

THE

LOWELL OBSERVER

EXPANDING OUR UNIVERSE

The quarterly newsletter of Lowell Observatory

Issue 97

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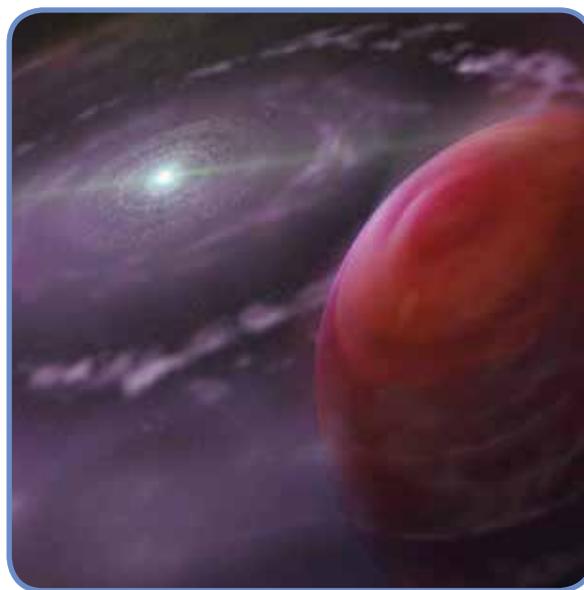
Detecting Molecules In An Exoplanet Atmosphere

A team of researchers, including Lowell astronomer Travis Barman, have made the most detailed examination yet of the atmosphere of a Jupiter-sized planet beyond our Solar System.

According to Quinn Konopacky, an astronomer with the Dunlap Institute for Astronomy & Astrophysics, University of Toronto, and lead author of the study, "We have been able to observe this planet in unprecedented detail because of the advanced instrumentation we are using on the Keck II telescope, our ground-breaking observing and data processing techniques, and because of the nature of the planetary system." The paper presenting this breakthrough discovery was published in the journal *Science* on March 21st.

The team, using the OSIRIS instrument at the Keck II observatory, has uncovered the chemical fingerprints of specific molecules, revealing a cloudy atmosphere containing water vapor and carbon monoxide. "With this level of detail," said co-author Barman, "we can compare the amount of carbon to the amount of oxygen present in the atmosphere, and this chemical mix provides clues as to how the planetary system formed."

There has been considerable uncertainty about how planets in other solar systems formed, with two leading



Artist's rendering of planet HR 8799c at an early stage in the evolution of the planetary system, showing the planet, a disk of gas and dust, rocky inner planets, and star HR 8799. Credit: Dunlap Institute for Astronomy & Astrophysics; Mediafarm.

For information about research and other Lowell news, visit our blog at: <http://www.lowell.edu/news/>

models called core accretion and gravitational instability. When stars form, a planet-forming disk surrounds them. In the first scenario, planets form gradually as solid cores slowly grow big enough to start acquiring gas from the disk. In the latter scenario, planets form almost instantly as the disk collapses on itself. Planetary properties, like the composition of a planet's atmosphere, are clues as to whether a system formed according to one model or the other. "This is the sharpest spectrum ever obtained of an extrasolar planet," said co-author Bruce Macintosh, an astronomer at the Lawrence Livermore National Laboratory. "This shows the power of directly imaging a planetary system – the exquisite resolution afforded by these new observations has allowed us to really begin to probe planet formation."

Although the planet's atmosphere shows clear evidence of water vapor, that signature is weaker than would

be expected if the planet shared the composition of its parent star. Instead, the planet has a high ratio of carbon to oxygen – a fingerprint of its formation in the gaseous disk tens of millions of years ago. As the gas cooled with time, grains of water ice formed, depleting the remaining gas of oxygen. Planetary formation then began when ice and solids collected into planetary

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Director's Update

by Jeffrey Hall

Greetings to all our friends, colleagues, and supporters.

In the first quarter of 2013, we were very pleased to see the first successful science nights carried out at the Discovery Channel Telescope (DCT). We are still mostly involved with bringing the new telescope into full operation, with only about 10 nights out of the 90 in the quarter devoted to science observations. However, it was still a milestone to see astronomers on our staff and from our partner institutions beginning to explore the capabilities of the DCT and its main imaging camera. While there were a few operational glitches (hardly unexpected for a new facility like this, and we're working on those) and a few bouts of bad weather (a little less obvious what we can do about that), in general the observers were extremely positive about the DCT's image quality as well as its ease of use.

