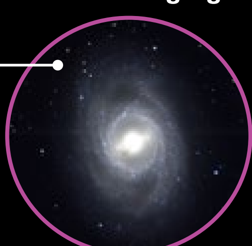
THE LOWELL OBSERVER
ISSUE 108 FALL 2016
THE QUARTERLY NEWSLETTER OF LOWELL OBSERVATORY
HOME OF PLUTO

Harlan J. Smith Telescope at McDonald Observatory. *Credit: Bill Nowlin Photography*

IN THIS ISSUE



The CI Tau b Young Giant Planet: A First of its Kind Detection

By Lisa Prato

How do planets form? Astronomers have long known that planets exist because we live on one and understand its properties well. It has also been common knowledge for centuries that our Sun is orbited by other planets as well, some with radically different properties from our own. Remarkably, over the past 20 years, astronomers have gone on to discover and, to some degree, even to characterize more than 3,000 planets around other stars! Thus we know that planets exist and there are indications that they are quite common—but how do they form?

Is it easy to form a planet? Difficult? Do ten planets form and are then destroyed through planet-planet collisions or star-planet mergers for every one planet that survives? Are there aspects of the planet formation process that make the formation of habitable terrestrial planets like our own Earth more or less likely? These are some of the questions that drive astronomers to study the planet formation process with both observational and theoretical approaches.

Although there are thousands of confirmed exoplanets—planets that orbit stars other than the Sun—they are almost all uniformly old. Impressively, astronomers are able to infer some information about planet formation from the aggregate of data for these mature planets discovered so far. However, it is a bit like trying to understand how human babies form by using binoculars to observe the adults-only inhabitants of an island. To get the story on planet formation, astronomers have to study very young stars to catch planets in the process of formation.

That doesn't sound like it should be a problem...except that stars young enough to host planet formation are at least 450 light years away, much more distant than almost all known exoplanets and thus relatively faint. Furthermore, young stars demonstrate behavior which is the stellar equivalent

continued on page 11

Volunteers Rediscover the "Red Shift"

See page 11 for more!

DIRECTOR'S UPDATE

By Jeffrey Hall

Just before I wrote this note for the *Observer*, I was talking to someone on the phone and noting that I've never been happier and prouder of the team. Every day, I see members of the Lowell team in all departments—astronomers, technicians and engineers, outreach staff, administrative and fundraising staff, buildings and grounds, volunteers and Advisory Board—doing things that far transcend just keeping things moving until the next paycheck.

This *Observer* gives you just a couple of examples.

Check out the articles about Joe Llama and Todd Gonzales. I'm thrilled to have both of them newly on board, and they're going to make great contributions to our science and development efforts. Todd is already a key player, along with Mica Gratton and Kevin Schindler, in planning a Lowell party-hearty eclipse spectacular in Madras, OR next year (see page 8).

Likewise, be sure to read the articles about Frank Paschal and Pat Roemer. Frank was a quintessential Lowell team member: dedicated, talented, and endlessly cheerful. And Pat, to her very last days, kept in touch with us from her quiet room in Tucson, and her interest and care for Lowell will live forever in a magnificent bequest to our newly-established Foundation.

These are just four faces of so many that we can tell you about: over 100 staff, nearly as many volunteers and Board members, and singularly generous benefactors. It's the quality of today's team that gives me happiness and great confidence in our near- and long-term goals and our ability to achieve them.

TRUSTEE'S UPDATE

By W. Lowell Putnam

To modify a well-known quote from Shakespeare, "What's past, *and present,* are prologue *to the future.*"

As I read the advance issue of the *Observer*, I was, once again, reminded of how many people have done, and are doing, great work at Lowell Observatory.

Whether the astronomical research of Lisa Prato or Will Grundy, the wonderful LMI images that Phil Massey and Kathryn Neugent keep delivering to us, the archival and preservation work that is saving our history and making it available for review done by Karen Kitt and Glenn Hill, the list of current contributors at Lowell goes on. And it is clear from the various social media sites that visitors get a great deal of enjoyment and knowledge out of their time on Mars Hill. Because the institution is well over a century old, we also get periodic and poignant reminders of how much those who were here did to make this place better during their tenure. It also shows me that there is such great potential for the future by the work being done today and the possibilities in front of us. Your support of the observatory helps make that future happen and it is clear from the efforts of people today that there will be great discoveries produced and shared in the time ahead.

Thank you!

New Twitter Handle

You can now find us under the username **@LowellObs**
Happy tweeting!

Joe Llama Joins Staff

Joe Llama has joined the science team at Lowell, accepting a tenure-track astronomer position earlier this summer. Joe is a familiar face at the observatory, having worked as a postdoctoral researcher with Evgenya Shkolnik from 2014-2015.

Joe earned a Masters of Physics honours degree in 2010 from the University of St. Andrews in Scotland and stayed there for his doctorate degree. His dissertation was titled, "Things that go bump in the light: an investigation into the effects of stellar activity on exoplanets", and he earned his Ph.D. in astrophysics in 2014.

