDATE

By W. Lowell Putnam

There is the old expression about how you can't keep a good person down. The events of the past few months have certainly shown that you can't keep a good observatory team down. As you will see throughout this issue, our science staff has continued to produce great research and our public program staff have pivoted quickly to the production of more online and live-streamed events. While we miss visitors on Mars Hill enjoying the exhibits and telescopes, our grounds team is taking advantage of their absence to improve the areas that get the most traffic.

Percival very much enjoyed engaging with the

general public about science and the past decade of steady increases in visitation show that there is a growing appetite for science in our population. It was a hard decision to shut down the campus, well before any governmental orders. But great experiences start first with being, and feeling, safe. Without that, the great conversations and transformational moments just do not occur. We will always work to create a great, and safe, environment for everyone who comes here.

I am also very much humbled and grateful for the continuing support that has come in during this period. It shows me that working hard to do the "right thing" is appreciated and rewarded. So my thanks to you for your help to the Observatory and we look forward to seeing you back on Mars Hill in the months to come. 🍷



Master Plan Update

By Dave Sawyer, Technical Project Manager

Despite the impacts from the COVID-19 global pandemic, we have been fortunate to be able to continue working on various campus expansion projects this spring. With funding secured, we have proceeded with the Astronomy Discovery Center (ADC) design and continue to advance it through the City planning process with the expectation that we will begin construction of the building in April 2021. In addition, since construction workers are exempt from the stay at home orders, we were able to start groundwork for the ADC utility extensions and road access drive modifications as well as installation of a new concrete walkway, embedded with glowing stones, from the Slipher plaza around the GODO and up to the Pluto discovery telescope. Up on the east ridge, the shiny new Brian Dyer 24" telescope was installed and has achieved first light (see inset photo)! Currently, efforts are underway to upgrade lighting in the dome, automate the dome control, and paint interior surfaces to further enhance the visitor experience.

The new Brian Dyer 24" Planewave Telescope replaces the John McAllister 16" Boller & Chivens for public viewing.

2019 Employee and Team of the Year

By Madison Mooney, Content Marketing Specialist

Hannah Rounds' selection as Employee of the Year comes after a five-year tenure at Lowell Observatory, during which she was promoted from Development Assistant, to Grant Writer, and finally, to Corporate and Foundation Relations Manager. Hannah employs her excellent writing skills to craft winning grant proposals that reflect the needs of the organization and appeal to the interests of prospective donor foundations and corporations. She has often been praised for her ability to remain calm under pressure and juggle multiple commitments under tight deadlines with ease.

Lowell Observatory's Snow Removal Team is responsible for keeping the

observatory up and running in snowy conditions. They begin shoveling, plowing, and distributing cinders on Mars Hill well before the observatory opens to the public, ensuring the safety of Lowell employees and visitors alike. The Snow Removal Team is made up of staff members from various Lowell teams—even director Jeff Hall has participated in snow removal on multiple occasions. 📧

Hannah Rounds' combination of a good-natured personality and excellent technical skills makes her a key member of the Lowell team.

Credit: Sarah Gilbert



New Dual Membership

We have introduced a new membership level in 2020 for those who do not fit into either the individual or the family membership categories. The dual membership allows admission for up to two adults per visit. Check the Lowell Observatory website for more details about this and other membership levels and their benefits at lowell.edu/membership.

Honolulu AAS Meeting

By Kevin Schindler, Historian

The Winter 2020 meeting of the American Astronomical Society (AAS) saw a record attendance of 3,600 people. Lowell Observatory was well represented, with several staff members and students participating. Highlights included first-author presentations by Erin Aadland, Danielle Adams, Catherine Clark, Zachary Hartman, Cody Huls, Kyler Kuehn, Lisa Prato, Kevin Schindler, and Gerard van Belle. Hall also co-led a panel discussion and press conference about the dark skies threat of satellite constellations, which garnered widespread media attention. The observatory's new display booth, designed by Lowell graphic designer Sarah Gilbert, was also a big hit.

Lowell Director Jeff Hall—Chair of the AAS Committee on Light Pollution, Space Debris, and Radio Interference—addresses the media at a press briefing about satellite constellations and their impact on astronomy. The visual on the screen shows trails of Starlink satellites. The image was captured by Lowell Educator Victoria Giris in May 2019.