We also were very pleased to carry out the first significant outreach

event from the DCT at the end of February. A crew from Discovery Education traveled to Flagstaff to produce a live online event streamed to schools across the United States through Discovery's education network. A daytime event went into a few thousand classrooms across the country with some tens of thousands of students tuned in; for about an hour we discussed how the telescope works, how it is engineered, and the kinds of science we will do with it. The question-and-answer feed was bursting with queries from kids from all over. The same evening, we reprised the event with the DCT fully in action, observing objects live and discussing how real astronomical data are acquired and analyzed.

The past two months have therefore amply demonstrated the enormous potential of our new facility, which comes online at precisely the time that general access for astronomers to research-grade telescopes is becoming increasingly scarce. The possible loss to the astronomical community of open access to facilities on Kitt Peak and elsewhere puts Lowell in a uniquely strong position as the owner of not only its new 4-meter-class telescope, but several other existing smaller telescopes and with observing access, through our contract with the U. S. Naval Observatory, to the Navy Precision Optical Interferometer. We

assumed substantial risk to get to this position, but it would be increasingly difficult to maintain our mission as a research observatory without it.

The essence of this letter, therefore, is simply to thank everyone who contributed to those first images that we delivered to our observers last quarter. This includes everyone on the Lowell staff, for building DCT took everyone we had. It includes Bill Putnam, Bob Millis, and John Hendricks, who drove the project forward. It includes our Advisory Board and all of our Friends and donors who have given so generously to Lowell over the years; I believe that especially in light of the increasingly grim prognosis for federal support of basic research, you will become the key to the security of Lowell and institutions like it, to

the communication of the excitement of what we do to the next generation, and to the pursuit of knowledge.

Many thanks to all and wishing you a very pleasant Spring. ☺

The Horsehead Nebula (below) is a dark nebula (dust cloud) that is seen silhouetted against the purplish glowing hydrogen gas that is ionized by the nearby bright star Sigma Ori. The Horsehead is located approximately 1,500 light-years away, in the constellation of Orion. The color composite was created with exposures taken with the Large Monolithic Imager (LMI), the DCT's National Science Foundation (NSF) funded science-grade CCD imager, on March 6th. It is a properly oriented commissioning image for demonstration purposes. More LMI/DCT pictures: <http://www.lowell.edu/techSpecs/LMI/gallery.html>

Image credit: Massey/Neugent/Lowell Observatory/NSF



Suited for Space

by Samantha Thompson

If you've had a chance to visit the Steele Visitor Center exhibit hall recently, you've surely noticed some changes! Gone are the old displays, making way for a rotation of engaging, temporary exhibits. These new exhibits will open several times a year, providing a wonderful opportunity to explore different areas of astronomy. Nearly 19,000 visitors experienced our opening exhibit "A New Perspective on Mars: The Red Planet in 3D" that featured 12 large 3D images of the Martian surface.

Our newest exhibit, "Suited for Space," takes visitors on a remarkable journey through the history of spacesuit design and development, from the earliest high-altitude pressure suits to the iconic white suits of Apollo. In May 1961, when President Kennedy promised to put a man on the Moon within a decade, the ability to fulfill that promise existed only in theory. To achieve this ambitious goal, astronauts would need not only a spacecraft to launch them safely into space, but a spacesuit that would protect them as well. The spacesuit was a critical piece of engineering that allowed Neil Armstrong to step onto another world and survive in the hostile environment of outer space. The Apollo spacesuit he



One of the exhibit's main attractions is a replica Apollo-era spacesuit. "Suited for Space" is developed by the Smithsonian Institution Traveling Exhibition Service (SITES) in collaboration with the Smithsonian's National Air and Space Museum. The national exhibition tour is generously supported by DuPont.

wore evolved from the groundbreaking advances of the Gemini and Mercury mission suits, facilitating movement and dexterity in small spaces, remaining pressurized in zero gravity, and providing essential oxygen, heating, and cooling in as efficient a manner as possible.