At Lowell he will continue his research that focuses on characterizing magnetic fields of both stars and exoplanets. He is also interested in the differential rotation of stars across the main sequence and the habitability of exoplanets.

Originally from Pembrokeshire, South Wales, Joe enjoys traveling and is a seasoned visitor to Norway to photograph the Northern Lights.

Former Lowell scientist John Spencer, now working at the Southwest Research Institute in Boulder, Colorado, is a leader of the *New Horizons* Geology and Geophysics Investigation Theme Team. Here, he gives a presentation in the Steele Visitor Center during the July *New Horizons* meeting at Lowell. *Credit: © Michael Soluri*

GUEST COLUMN Pluto: One Year Later

By Andy Chaikin, science journalist and author of several books, including *A Man on the Moon: The Voyages of the Apollo Astronauts*

Last July 14 marked the one-year anniversary of one of the most extraordinary unveilings in the history of exploration: the flyby of Pluto by NASA's *New Horizons* spacecraft. To mark the occasion mission scientists gathered on July 6-8 at Lowell Observatory to discuss the latest findings from *New Horizons'* rich haul of data. I was there as a member of the Geology, Geophysics and Imaging Team, which I joined as an embedded journalist a few months before the flyby. For me, this was a chance to immerse myself once more in the incredible experience of probing Pluto's mysteries.

It's hard to fathom how surprising, how complex, and how weird Pluto has turned out to be. *New Horizons'* cameras revealed glaciers of frozen nitrogen, vast fields of elongated pits, bladelike formations like the skin of an icy dragon, and enormous mountains that may be ice volcanoes. There are even features resembling drainage channels that may have been created by subsurface aquifers of liquid nitrogen. Then there is Pluto's wispy atmosphere, which displays a remarkable amount of structure, with global haze layers that show up beautifully in images of Pluto backlit by the Sun. And even though Pluto's atmospheric surface pressure is measured in microbars—millionths of the pressure here on Earth—the atmosphere interacts with the icy surface in complex ways that scientists are still working to describe and explain. One of the hot topics at the science meeting was a new computer model designed to characterize the evolution of Pluto's atmosphere and surface under the influence of complex seasonal cycles that scientists are still trying to understand.

In fact, almost everything about Pluto falls into the category of "can't explain yet," even something as basic as the physical characteristics of its surface materials. Lowell Observatory's Will Grundy, leader of the *New Horizons* team studying Pluto's composition, commented several times that when it comes to understanding the behavior of Pluto's exotic ices—a mixture of frozen nitrogen, methane, and carbon monoxide—we are just beginning. To find out more, Grundy and his students have been creating tiny chunks of synthetic Plutonian ice in their lab at Northern Arizona University.

Even Pluto's five moons have been the source of considerable head scratching. Texas-sized Charon has its own complex geology, including towering cliffs that appear to have been formed by fracturing of the moon's icy crust. And the small satellites Kerberos, Styx, Nix, and Hydra have strange rotational patterns that offer clues to their formation—clues that scientists are still trying to decipher.

Faced with so much complexity, so many puzzling phenomena, Pluto scientists express not frustration but exhilaration. This is what they signed up for: the quest to explore one of the solar system's most mysterious worlds, which has only become more fascinating now that we've seen it up close. One night during the conference several team members had a chance to view Pluto through the 24-inch Clark refractor. In the eyepiece, it was an elusive point of light, all but lost among the stars, just as it was when Clyde Tombaugh first discovered it more than 86 years ago. It was a wonderful moment underscoring how far we've come—and will continue to go.

More than 50 scientists and support personnel participated in the *New Horizons* meeting, including many former Lowell staff members. The group poses here on the steps of the Rotunda Museum. *Credit: © Michael Soluri*

Elizabeth Roemer, shown in this picture from 1963, discovered the asteroids 1930 Lucifer and 1983 Bok. In 1975 she co-discovered Themisto with Charles Kowal. Themisto is an irregular moon of Jupiter that was lost soon after its discovery but finally recovered in 2000.

Elizabeth Roemer
September 4, 1929 - April 8, 2016

By Antoinette Beiser

Elizabeth "Pat" Roemer, emerita professor at the University of Arizona, passed away on April 8, 2016. She was well-known as the recoverer of lost comets, detecting the return of 79 periodic comets while also computing the orbits of comets and minor planets. Pat specialized in the study of astrometry, making precise measurements of the movements and positions of celestial bodies. Her observations led to numerous significant cometary discoveries.