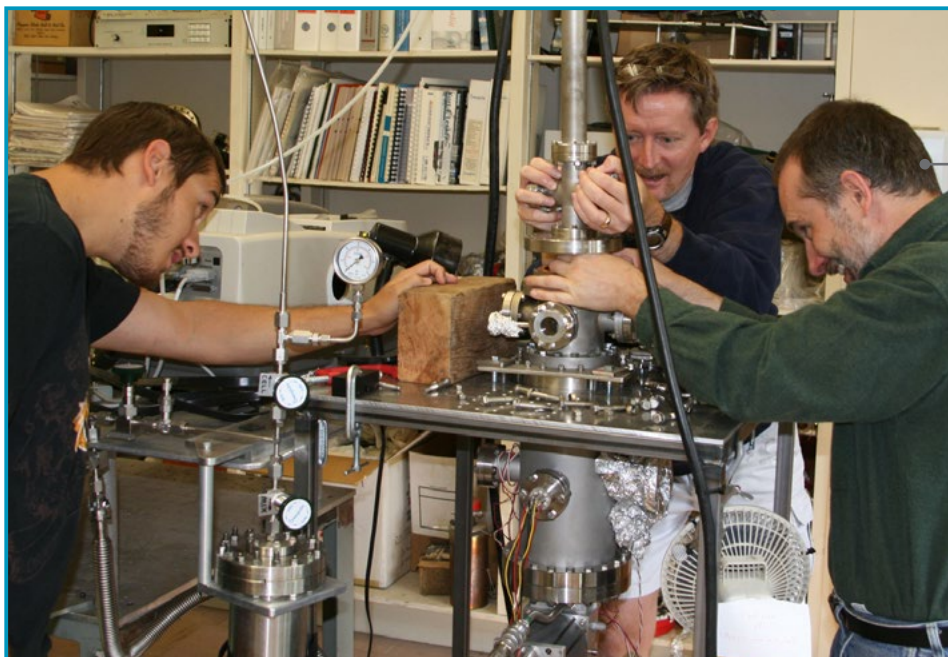
Apollo Artifact Donated to Lowell

By Kevin Schindler, Historian

During the Apollo 15 mission to the Moon, astronaut Dave Scott carried a hand lens onto the lunar surface. It belonged to geologist Gordon Swann, who played a key role in training the astronauts for geological exploration of the Moon. Scott returned the lens to Swann, who kept it until his death in 2014. Last year, during the 50th anniversary celebration of the first manned mission to the Moon, Swann's widow Jody donated the hand lens to Lowell Observatory. It is now displayed in the Putnam Collection Center.

Hand lens carried by Dave Scott onto the Moon.





Former NAU student Matt Bovyn (left), NAU Professor Stephen Tegler (center) and Lowell's Will Grundy (right) set up an experiment at NAU's Astrophysical Ice Lab.

LDT Partner Perspective

By Nadine Barlow, Northern Arizona University

As Chair of the Department of Astronomy and Planetary Science (DAPS) at Northern Arizona University (NAU), I am often asked how DAPS interacts with Lowell Observatory. The short answer is “in many ways”! DAPS has 13 faculty members, about 70 majors in our nationally-ranked undergraduate astronomy degree program, and 27 graduate students in our PhD program in Astronomy and Planetary Science. Faculty research spans many areas, including planetary surface processes, astrobiology, exoplanets, planetary formation, laboratory astrophysics, small solar system objects, and spacecraft missions. Many of our undergraduate majors spread their love of astronomy by volunteering with Lowell's public program. Lowell astronomers mentor our undergraduate and graduate students on research projects, and Lowell employs some of our graduates in various capacities. Faculty at NAU and Lowell collaborate on a number of research projects—for example, NAU's Stephen Tegler works with Lowell's Will Grundy and Jennifer Hanley in the NAU Astrophysical Ice Lab, where they recreate ices and liquids found in the outer solar system and characterize their behaviors and spectral properties under low temperature conditions. They also work closely with NAU's Mark Loeffler, whose lab studies the effects of micrometeorite bombardment

and solar radiation on the spectral properties of icy surfaces.