Through rare and original photography, including unique, new X-ray images of the interiors of the spacesuits, this Smithsonian Institution-designed exhibit reveals how the modern technological marvel that is the spacesuit enables astronauts to live and work in space. While the fragility of these spacesuits prevents them from traveling, this exhibit features a replica Apollo spacesuit on loan from NASA and 10 original objects from the National Air and

Space Museum's collection, including a glove, a boot and helmets. Visitors can examine unusual details of every suit, get up close and personal with objects and artifacts, hold an astronaut's glove and even take a photograph "wearing" an Apollo suit.

See for yourself the unparalleled creativity and determination of the extraordinary few who ventured into space and the brilliant ingenuity of the hundreds more who worked tirelessly to get them there. Flagstaff is just one of 11 cities privileged to host this exhibit so don't miss this opportunity to see a piece of history. "Suited for Space" is open until June 16th. 📍

For more visit: http://www.lowell.edu/visit_specialexhibit.php

Online Fundraising Campaign Launched To "Restore The Clark"

Restore The Clark



After 117 years of service, the massive Clark Telescope needs an overhaul so it can continue to be the centerpiece of our public program for the next century. However, such an effort isn't easy or cheap so we need your help!

On March 13th – Percival Lowell's birthday – we launched an official crowdfunding campaign on Indiegogo.com to raise the much-needed funds for the Clark restoration. Donors will receive Clark-related merchandise/experiences commensurate to their gift to the campaign.

Help us restore the behemoth used by Percival to study Mars, by V.M. Slipher to detect the first evidence of the expanding nature of the Universe, and looked through by more than a million visitors in the past 20 years alone. Our Director

of Technical Services and telescope guru extraordinaire Ralph Nye will set the Clark up for another century of good seeing for visitors to Mars Hill! **Indiegogo campaign homepage:** <http://igg.me/at/restoretheclark>

Exoplanet Atmosphere

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cores. “Once the solid cores grew large enough, their gravity quickly attracted surrounding gas to become the massive planets we see today,” said Konopacky. “Since that gas had lost some of its oxygen, the planet ends up with less oxygen and less water than if it had formed through a gravitational instability.”

“Spectral information of this quality not only provides clues about the formation of the HR8799 planets but also provides the guidance we need to improve our theoretical understanding of exoplanet atmospheres and their early evolution,” added Barman. “The timing of this work could not be better as it comes on the heels of new instruments that will image dozens more exoplanets, orbiting other stars, that we can study in similar detail.”

The planet is one of four gas giants known to orbit a star called HR 8799, 130 light-years from Earth. The authors and their collaborators previously discovered this planet, designated HR 8799c, and its three companions back in 2008 and 2010. Unlike most other planetary systems, whose presence is inferred by their effects on their parent star, the HR8799 planets can be individually seen. “We can directly image the planets around HR 8799 because they are all large, young, and far from their parent star. This makes the system an excellent laboratory for studying exoplanet atmospheres,” said coauthor Christian Marois, an astronomer at the National Research Council of Canada. “Since its discovery, this system just keeps on surprising us!”

Although the planet does have water vapor, it is incredibly hostile to life – like Jupiter, it has no solid surface, and it has a temperature of more than 1,000 degrees Kelvin as it glows with the energy leftover from its

original formation.

The study of these super-sized planets will continue, taking advantage of a recent upgrade to the OSIRIS instrument (developed at the Dunlap Institute) and access to the Keck Observatory provided by support from NASA and NExScI. “These future observations will tell us much more about the planets in this system,” said Konopacky. “And

the more we learn about this distant planetary system, the more we learn about our own.” ☺

For the complete Science Magazine article, go to <http://www.sciencemag.org/content/339/6126/1398.full>

Read our blog at:
<http://www.lowell.edu/news/>



Dr. Wasserman gave multiple live interviews about both events to the Phoenix CBS affiliate, KPHO, from Meteor Crater near Winslow, AZ on February 15th.

NEOs Abound!