Pat was born in Oakland, California on September 4, 1929. She graduated from the University of California, Berkeley in 1950 with a B.A. in astronomy as a Bertha Dolbeer Scholar. She continued her research there in the doctoral program where she earned her Ph.D. in 1955. Her passion for teaching bloomed during her graduate studies when she taught classes at local public schools to finance her tuition. Upon completing her education she worked as an assistant astronomer at U.C. while also conducting research at the University of Chicago's Yerkes Observatory. After her time at U.C., she became an astronomer at the U.S. Naval Observatory in Flagstaff. It was there that she began rediscovering comets by using a high-definition, 40-inch atmospheric reflecting telescope to photograph and analyze comet nuclei. In 1966 she was hired by the University of Arizona as an associate professor in the Lunar and Planetary Laboratory. Three years later she was promoted to full professor. In 1980, she became an astronomer at Steward Observatory in Tucson while still serving as a faculty member at the University. She retired in 1998 but continued her research on comets and asteroids.

Pat was an exemplary member of the astronomy community and served on many astronomical commissions and organizations. She was president of the International Astronomical Union Commission 6 (Astronomical Telegrams) and vice president of Commission 20 (Positions and Motions of Minor Planets, Comets, and Satellites). She also served as chairman of the American Astronomical Society Division on Dynamical Astronomy.

She received numerous awards for her groundbreaking work in astronomy. Among these were the B.A. Gould Prize of the National Academy of Sciences, the NASA Special Award, and the Donohoe Lectureship of the Astronomical Society of the Pacific. In honor of Pat's scientific efforts, the asteroid "Roemera" was named in her honor.

Pat is survived by her niece, Carole. She will be greatly missed by all those who knew her.

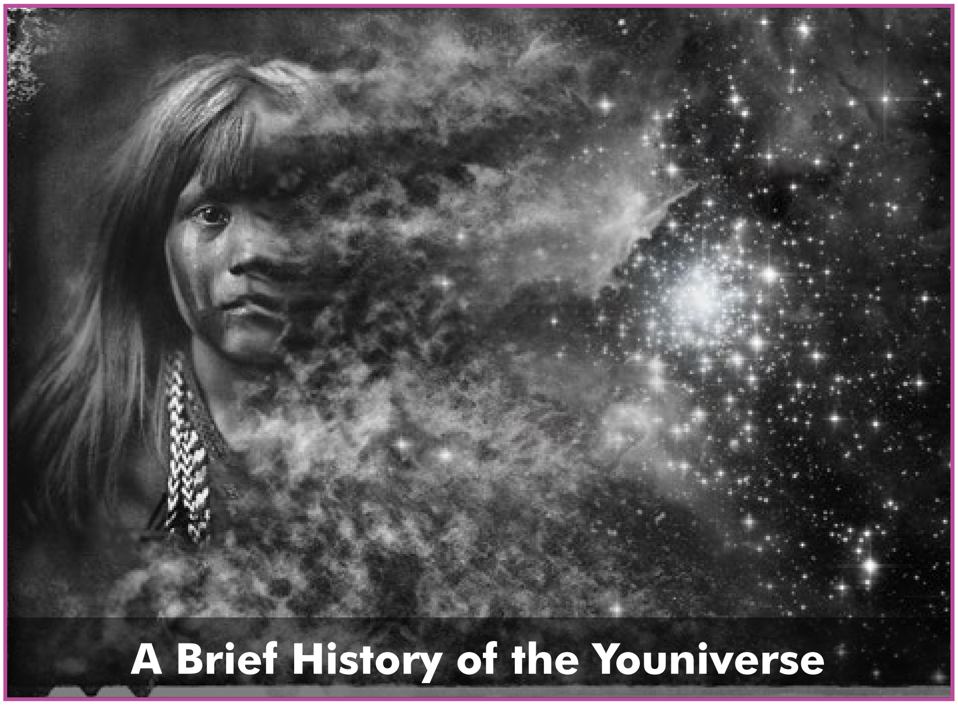
Lowell's Summer Studentship Program: Training Tomorrow's Astronomers Today

Each summer, Lowell Observatory hosts top undergraduate and graduate students from across the country and around the world. This summer was no exception, with more than a dozen students working closely with Lowell astronomers on research projects that explore everything from the nearby solar system to the most distant objects in the universe. The students have diverse backgrounds but all share a passion for astronomy. Many will go on to pursue careers in the field. — *Michael West*

Sara Aljanahi, University of Oregon, Supervisor: Scott Barrows | Fatima Alketbi, University of Sharjah, Supervisors: Jennifer Hanley & Will Grundy | Anicia Arredondo, Wellesley College, Supervisor: Amanda Bosh | Ian Avilez, NAU, Supervisors: Lisa Prato & Tom Allen | Madeleine Beck, Wellesley College, Supervisor: Phil Massey | Lauren Biddle, NAU, Supervisors: Lisa Prato & Tom Allen | Conor Benson, CU Boulder, Supervisor: Nick Moskovitz | Katie Dunn, MIT, Supervisor: Stephen Levine | Kate Evans, Caltech, Supervisor: Phil Massey | Sam Gallardo, Cal State Los Angeles, Supervisor: Deidre Hunter | Patrick McClure, MIT, Supervisor: Amanda Bosh | Ryan Muzzio, Kenyon College, Supervisors: Lisa Prato & Tom Allen | Logan Pearce, University of Texas, Supervisors: Will Grundy & Jennifer Hanley | Cody Stein, NAU, Supervisor: Gerard van Belle | Garrett Thompson, NAU, Supervisor: Will Grundy | Justin Toller, NAU, Supervisor: Michael West | Matthew Wittal, Embry Riddle, Supervisors: Lisa Prato & Tom Allen