NAU became a partner in the Lowell Discovery Telescope in 2014 and recently renewed the partnership through 2023. We realized having access to this world-class 4-meter telescope would greatly enhance the department's goal of becoming an internationally recognized center for astronomy education and research. Projects focus on studies of various solar system objects. Cristina Thomas is conducting lightcurve observations of asteroid 65803 Didymos in preparation for the Double Asteroid Redirection Test (DART), a technology demonstration mission for planetary defense. David Trilling and graduate student Andy Lopez use the LDT to characterize the orbital and physical properties of asteroid families and Near Earth Asteroids. Graduate student Colin Chandler is studying objects in the asteroid belt which display cometary activity. Graduate student Annika Gustafsson is conducting near-infrared observations of close-approaching comets to search for color and compositional heterogeneity across the coma.

NAU Graduate Student Annika Gustafsson prepares for a night of observing at the Lowell Discovery Telescope.

Stephen Tegler conducts spectroscopic observations of Centaurs and Kuiper Belt objects to determine the origin of the compounds which make these objects reddish in color. Chad Trujillo and graduate student Will Oldroyd use the LDT to characterize distant Kuiper Belt and Oort Cloud objects. As more of these distant objects are discovered and their orbits are established, Trujillo uses these results in the search for a possible giant planet in the outermost part of the solar system. NAU and Lowell also are part of the new Deep Ecliptic Exploration Project (DEEP), a consortium effort to discover more Trans-Neptunian Objects. LDT will be used for follow-up studies of the brighter unusual objects revealed by the DEEP survey. I serve as Chair of the Department and study impact craters throughout the solar system. I became interested in Mars after reading Percival Lowell's books in high school, and Mars remains a major focus of my research.

Lowell and NAU DAPS have had a long-standing partnership which has only strengthened in the past few years. Both institutions benefit greatly from this collaboration and the sharing of resources to make Flagstaff a premier location for astronomy research, education, and outreach. ☺



While the observatory remained closed to the public throughout the spring, the grounds crew was on hand to continue caring for the facilities. In this picture, Facilities, Grounds, and Maintenance Manager Dave Shuck tears down an old shed near the future site of the Astronomy Discovery Center. | Credit: Kevin Schindler



Temporary Closure

By Danielle Adams, Deputy Director for Marketing & Communications

On March 13, ironically founder Percival Lowell's birthday, Lowell Observatory temporarily closed its on-site visitor program to help deter the spread of coronavirus (COVID-19). The observatory soon also closed down research operations and all but essential Lowell staff were directed to work remotely from home.

As a nonprofit research institution that attracts large groups of people from around the world, the observatory considers the safety of both visitors and staff paramount. Doors to the public will likely remain closed until at least July, though research facilities—with appropriate modifications to operational procedures that will ensure safety of staff and visiting observers—reopened during the week of May 18.

Lowell Observatory Director Dr. Jeff Hall said, "We are an institution of science, and we would be doing a disservice to our mission, our staff, our guests, and our community to do less than what the data are clearly telling us. I was sad to see our campus go silent, but it was the right thing to do."

Each year, more than 100,000 national and international visitors come to Lowell Observatory to discover the wonders of the universe. As the spring break travel season ramped up across the United States, observatory officials believed this closure was in the best interests of staff and visitors

alike. This effort was intended to help slow the spread of coronavirus.

In lieu of on-site visitation, Lowell has developed a variety of online digital experiences (see story on page 8) that are engaging would-be visitors within the safety of their own homes.

"With the current uncertainty around circulating virus in different communities in the US, it is prudent to consider the risks of exposure when large groups from various communities come together, for tours or other social activities," said Dr. Dave Engelthaler of TGen North, the Flagstaff branch of the Translational Genomics Research Institute. "I applaud Lowell Observatory's forward-thinking actions to protect the health and safety of its staff and visitors."

To further support its public-facing staff, the observatory instituted an unlimited sick leave policy and committed to maintaining the income streams for its staff through other duties that do not require face-to-face interaction with the public. 🌐



Matching Gifts

By Stephen Riggs, Development Manager

Many employers have programs that double or even triple their employees' giving to charitable organizations. Some companies will match retirees' charitable giving as well; sometimes at the same ratio, sometimes at a reduced ratio, depending on the company. Others will match gifts from members of their boards of directors. If you work for one of these employers, a little bit of effort can greatly increase the impact of your giving at no cost to you. To find out if your employer or former employer will match your charitable giving and how to begin this process, visit the Lowell Observatory matching gift web page at lowell.edu/matching-gifts, or contact Lowell's Annual Giving Officer, Rachel Edelstein at redelstein@lowell.edu or by phone at 928-255-0229.