On Friday, February 15th, the sky seemed to be falling as Earth had two close calls with near-Earth objects (NEOs). Astronomers around the world – including Lowell’s Larry Wasserman and Brian Skiff – were fully aware of and monitored the predicted close approach of near-Earth asteroid 2012 DA 14. Approximately 100 feet in diameter and weighing an estimated 40,000 metric tons, 2012 DA 14 passed 17,200 miles from Earth’s surface, 5,000 miles closer than satellites in geosynchronous orbit (such as broadcast satellites).

If that weren’t enough, another completely unrelated and unknown asteroid entered Earth’s atmosphere over Chelyabinsk, Siberia that day, becoming a blinding, shadow-casting superbolide meteor. Scientists believe it exploded at an altitude of 14.5 miles, causing a bright flash, meteorite fragments, and a very strong shock wave that shattered windows, injuring about 1,500 people – the only confirmed meteor event to have resulted in a large number of injuries. At about 60 feet in diameter and weighing an estimated 11,000 metric tons, the Chelyabinsk meteor is the largest known object to have entered Earth’s atmosphere since the 1908 Tunguska event (also over Siberia and known for knocking down an estimated 80 million trees over 830 square miles).

LARI Crosses the Atlantic: Catching Up with @NickAstronomer

by Tom Vitron



Left: Faulkes Telescope North Clamshell Dome located on Mount Haleakala on Maui, Hawaii.

Right: Nick Howes in action.

It was easy to fall in love with space and astronomy when the 1960s "Space Race" was raging between the U.S. and U.S.S.R. You could hardly help but be enthralled at the sight of astronauts on the Moon, the Skylab, and then the Space Shuttle. But with the latter now retired and no immediate replacement for it, the obvious hooks to get kids

interested in space are getting more scarce. That's where educators and avid amateur astronomers like Nick Howes get involved. Through the groundbreaking STEM (science, technology, engineering, mathematics) school program at the UK's Faulkes Telescope Project, Nick is not only getting kids interested in science, he

is putting them to work and in some cases, they're doing work for Lowell scientists!

"Apollo was the hook for me," says Nick, a computer programmer for the government by day, a widely published astronomy freelance writer and pro-am project manager for Faulkes by night since 2009. "There are literal

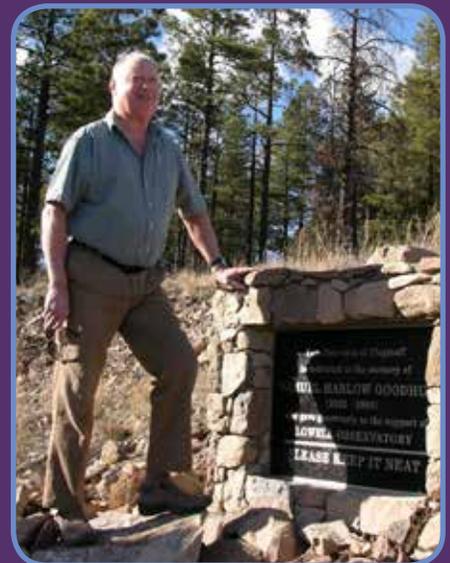
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Lowell Trustee Wins Viola Mayor's Award

In March, Lowell Trustee Mr. William Lowell Putnam III won the Mayor's Award for Lifetime Contribution to the Arts & Sciences at the Viola Awards, Flagstaff's cultural and scientific awards event. His efforts to ensure Lowell's continued growth and competitiveness during the past quarter century are too many to list here. Relatively unsung is his support of the Flagstaff Symphony Orchestra, the Orchestra's summer concert series at Lowell, and of KNAU, our local public radio affiliate. The latter broadcasts an all-classical feed, and has worked with Bill to bring Garrison Keillor's "A Prairie Home Companion" to Flagstaff twice in the past three years. Congratulations to a most deserving winner!



The 2013 Viola Award is a kaleidoscope created by local artist Christina Norlin.



Lowell Trustee William Lowell Putnam III.

LARI Crosses the Atlantic

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remnants of Apollo that you can look at, including the Apollo 10 LM (lunar ascent module), which is one of our programs at Faulkes (called Project Snoopy). But the real hooks for kids are exoplanets, comets, near-Earth objects, brilliant galaxies, and everything jaw-dropping that we can show them at Faulkes."