DISPATCHES FROM THE UNIVERSE

By Michael West



In the afterlife, you get to meet all the atoms you were made of during your lifetime. It's an unnerving experience. Not just because there are so many of them, but because they've had way more fun than you ever did. And they're annoyingly smug about it.

Your atoms were yours for only a short time, which is why they resent having to meet with you in the afterlife. Even while you were alive they came and went like migrant workers, never staying long. They've already moved on from you.

Their history goes back much longer than yours, of course. They've been around in one form or another since the Big Bang. And they've seen plenty of action during the past 14 billion years, which they'll tell you about *ad nauseum* if you ask.

In fact, it's hard to comprehend all the places the atoms formerly known as you have been. Each has a unique history. That's one reason they think these afterlife meetings are a waste of time; we dimwitted humans can't grasp the immensity of space and time or the multitude of experiences each atom has had.

Your atoms—and they hate being called that—have been in places you can't even imagine. They spent eons drifting through space, tugged this way and that by gusts of gravity from passing stars. They've spent long periods simply waiting, punctuated by occasional bursts of excitement. Patience is a virtue all atoms learn.

Fortunately, things have gotten more interesting over time as the universe developed more texture and more opportunities for atoms to do things other than wait.

An oxygen atom you breathed while walking through the streets of Phoenix in 2009 was breathed by 8,249,837 other people before you. An even greater number of birds, dinosaurs, frogs, rodents, and trilobites all breathed this same oxygen atom during their lifetimes.

But your atoms spent most of their time as parts of inanimate objects. Water. Dirt. Clouds.

One of your carbon atoms, for example, spent nearly two billion years lodged in a rock at the bottom of what is today the Indian Ocean. As the continents divided, the rock ended up on a seashore, where pounding waves eventually broke it apart and freed the atom to continue its journey. But before getting to you, it first became part of a stagnant pool of water, smoke from a wildfire in southern Argentina, a prehistoric type of fish that scientists have yet to discover, a Norwegian fjord, and countless other stops along the way. Sometimes it simply drifted in the air for years, going nowhere in particular.

You notice a few of your atoms looking uncomfortable. When it's their turn, they confess that they're the ones who created the blockage in your artery that caused your death from a heart attack. Nothing personal, they say sheepishly.

Then there were the years before Earth, or "B.E." as the atoms call it with some nostalgia. Our planet didn't even exist for the first two-thirds of the universe's history, but your atoms did. They've been part of other stars, other worlds, and other lives.

With few exceptions, all your atoms have been trapped here on Earth for nearly five billion years. Most of them are eager to move on. Although they won't say it to your face, they're looking forward to the day when the dying Sun incinerates our planet and they're free again to roam the universe.

Eventually you come to understand that it's not possible for any person to grasp the immensely rich histories of their atoms. The meeting ends, as they usually do, in awkward silence as your atoms realize you've become overwhelmed with too much information and you just want a drink.

Goodbyes are exchanged with promises to keep in touch, but you and they know it'll never happen. You're dead after all, and they're now part of other dreams.

Remarkable Imaging of LMI

By Phil Massey

One of the things that makes the DCT so great is that it provides excellent image quality, which means that the crispness of most images is limited only by how stable the atmosphere is. Since the DCT is located at a really good site, where conditions are usually excellent, it means that what astronomers call "the seeing"—how sharp the images are—is usually sub-arcsecond.

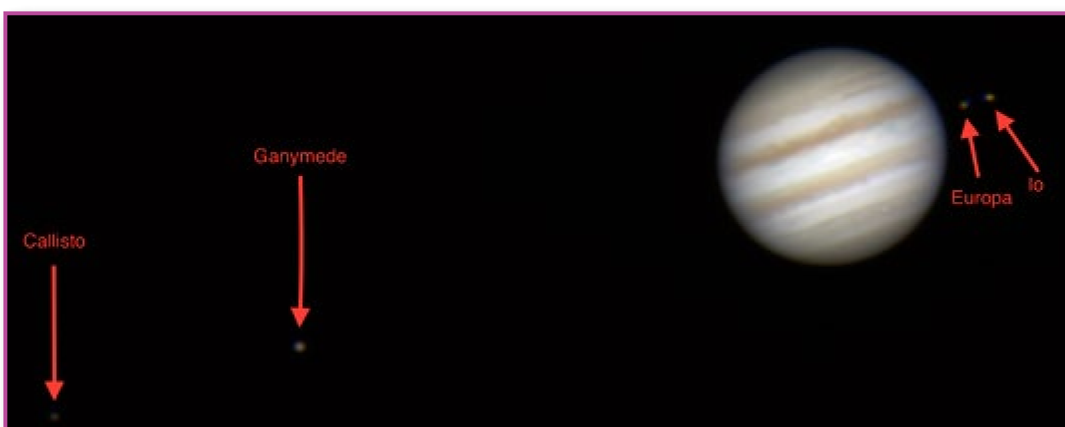
(One arcsecond is 1/3600th of a degree, or about the angular size of a U.S. dime at a distance of 2.5 miles.)