DISPATCHES FROM THE UNIVERSE



Shake the Sky

By Michael West, Deputy Director for Science

“Life would be tragic if it weren't funny,” Stephen Hawking once said, and nobody knew that better than him.

Hawking, one of the most brilliant scientific minds of all time, was only twenty-one when he was diagnosed with amyotrophic lateral sclerosis, or ALS, an incurable disease that slowly imprisons its victims within their own bodies as they lose the ability to move, speak, swallow and, eventually, breathe. He was given only three years to live.

But Hawking defied the odds by surviving another half a century.

It wasn't easy. Confined to a wheelchair most of his life, he required around-the-clock care. Hawking lost his ability to speak after a severe bout of pneumonia led to a tracheotomy. In his later years, he was able to communicate only through a speech synthesizer that he controlled by laboriously twitching a single muscle in his cheek.

Confronted with this reality, many of us would sink into depression and self-pity. Hawking himself admitted that he “briefly tried to commit suicide” in the 1980s as his disease progressed.

Instead, Hawking found joy in life, his mind roaming freely through a universe of black holes and quantum gravity even as his body shut down. And through it all he never lost his sense of humor or his mischievous grin, which endeared him to millions.

Hawking's wry humor was often on display. In a lecture given at Cambridge University on his sixtieth birthday, he described the satisfaction of discovering something that no one knew before by quipping, “I won't compare it to sex, but it lasts longer.”

Self-effacing and quick-witted, he was only too happy to lampoon his iconic image in appearances on television shows such as “The Simpsons” and “The Big Bang Theory”, where he was remembered as having “a sense of humor as vast as the universe.”

Then there was the time in 2009 when Hawking threw a party and, to his delight, nobody came. To demonstrate the impossibility of time travel, Hawking had invited travelers from the future to join him for champagne and hors' d'oeuvres but didn't send out the invitation until after the party. “I sat there a long time, but no one came,” he said impishly.

The *Odyssey*, Homer's epic tale of the ancient Greeks and their gods, reminds us that an “unextinguished laughter shakes

the skies.” As Stephen Hawking's life showed, life isn't always fair, but it's always better with laughter.

So look up at the night sky from time to time and chuckle at the absurdity of it all. In a universe where we humans sometimes feel like the punchline to some great cosmic joke that we don't get, it's our ability to laugh that turns gravity into grace.

Shake that sky. 🌌



Deputy Director for Science Michael West

Jim Cole at the Giovale Open Deck Observatory dedication, September 14, 2019.



STAFF HIGHLIGHT

Jim Cole


By Madison Mooney, Content Marketing Specialist

Jim Cole has been at Lowell Observatory for a collective nine years, starting as a volunteer before beginning work as an educator. Jim was drawn to Flagstaff by its dark skies in 2001, eager to pursue his passion of amateur astronomy after a career that included work in marine biology (he has a Master's degree in the field), operating a scuba shop, and serving as project manager at a software company.

Despite being a major driving force behind the construction of the Giovale Open Deck Observatory (GODO), Jim is most proud of his work as an educator. "The GODO is awesome, those telescopes were my baby for almost two years," he says.

"It was an impressive thing that we put together and people are calling that a legacy, but I'll take my time as an educator."

Currently, Jim is working to keep the GODO fully operational, facilitating daily telescope maintenance as well as the installation of a new 24-inch Planewave. He is also a key member of the team developing exhibits for Lowell's Astronomy Discovery Center (ADC), set to open in 2023.

Looking ahead, Jim is most excited about the construction of the ADC and the cutting edge exhibits it will offer. Jim sees the construction of the ADC as the beginning of a new era for Lowell Observatory. 