Started by businessman and philanthropist Dill Faulkes to get the UK interested in astrophotography, Faulkes aims "to provide free access to robotic telescopes and a fully supported education program to encourage teachers and students to engage in research-based science education." When Nick visited Lowell early last year, he was like a kid at Disneyland. When he subsequently found out on Twitter about the Lowell Amateur Research Initiative (LARI) and the research-matching opportunities, he recognized an immediate fit for Faulkes and its online outreach programs. While kids were already involved with European Space Agency (ESA) projects, this extended Faulkes' reach across the Atlantic.

Partnering with Lowell astronomer Larry Wasserman, Nick and various schools are trying to spy on some of the furthest, smallest (and hence faintest) objects in our Solar System. Using Faulkes' two robotic 2-meter telescopes (one in Hawaii, one in Australia), schoolchildren are assisting Dr. Wasserman in finding positions of Trans-Neptunian and Kuiper Belt Objects, which live in the far reaches and along the outside edge of the Solar System. "I always impress the distance to these objects when I talk to the kids," Nick says. "These objects require a lot of time, about 4 to 5 hours straight of observing. So they learn about patience as well."

The way Faulkes works is that schools get to pick a time slot during themed observing days. Not only

do they get hands-on experience that can inspire a career in science, kids get credited for their work and discoveries in any subsequent research papers. "What a way to teach kids about science, and more specifically astrometry," adds Nick, an avid fan of all Solar System bodies. "The Faulkes Telescopes are huge and can get great images so the kids love it. What I try to do is move them from the 'pretty picture stuff' to more true science."

Reaping the rewards of patient sky observers, Nick and participating schools have successfully hunted asteroids and near-Earth objects (NEOs), and have made national news with observations of a Jupiter Trojan asteroid and of a fragmenting comet. More recently, Nick and the Faulkes program made two very interesting discoveries. First, while doing LARI work, a new comet – C/2010 U3 – was spotted using both Faulkes Telescopes. The Minor Planet Center confirmed in November that the Faulkes' newly discovered NEO was in fact a magnitude 20 (very dim) comet. Second, data from the Faulkes North Telescope's tracking of Comet 103P (a.k.a. Hartley/2 made famous by the successful EPOXI spacecraft fly by) indicated "unusual and rapid activity in the comet's inner coma." The data seem to indicate that if the comet increases its spin rate, it might well break up. Seem too good to be true for an amateur-driven effort? "Amateurs are not constrained by budgets," explains Nick. "They make very valuable contributions to really important science."

"Having Nick on board as our Pro-Am Manager has been great; his enthusiasm and the sheer amount of work he gets through makes a huge difference to the projects we are able to offer our users. He has engaged both amateur astronomers and school groups in the UK and overseas with several programs involving asteroids, comets and other small Solar System

bodies, but the LARI project has been particularly successful," says Faulkes Telescope Project Director Prof. Paul Roche of the University of Glamorgan.

So after he is done "paying the bills" with his day job, Nick enters the realm he truly loves, a realm his parents led him to because they could see the passion in his eyes for all things space, from rockets to robots, from *Star Wars* to supernovae. Even as our Skype session crackles, his passion for science education comes through clearly, even if complete words do not. No need to ask why he gets asked to give astronomy talks all over the UK. He embodies astronomy outreach. "I firmly believe that if I can get one person interested in astronomy and one involved at each talk, my job is done!" Follow Nick on Twitter: @NickAstronomer. For more about Faulkes, visit <http://www.faulkes-telescope.com/> 

To learn more about participating in LARI, visit http://www.lowell.edu/LARI_welcome.php. After a successful first year, LARI needs your financial support to continue to grow and thrive. If you can help, please contact Antoinette Beiser at asb@lowell.edu or call (928) 233-3216.

Michael C.J. Putnam Wins Distinguished Service Award

The American Philological Association (APA) presented Michael C.J. Putnam, former Lowell Trustee and current Brown University Professor of Classics, with the Distinguished Service Award at the 2012 Plenary Session of its 144th Annual Meeting in Seattle. This award – given occasionally rather than annually – is presented for extraordinary service to the profession of classics and the American Philological Association.