However, if a weather front is moving in then the seeing can blow up. That's what happened when the picture on the left was taken of M95 (NGC 3351). The seeing in this case was 2.3 arcseconds. Although the picture is still quite pretty, we have been anxious to obtain a better one under more typical conditions. On February 27, 2016 we were successful, as shown on the picture on the right. Those images were taken when the seeing was 0.9 arcseconds—certainly not the best we've seen at the DCT by a lot, but at least much better than we had obtained two years earlier. The data consisted of multiple short (100-second) exposures through blue, green, and red filters with the Large Monolithic Imager (LMI), and then turned into these beautiful color pictures by Kathryn Neugent, a Lowell Research Associate.

M95 is a barred spiral galaxy located at a distance of 10.2 million parsecs (33 million light years) in the constellation Leo. The delicate blue colors denote massive stars. A Type IIP core-collapse supernova was seen in this galaxy in 2012. M95 is sufficiently close that it was possible to unambiguously identify the precursor as a faint red star, likely a red supergiant.

On the "good seeing" image on the right, you may notice a blue, green, and red streak at upper right. That was made by an asteroid moving through the field during the exposures through the three different filters.

Another nice picture taken with the LMI is shown below. This time the seeing was exceptional, 0.55 arcseconds. Jupiter is the largest of the Sun's planets, with a mass two and half times that of all of the other planets combined. Despite its huge size (11 times that of Earth's) it rotates in just 10 hours, resulting in a noticeable oblate shape. It takes nearly 12 years to go around the Sun. Numerous moons circle Jupiter, each a little world in its own right: here we see the four satellites discovered by Galileo. Close examination of the image will allow you to determine the direction of motion of each of the four moons, as a minute or two passed between the three images used to make the composite, with the blue image taken fist, and the red image last. The observations were taken with extremely short exposure times (0.001-0.003 seconds) on February 8, 2015.



Frank Paschal epitomized the family atmosphere of Lowell Observatory, with a warm and cheerful demeanor coupled with a genuine pleasure in helping his colleagues. Whether fixing a bad electrical connection or replacing a lock, Frank was always smiling and happy to be at Lowell.

Remembering Frank Paschal

By Ted Dunham and Jeff Gehring

Lowell suffered a great loss in late April when our electronics specialist, Frank Paschal, passed away suddenly and unexpectedly at home. Frank came to us from Austin, Texas very nearly one year before. In addition to being an electronics expert, Frank was an avid amateur astronomer and just a nice guy whose dedication, competence, and good company we enjoyed every day.

Though he was only with us at Lowell for a year, he touched many parts of the observatory including work on the Clark Telescope drive, portable telescopes for the public program, the Mallincam video system's wiring, upgrading the LONEOS telescope control electronics, and fixing various thorny problems at both Anderson Mesa and on Mars Hill. Frank was thinking ahead to upgrading the Pluto Telescope's drive system, a task, alas, that will fall to someone else. As it happens, Frank was also a locksmith who helped us out in this capacity on several occasions.

Frank very much enjoyed plying his trade in the interests of astronomy, combining his vocation and avocation as so many of us here at Lowell are privileged to do. We miss him every day, and our thoughts go out to his family.

The Pluto Discovery Telescope and its housing have been in use for nearly nine decades and are in desperate need of repair.

Did You Know...?

After discovering Pluto in 1930, Clyde Tombaugh continued to generate and examine photographic plates of the sky until 1942, at which time he had photographed about 75% of the sky visible from Flagstaff.

Lowell Observatory is now planning to restore the Pluto Discovery Telescope, which Tombaugh used for all of this work. Please consider helping us in this effort by making a financial donation at https://lowell.edu/priority-projects/pluto-telescope/

Science of Space Gala Recap

This past June, 263 people attended *The Science of Space*, Lowell Observatory's 5th Annual Fundraising Gala, at the High Country Conference Center. Highlighted by a science expo and presentation by space exploration pioneer Stamatios Krimigis, the event generated nearly $80,000. These proceeds will support new research and outreach initiatives and the preservation of Lowell's historic Pluto discovery telescope. Sponsors of the Gala included APS (presenting sponsor), Blue Cross Blue Shield of Arizona, M3 Engineering, NAU Office of the President, Northern Arizona Healthcare Foundation, Findlay Toyota, Loven Contracting, and Michael Beckage.