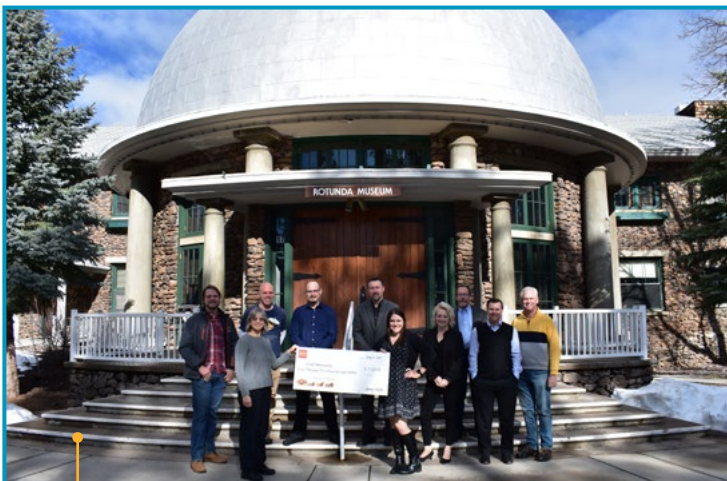


Rendering of the Dark Sky Planetarium. Credit: Kei Space

Caris Gift

By Hannah Rounds, Corporate and Foundation Relations Manager

The Richard F. Caris Charitable Trust committed the second major gift to the new Kemper and Ethel Marley Foundation Astronomy Discovery Center. The Caris Trust's \$6 million gift will name the Dark Sky Planetarium located on the roof of the center, under Flagstaff's dark skies. The Richard F. Caris Dark Sky Planetarium will be elevated above the rooftop garden providing heated seats and unobstructed views of the Milky Way. This exciting new space is designed to give guests the feeling of floating in the Universe.



Wells Fargo Grant

By Hannah Rounds, Corporate and Foundation Relations Manager

The Wells Fargo Foundation made a \$7,500 grant to the Native American Astronomy Outreach Program. The grant supports expenses of one school-year partnership between a Lowell astronomer and a classroom on the Navajo Nation. Wells Fargo staff contributed volunteer time to the program as well, helping to put on star parties for the schools. Local Wells Fargo representatives visited Lowell on December 9 to present a check to program staff. Wells Fargo's support helps inspire Native American children to see science as fun and accessible.

Back row, left to right: Todd Gonzales, Glenn Feldmann, Chris Fondow, and Stephen Riggs. Front row: Travis Brown, Deidre Hunter, Rachel Davila, Erika Harting, Anthony Hannigan, and Bruce Kosaveach. | Credit: Hannah Rounds



Master Teacher Todd Gonzales talks science during a virtual Camps for Kids presentation.

New Online Educational Programming

By Kevin White, Public Program Supervisor

A core part of Percival Lowell's mission for his observatory was to bring the results of astronomical research to the public. Even while Lowell Observatory's physical campus closed to the public, our outreach mission has remained active through a wide variety of online programming. Through these efforts, Lowell Observatory has been able to reach a new audience. For example, in January of this year, Lowell Observatory's YouTube videos were viewed 1891 times. In April, our YouTube videos were viewed 151,308 times.

Our most popular online programs have been about celestial special events. For example, a program explaining a recent pink supermoon has been viewed 73,000

times. A video explaining the Lyrids meteor shower has garnered some 20,000 views.

Lowell staff have also produced a Science Challenge video series, aimed at teaching basic scientific concepts to young children. These challenges range from growing plants to testing Newton's laws to measuring the speed of light in Jell-O. These programs are designed to meet official Arizona science curriculum standards, and will be a valuable resource for parents and teachers. Other programs include videos on star lore and on how to find planets and constellations, and a video taken from a Lowell Observatory telescope of an asteroid as it made a near pass with Earth.

Lowell Observatory's astronomers have also participated in online outreach efforts. Our Meet an Astronomer event, normally a regular weekly fixture of the in-person evening programs, have moved online, giving anyone with access to a computer the opportunity to interact

with and ask questions of professional astronomers. Astronomers and educators have also participated in a weekly Cosmic Coffee series, which delves into other topics such as dark skies preservation and northern Arizona's role in training Apollo astronauts.

These programs are an exceptional opportunity in another way as well. As Lowell Observatory builds and expands our public outreach and education program, we will be building and expanding our online presence as well. By having more time and space to put out online programming, we can also experiment, gain practice and experience in the medium, and learn what works best for us. After we re-open our in-person programming and through the coming years, we will be able to continue the most successful elements of our new online programming, and incorporate what we have learned into our online and in-person programming in the future.

Percival Lowell himself loved new technology, was an avid international scholar and world traveler, and was a passionate science educator. He would be thrilled to know that the observatory he founded is using the internet to bring its education mission to a global audience. We are grateful both for the staff who have produced this new online content, and to everyone who has taken time to engage with us through it. 🌟

Support for STEM Education

By Stephen Riggs, Development Manager

amazonsmile
You shop. Amazon gives.