Lowell Amateur Collaborator's Work for Dr. Deidre Hunter Featured by NASA

Lowell Amateur Research Initiative (LARI) collaborator Stephen Leshin recently submitted an image of NGC 6822, Barnard's Galaxy, to NASA's Astronomy Picture of the Day (APOD). The beautiful image was captured in collaboration with Lowell astronomer and Deputy Director for Science Dr. Deidre Hunter as part of the LITTLE THINGS dwarf galaxy survey. APOD featured the image Friday, February 8th with a plug for LARI and LITTLE THINGS. Thanks so much to Steve and all our LARI collaborators for the amazing work they do for us! Check out the image's APOD page: <http://apod.nasa.gov/apod/ap130208.html>



NGC 6822, Barnard's Galaxy, a dwarf irregular galaxy in the constellation Sagittarius. A member of our Local Group of galaxies, NGC 6822 is only 1.5 million light years from Earth. It is filled with young blue stars and mottled with the telltale pinkish hydrogen glow of star-forming regions in the deep color composite image. *Image Credit & Copyright: Stephen Leshin, Collaboration: Dr. Deidre Hunter and LARI*

Stratospheric Marketing

Lowell scientists aboard SOFIA (Stratospheric Observatory for Infrared Astronomy, NASA/DLR's airborne observatory) had a little fun at 40,000 feet. The Lowell-built HIPO (High-Speed Imaging Photometer for Occultations) instrument is one of a few specially built SOFIA instruments.



Somebody attached a packing sleeve to HIPO with our rack card tucked inside. . .

Retail Specialist Wins Greenberg Scholarship

Diana Weintraub, Lowell's Retail Specialist, recently received the Greenberg Scholarship to attend the Museum Store Association (MSA) Retail Conference & Expo in Los Angeles. Nice job, Diana!



ARRIVALS

- Oakley Anderson-Moore, Media Assistant
- Nicole Bird, Accounting Intern
- Sarah Conant, Graphic Designer
- Ben Dirgo, NAU Research Intern
- Mica Doucette, Annual Giving Officer
- Katrina McLaughlin, Educator
- Catie Tackitt, Educator
- Aaron Walker, Educator

DEPARTURES

- Michael Gary, Educator
- Joe Jaeger, Graphic Design Intern

2013 PUBLIC PROGRAM SPRING SPECIAL EVENTS

Suited for Space Exhibit: Open until June 16 (regular public hours; see page 3 for more exhibit information)

Second Friday Science Nights: Fridays 4/12 and 5/10

School's Out & Kids are Free Day: Monday 5/27

APRIL

Regular Public Hours:

M/W/F/Sat 9:00 a.m. - 9:30 p.m.

T/TH/Sun 9:00 a.m. - 5:00 p.m.

SAT 20

Astronomy Day

(9:00 a.m. - 9:30 p.m.) – Lowell Observatory will celebrate Astronomy Day with activities throughout the day, including science demonstrations, telescope viewing of the sun, grounds tours, and multimedia presentations. At night, enjoy more science demonstrations, telescope viewing and stargazing.

SUN 21

Lyrids Meteor Shower Star Fest

(5:00 p.m. - 9:30 p.m.) – Join Lowell Observatory for a fun and educational meteor shower night. Learn about the origins of meteor showers, how to differentiate between meteorites, and participate in many science-based, exciting hands-on activities that are sure to be fun for the whole family!

SAT 27

Saturn Opposition

(5:00 p.m. - 9:30 p.m.) – Tonight, Saturn will make its closest approach to Earth this year. Come in to see the ringed planet up close through telescopes, and also enjoy SlipherVision programs and stargazing.

MAY

Regular Public Hours:

M/W/F/Sat 9:00 a.m. - 9:30 p.m.

T/TH/Sun 9:00 a.m. - 5:00 p.m.

SUN 26

Memorial Star Fest

(5:00 p.m. - 9:30 p.m.) – This special event will feature our SlipherVision space show and telescopes set up for viewing celestial objects. At 7 p.m., retired scientist Kent Colbath will give an indoor presentation "Dinosaurs, Plankton and Asteroids: the Science of Studying Mass Extinctions."



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