Lowell Director Jeff Hall, left, greets local artist George Averbeck during the Gala's Astronomy Expo.

The Mallincam video system is an excellent tool for describing astronomical objects and their features to large audiences. Both educators and astronomers use Mallincam during select public evenings. Here, astronomer Gerard van Belle points to a galaxy on the Mallincam screen.

Mallincam Gives Visitors Live Astronomy Video

By Travis Brown

The Public Program has grown a whole lot in the past few years: we have more tours, more evening programming, and the restored Clark Telescope has been back in operation for nearly a year. But as of late there's more: if you come on the right night, on your way out to the telescopes you'll encounter the soft glow of a giant screen showing live, long-exposure images of otherwise difficult-to-discern celestial objects: the spiral arms of the Whirlpool Galaxy, the pinks, blues, and greens of nebulae, the multiple tails of passing comets, and more.

The Public Program's astronomy video system—called Mallincam after the specially designed Mallincam camera—is being used more than ever. It's comprised of an 8-inch reflecting telescope, our finest portable tracking mount, the camera, and a rolling 51-inch plasma TV. Educators and volunteers roll the telescope and display out to various points on campus, use the TV to educate and present on astronomy before sunset, and perform a fresh alignment after sunset every night to facilitate exposures upwards of a minute long. Ask an educator, and they'll be happy to show you saved images from past nights.

It started years ago with the efforts of volunteer Bill MacDonald. Although the Mallincam unit doesn't strictly need a computer to show good images, in 2006 a PC was set up on a cart with a large monitor and the staff started to learn to use the system to amaze the public. Earlier this year, the system underwent a complete overhaul: now we are using a new computer and a larger TV screen, on a better-functioning (and better-looking) mount made by Jeff Gehring and innovatively wired by the late Frank Paschal. Our new system allows us to perform hot pixel removal, live image processing, image capture, and frame stacking functions.

Lately, we bring the system out every Friday to show the public not just incredible images of the heavens, but to act as an avenue of education directly from the research staff. Lowell astronomers are invited to join Public Program staff and use the display—and relevant images, if they are to be had that evening—to educate guests about the research they're performing and to generally give guests a chance to meet an astronomer and ask questions.

As with any of our telescopes, we can't bring it out every night due to weather concerns, but since it is able to show long-exposure images, the Mallincam is sometimes the best instrument we have available, especially on hazy evenings. If you haven't had the pleasure of seeing what it has to offer, grab a cup of hot chocolate and stop by!

2017 Solar Eclipse Event in Oregon

Join Lowell Observatory in Bend, Oregon for the 2017 solar eclipse. In addition to 2:04 minutes of total darkness (we will venture north of Bend), we'll host star parties and astronomer talks. Check the Lowell website for up-to-date information and registration information.

https://lowell.edu/lowell-observatory-solar-eclipse-experience/

Madras, Oregon is a farming community with a population of about 6,000 people. Located 43 miles north of Bend, it will be the site for Lowell's total solar eclipse experience next August.

Carl Lampland worked his entire professional career at Lowell Observatory, from 1902 until his death in 1951. Besides his vast collection of correspondence, he also kept a daily diary of observatory activity. Today this serves as a valuable resource for historians.

Carl Lampland Collection, Part 2

By Karen Kitt

Since my original project to review and update entries of Carl Lampland's correspondence in the Lowell archive database (DB) has been completed, I am now scanning the more significant letters and importing them into the DB. As a result, when users access the DB they will be able to read the actual correspondence.

I wrote in my first article that Carl was a jack-of-all-trades and I must now say that is an understatement. He was recognized as an authority on the measurement of planetary radiation after his extensive Mars investigations. He built, tested, and successfully implemented all sorts of apparatus (including an inexpensive blink comparator for amateur astronomers) in order to do his research and to assist others in pursuing theirs. And he garnered the respect of many of the scientists he collaborated with. One prime example is reflected in his correspondence with Clyde Tombaugh while Tombaugh was at Kansas University.

One of Lampland's tasks outside of actual astronomy included creating the library at Lowell. Starting in 1917 he wrote to the Library Bureau for guidance and materials. In addition, he accompanied Percival Lowell on his botanical expeditions and ordered much of the material needed on these journeys. Speaking of journeys, he and the Sliphers often attended various conferences (American Astronomical Society, American Association for the Advancement of Science) around the world. Early on it was quite an ordeal: train rides to the east or west coast and then travel on a ship for a few more weeks.

In today's world we take for granted the speed of communications. In seconds an email reaches its destination. But back in Lampland's time, especially in the early 1900s, just about everything was done by mail and telegraph. Problems and issues that needed answers were misunderstood or an important letter was lost in the mail. The confusion that arose sometimes lasted months with many letters back and forth.