When we closed to the public in mid-March, Lowell educators immediately developed online astronomy, physics, and math lessons for school-aged children to do at home. One donor, David Early, responded by purchasing equipment and supplies from the Lowell Observatory AmazonSmile wish list to help educators. He is a devoted supporter whose past gifts to archives projects have helped preserve the observatory's rich history of exploration and discovery. This spring,

he not only contributed in-kind gifts but also made arrangements with his employer's foundation to match monetary contributions one-to-one. Thanks to David and the Texas Instruments Foundation, we are meeting the needs of home-bound, budding astronomers!

Kent and Barbara Robinson's Gift: A Columbarium on Mars Hill

By Mattie Harrington, Executive Assistant

After retiring from a career in engineering management, Kent Robinson and his wife Barbara moved to Prescott, Arizona to be near family. On a trip to Lowell Observatory in 1998, they noticed a collection of old books in the Slipher Building Rotunda. This sparked a fire in them to volunteer because one of Barbara's hobbies is the restoration of old books. They spoke to the staff about cataloging and restoring the Rotunda Museum book collection.

Kent and Barbara functioned as a team. She brought the books down the narrow staircase and he cataloged them. Barbara was grateful she made it up and down each trip without tumbling with an arm full of books. The process took so much time to complete that they stayed in the Slipher Building's Tombaugh apartment for 23 days, off and on. During their stay, they received an up-close and personal view of the observatory, deepening their appreciation of its mission.

After the project, Kent and Barbara suggested that the observatory build a proper library and a place to store historic

collections. This conversation would be the beginning of planning the Putnam Collection Center, and Kent served as project manager. Kent's background as a project/process engineer and research biochemist, and his knowledge of grant writing, came in handy. With Kent at the helm, the project was completed on time and within budget, a true sign of a meticulous engineer/PhD biochemist.

The Putnam Collection Center houses Lowell's archives and artifacts, including many of the books Kent cataloged which were deemed too valuable to restore.

For years Kent and Barbara continued to share their time, talent, and treasure with the observatory. Kent served as a member of the Executive Committee that provides input to Lowell Observatory's Advisory Board.

The Robinsons believed the observatory would be a wonderful final resting place for those who loved Lowell as they did. They proposed the idea of a columbarium, a repository for cremains, on Mars Hill and even put a provision in

their estate plans to fund it. Sadly, Kent passed away in 2019. To honor Kent's wishes, Barbara and her family provided funds for the columbarium last fall. Construction is now underway. The family has selected a niche for Kent's ashes, with space for Barbara's, too. Thanks

to the Robinsons' foresight, there will be a place on the hill to reflect, enjoy the serenity and surroundings, and especially to remember loved ones.

Trustee Lowell Putnam, remembers, "Barbara and Kent have been great friends and supporters of the Observatory. From their early involvement in the archives and Barbara's careful and painstaking repair to our older books, through Kent's involvement on the Executive Committee and stewardship as Chair of the committee that built the Putnam Collection Center, they have been involved and engaged. Kent talked over the years of wanting to be 'On the Hill' when he passed and Barbara and her family's gift have allowed that to happen, not only for him but for others to whom Lowell Observatory and Mars Hill remain a special place. They will all be in good company." 🍷



Kent and Barbara Robinson in front of the Putnam Collection Center.



One of the top projects to be funded in 2019 was the Giovale Open Deck Observatory, which opened October 5. | Credit: Joe Llama

Record Fundraising in 2019

By Stephen Riggs, Development Manager

2019 was a banner fundraising year for Lowell Observatory with \$25,648,688 raised in gifts and pledges. Many of these gifts were for the Giovale Open Deck Observatory and for the future Kemper and Ethel Marley Foundation Astronomy Discovery Center (ADC), although gifts for general operating through the Annual Fund and membership also exceeded previous years. For details about Lowell's fundraising efforts, please contact Stephen Riggs at 928-255-0186 or by email at sriggs@lowell.edu.

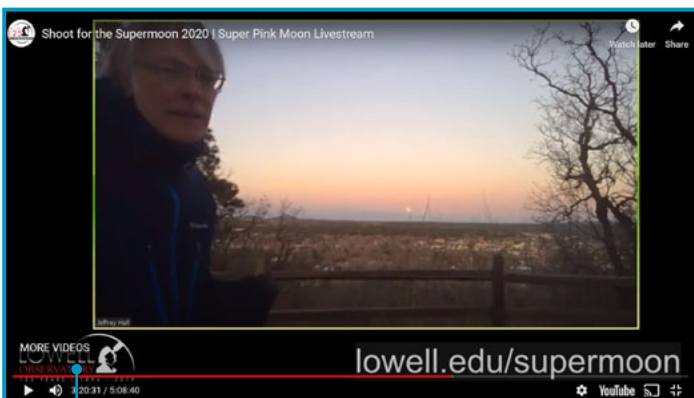
Inspiration Fund

By Stephen Riggs,
Development Manager



In 2019, the Lowell Observatory Foundation established a new endowed fund, the Inspiration Fund. Earnings from this endowed fund will support, in perpetuity, a critical component of Lowell Observatory's mission: to share astronomical discoveries with the public. The endowment will help pay for the observatory's popular daytime and nighttime public astronomy programs for children and adults, as well as STEM camps for children, science exhibits, historic Mars Hill tours, and virtual exhibits and experiences.

It is a policy of the Lowell Observatory Foundation Board that an endowed fund must contain a minimum of \$50,000 before earnings' payouts can begin, and while the Inspiration Fund has already received gifts since its creation, the current total is less than the threshold needed to begin its funding support. If you are interested in helping to grow the Inspiration Fund to the payout level and beyond, please contact Stephen Riggs at 928-255-0186 or sriggs@lowell.edu for more information.



Brian Skiff leads a virtual discussion about the Moon during the Pink Supermoon Fundraiser.

Shoot for the Supermoon a Success

By Rachel Edelstein,
Annual Giving Officer

In April, the AZ Gives Day online fundraiser coincided with the

Pink Supermoon, one week after we closed to the public and outreach efforts went online. The five-hour educational extravaganza began with STEM lessons for families to do at home. As the Moon rose, astronomers and educators shared Moon-related lore and science in honor of the supermoon. Donors contributed almost \$10,000 online! If you missed the program, you can still view it on the Lowell Observatory YouTube channel.

Recent Publication

Levesque, Emily M.; **Massey, Philip**. Betelgeuse Just Is Not That Cool: Effective Temperature Alone Cannot Explain the Recent Dimming of Betelgeuse. *The Astrophysical Journal Letters*, Volume 891, Issue 2, id.L37

See our website lowell.edu/research/recent-publications for more publications

NEW AGREEMENT WITH DISCOVERY, INC

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vetted content with broad dissemination. We look forward to this renewed and mutually beneficial relationship with them.”

Under this new agreement, Discovery has already produced a program entitled #TeamPluto (go.discovery.com/tv-shows/teampluto), which was released on February 18, the 90th anniversary of the discovery of Pluto at Lowell Observatory. Lowell Deputy Director for Marketing and Communications Danielle Adams said,

“This program is the first of many efforts that will leverage the new partnership between Lowell and Discovery to promote the wonders of scientific discovery to individuals all around the world.”

Renaming Lowell’s 4.3-meter telescope as the Lowell Discovery Telescope is a positive move for both Lowell and Discovery. Hall explained, “The name Lowell Discovery Telescope makes clear that Lowell Observatory is its owner and operator, while the word Discovery takes on a fun double meaning. It recognizes the generous capital gift from Discovery

that enabled us to build the telescope and emphasizes the observatory’s tradition and mission of astronomical discovery.” Adams added, “Discovery’s current mission is also reflected in this name change, because the organization today has a far more expansive media presence than just the Discovery Channel did 17 years ago.” 📺

FRONT COVER IMAGE: Lowell’s flagship 4.3-meter instrument is now being operated as the Lowell Discovery Telescope. | Credit: Joe Llana

DIMMING OF BETELGEUSE

continued from page 1

at the Lowell Discovery Telescope (LDT) allowed them to calculate the average surface temperature of the star. They discovered that star is significantly warmer than expected if the recent dimming were caused by a cooling of the star’s surface.

The new calculations lend support to the theory that Betelgeuse—as many red supergiant stars are prone to do—has likely sloughed off some material from its outer layers.

“We see this all the time in red supergiants, and it’s a normal part of their life cycle,” said Levesque. “Red supergiants will occasionally shed material from their surfaces, which will condense around the star as dust. As it cools and dissipates, the dust grains will absorb some of the light heading toward us and block our view.”

It is still true: Astronomers expect Betelgeuse to explode as a supernova within the next 100,000 years when its core collapses. But the star’s dimming, which began in October, wasn’t a sign of an imminent supernova, according to Massey.