For those individuals wishing to see an example of some of the correspondence now in the DB, I have finished scanning and importing Lampland's correspondence with A. Lawrence Lowell, Percival's brother and author of Percival's biography. Lawrence was very appreciative of Lampland's work in compiling the extensive data at the observatory and in his explanations of many scientific matters that Lawrence was not familiar with.

To access the archive, on the Lowell home page select "Research" then click on "Library and Archives Catalog" under "Research Resources". Select "Correspondence" from the dropdown menu under "Archives". After clicking on "Search", enter Lampland as the "Collection" and the correspondent's name in the space next to "Correspondents". After clicking on "Search" scroll down to view the actual letter(s).

I have just finished working on Lampland's correspondence with Constance Lowell, Percival's wife, so check it out.

Preserving Blueprints and Drawings

The Lowell Observatory Archives houses more than one hundred original blueprints and drawings of the observatory's telescopes and buildings, including the Clark Telescope and Slipher Building. Many of the drawings have been rolled up for decades and need to be flattened using humidity. Facilities Assistant Glenn Hill built a humidification chamber from reclaimed wood, and volunteer Winston Fredrickson has been busy with the project. Once the drawings are flat, we catalog and move them to the Putnam Collection Center. Future plans include digitizing them for use by researchers and the public. — *Lauren Amundson*

Glenn Hill's humidification chamber is set up in the basement of the Slipher Building. Documents are first put into the chamber for a short time, then unrolled and flattened underneath a heavy piece of glass.

Todd Gonzales will combine his love of astronomy, extensive training in education, and outgoing personality to help further Lowell's development efforts.

Todd Gonzales Joins Development Team

Todd Gonzales has been a familiar face in the Public Program since 2010, giving lively tours, operating telescopes, and sharing his passion of astronomy with guests. Now he will use his talents in the Development Department, where he recently took on the new position of Philanthropy Ambassador/Formal Educator. Todd grew up in Victorville, California and later attended Northern Arizona University, where he earned a Bachelor of Science Education degree. He has taught in both formal and informal settings, including two years of middle school and a variety of camp and community education courses. He will take on a number of tasks in his new position as Lowell, focusing on helping to create and maintain positive relationships between donors and the observatory that will result in a wide variety of gifts. He will also continue to help Lowell's outreach efforts, using his strong background in education to develop curriculum for efforts such as the Navajo-Hopi Astronomy Outreach Program.

Guest Comments

Many visitors review Lowell Observatory on crowdsourced review websites. Here are a few recent comments:

Trip Advisor

"Something for the science as well as the history geeks at every turn. Well done!"

August, 2016 Guest

"Be brave and find your inner astrophysicist! It truly was interesting and educational. Very glad I went!"

July, 2016 Guest

Google Reviews

"It's definitely a must do if you are in Arizona!"

August, 2016 Guest

"Plenty of telescopes to look through. Lots of information both displayed and being explained by the staff. Definitely a fun place for any type of occasion."

April, 2016 Guest

"It was an experience that I will remember for the rest of my life."

March, 2016 Guest

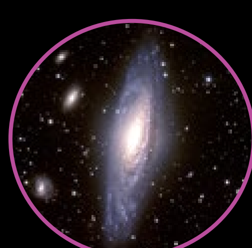
"Great presentations, wonderful displays and very friendly staff. We bought the family year membership, that's how much we enjoyed our visit. We will be back as often as possible."

January, 2016 Guest

Upcoming Members-Only Event

We invite all our members to join us for an afternoon at Lowell Observatory on **October 8, 2016** from 3 to 5 p.m. Come enjoy family-friendly activities such as a special SlipherVision presentation, science experiments, and solar viewing (weather permitting). We hope to see you there!

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.

Hunter, Deidre A.; Elmegreen, Bruce G.; Gehret, Elizabeth. Young Star Clusters in the Outer Disks of LITTLE THINGS Dwarf Irregular Galaxies. *The Astronomical Journal*, Volume 151, Issue 6, article id. 136, 12 pp.

Image: Neugent/Massey/Lowell Obs./NSF

THE CI TAU b YOUNG GIANT PLANET
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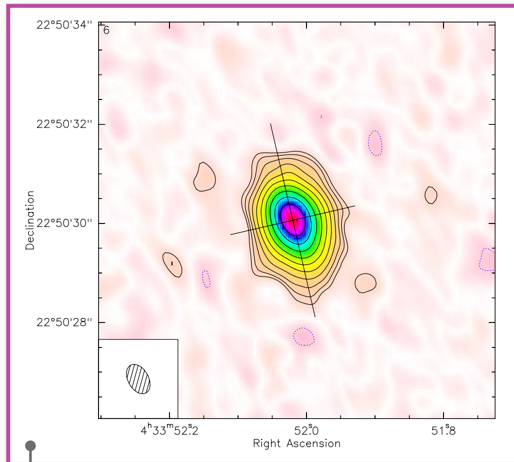
of the worst human infant tantrum imaginable times 100! They display massive star spots, analogous to sunspots, which can cover half of their surface. They are surrounded by the remnant material from their formation in a disk of dust and gas, stretching out to two times the extent of our own solar system. These disks provide the raw material for planet formation but also are a source of gas streams onto the central star, giving rise to hot spots and massive shocks.