One theory was that newly formed dust was absorbing some of Betelgeuse’s light. Another posited that huge convection cells within Betelgeuse had drawn hot material up to its surface, where it had cooled before falling back into the interior. “A simple way to tell between these possibilities is to determine the effective surface temperature of Betelgeuse,” said Massey.

Measuring a star’s temperature is no straightforward task. Scientists can’t just point a thermometer at a star and get a reading. But by looking at the spectrum of light emanating from a star, astronomers can calculate its temperature.

The light from bright stars is often too strong for a detailed spectrum, but Massey employed a filter that effectively

“dampened” the signal so they could mine the spectrum for a particular signature: the absorbance of light by molecules of titanium oxide.

Titanium oxide can form and accumulate in the upper layers of large, relatively cool stars like Betelgeuse, according to Levesque. It absorbs certain wavelengths of light, leaving telltale “scoops” in the spectrum of red supergiants that scientist can use to determine the star’s surface temperature.

By their calculations, Betelgeuse’s average surface temperature on February 14 was about 3,325 degrees Celsius, or 6,017 Fahrenheit. That’s only 50-100 degrees Celsius cooler than the temperature that a team—led by Massey and then-undergraduate Levesque—had calculated as Betelgeuse’s surface temperature in 2004, years before its dramatic dimming began.

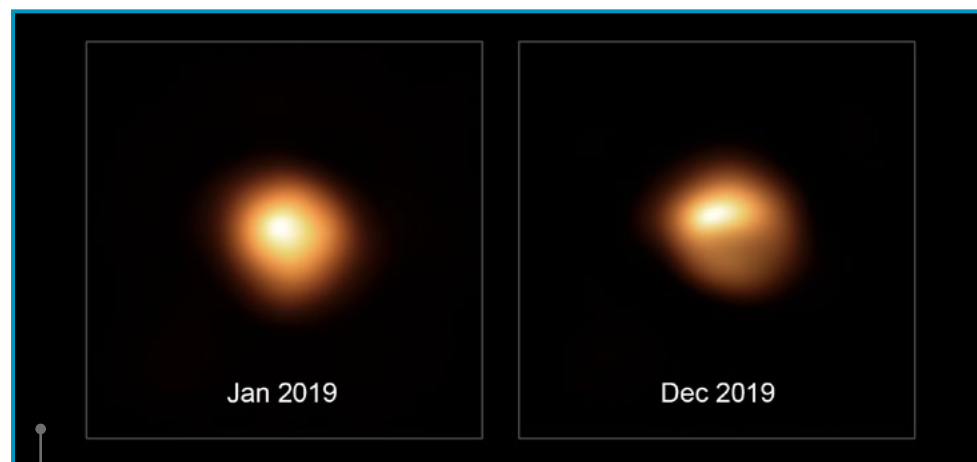
These findings cast doubt that Betelgeuse is dimming because one of the star’s massive convection cells had brought hot gas from the interior to the surface, where it had cooled. Many stars have these convection cells, including our own sun. They resemble the surface of a

pot of boiling water, said Levesque. But whereas the convection cells on our sun are numerous and relatively small—roughly the size of Texas or Mexico—red supergiants like Betelgeuse, which are larger, cooler and have weaker gravity, sport just three or four massive convection cells that stretch over much of their surfaces.

If one of these massive cells had risen to Betelgeuse’s surface, Levesque and Massey would have registered a substantially greater decrease in temperature than what they see between 2004 and 2020. “A comparison with our 2004 spectrum showed immediately that the temperature hadn’t changed significantly,” said Massey. “We knew the answer had to be dust.”

Astronomers have observed clouds of dust around other red supergiants, and additional observations may reveal similar clutter around Betelgeuse. 📺

FRONT COVER IMAGE: Observations of the star Betelgeuse taken by the ESO’s Very Large Telescope in January and December 2019, which show the star’s substantial dimming. Credit: ESO/M. Montargès et al.



Observations of the star Betelgeuse taken by the ESO’s Very Large Telescope in January and December 2019, which show the star’s substantial dimming. | Credit: ESO/M. Montargès et al.



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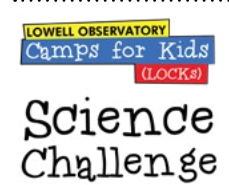
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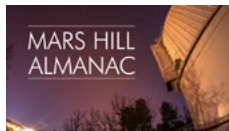
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