In spite of all the drama involved in the behavior of young stars, my team has detected evidence for an extremely young and massive planet, more than 11 times the mass of Jupiter, in the CI Tau system. For more than a decade we recorded tiny but systematic shifts in the velocity of the star characteristic of the gravitational tug of an unseen planet (because planets "shine" in reflected star light). What is exceptional about our detection is that we have truly caught this system in the act: CI Tau is a young star surrounded by a substantial disk of material inside of which we see the emergence of a baby giant planet. With these observations of all the pieces of the puzzle, we can say with confidence that planets form rapidly after their parent stars, they form from the circumstellar disk material, and very massive planets are possible at very young ages even extremely close to the star. CI Tau b orbits its star, CI Tau, every nine days!

These findings have important implications for astronomers' understanding of all planet formation and are particularly intriguing for their impact on the formation of Earth-like planets in the inner parts of these distant star systems.



The colored contours in this image show the dust and gas disk, tilted with respect to our line of sight, which surrounds the young star CI Tau and its giant planetary companion. Astronomers have long believed that planets form from the gas and dust in such disks; the detection of a planet in the CI Tau system demonstrates the viability of this process. *Credit: Stephane Guilloteau, University of Bordeaux*

LOWELL OBSERVATORY FOUNDATION *Supporting the Mission of Lowell Observatory*

Elizabeth Roemer Foundation Donation

Elizabeth Roemer was a member of the Friends of Lowell Observatory since 2006 and also a member of the Percival Lowell Society.

Before passing away this past April (see her obituary on page four), she made a donation that was used to create an instrumentation fund in the Lowell Observatory Foundation. This will go to support the acquisition, development, maintenance of, and access to technologies, instruments, and telescopes located within the observatory's facilities or elsewhere. Such support includes any infrastructure needed for safe and effective operation of that equipment and technology.

Volunteers Rediscover the Red Shift

Many visitors come to Lowell to look through our telescopes and marvel at Flagstaff's pristine night skies. The observatory's daytime tours and beautiful campus add further dimension to the visitor experience, opening doors to our rich history and astronomical achievements. Among the most significant of these is Lowell astronomer V.M. Slipher's 1912 discovery of the large recessional velocities of galaxies, commonly called the Red Shift.

Some visitors might not be aware that another Red Shift (with the scientific name Coreopsis), a perennial flower with yellow blooms that shift to red in the fall, decorates several areas on the campus. Dozens of other plants, shrubs and trees help provide a unique and memorable visit for observatory guests.

Two Lowell volunteers, Marie Schimmelpenninck and Amanda Blanco, have begun a yearlong project to photograph and describe Lowell's botanical treasures and create signs to aid visitors in identifying our fabulous flora.

— *Mary DeMuth*

Marie Schimmelpenninck peaks around Amanda Blanco in front of the Putnam Collection Center during a recent excursion to document the plant life on Mars Hill.

THE LOWELL OBSERVER

UPCOMING SPECIAL EVENTS

OPEN YEAR-ROUND
Monday - Saturday: 10 a.m. - 10 p.m.
Sunday: 10 a.m. - 5 p.m.

HOLIDAY HOURS
Closed at 5 p.m. Nov 23 | Closed all day Nov 24 and Dec 24-25

RECURRING EVENTS

2nd Friday Science Night | OCTOBER 14 *(Optics and Optical Illusions),* **NOVEMBER 11** *(Air Pressure and Fluid Dynamics)* **| DECEMBER 9** *(Energy and Thermodynamics)*
Show at 6 p.m.

School is Out and Kids are Free | NOVEMBER 11
10a.m. - 5 p.m.

Coconino Astronomical Society Monthly Meeting | OCTOBER 8, NOVEMBER 5
6:45 - 8 p.m. | *Free*

OCTOBER

FRI 21 | Orionid 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*

28-29 | Halloween
(5 - 10 p.m.) *Special Halloween-themed activities*

NOVEMBER

FRI 18 | Leonid and Taurid Meteor Shower
(6 and 8 p.m.) *Family-friendly meteor shower activities*
(7 p.m.) *Lecture about the source of the meteor showers and viewing tips*

DECEMBER

TUE 13 | 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*

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

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LOWELL OBSERVATORY

The Lowell Observer is published quarterly by
Lowell Observatory, 1400 W. Mars Hill Road, Flagstaff, AZ 86001
For comments about the newsletter, contact
Historian Kevin Schindler: kevin@lowell.edu | 928.233.3210
Layout and Design by Sarah Conant
 ISSN 1054-0059

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