From Discovering to Describing Near-Earth Asteroids

by Tom Vitron

When the Lowell Observatory Near-Earth Object Search (LONEOS) came to a close in 2008, it did not mark the end of near-Earth object research at Lowell. Rather, it marked a shift from discovering these objects to characterizing them. “[Dr. Ted Bowell] opted to use our resources to study one of the physical properties of near-Earth asteroids (NEAs): rotational period,” says Dr. Bruce Koehn, who recently took the reigns from Dr. Bowell (see article on page 5) and is the principal investigator to LONEOS’s successor, the Near-Earth Asteroid Photometric Survey (NEAPS). The goal is to watch several NEAs each night and, ultimately, get statistics on the rotational properties of NEAs, says Dr. Koehn. Insights are being gleaned about the variety of rotational periods (or how long it takes an asteroid to rotate on its axis), the type of rotation (principal axis or tumbling), and the number of NEAs that have “companions,” or other, even smaller objects orbiting around them. “If we were lucky, we could also find the direction of the principal axis and shape of the asteroid,” explains Dr. Koehn.

With the 24-inch Schmidt Telescope as the workhorse instrument, research assistant Brian Skiff and other observers generated a lot of data over the course of the project. For example, one of the most challenging asteroids observed by NEAPS was 2011 AL37. This asteroid closely approached Earth on January 26, 2011 and was moving at almost 60 degrees per day. Fortunately, it was bright enough that Skiff took short exposures using the Schmidt telescope. The Schmidt, with its wide field, could keep the asteroid in sight even when it was moving so fast. The NEAPS team found the asteroid had a rotational period of 6 minutes, 20 seconds. The only way it could be rotating so fast is if it was a solid piece of rock. Otherwise, it would come apart. Strangely, astronauts would not be able to stand on the surface of this asteroid. If they tried, they would be hurled into space.

NEAPS researchers produced several hundred light curves, which are the project’s main data output. However, more work is required before robust statistics about NEA rotation can be compiled.

Since this research does not require the biggest, most modern telescopes, amateur astronomers are participating in asteroid research. “Their data, combined with ours, will likely make a very good data set,” says Dr. Koehn. “We have made a significant contribution to the understanding of rotation of near-Earth asteroids.”
Summer at Lowell started in the second week of last June in characteristically busy fashion. Not only did we hold the annual meeting of our advisory board, but also a Friends of Lowell thank you event that featured a wonderful talk by Bill Sheehan, noted Lowell and Mars historian. In addition, thanks to the impetus and support of our trustee Bill Putnam, Flagstaff enjoyed a visit that week by Garrison Keillor and a live broadcast of his well-known radio show from Fort Tuthill County Park.

I remember reading Keillor’s story collections as a teenager and smiling as each tale opened with his signature line: It has been a quiet week in Lake Wobegon. Invariably those weeks ended up involving headless chickens, septic tanks, or waterlogged Lutheran pastors, proceeding with glorious inevitability from quiet into mayhem. In that spirit, it has been a quiet summer on Mars Hill. I am not aware of anything involving chickens, except possibly as part of the non-seafood menu at the Trustee’s annual staff lobster party in August.

But the summer has involved Boeing aircraft, specifically the remodeled 747 called Stratospheric Observatory for Infrared Astronomy (SOFIA) that performed its successful first flights in late June, with a number of Lowell folks involved in the airplane itself and afar, including Ted Dunham, Georgi Mandushev, Tom Bida, Brian Taylor, Amanda Bosh, and Stephen Levine.

The summer also involved the Discovery Channel Telescope (DCT) engineers successfully mounting the primary mirror in its support cell and lifting the whole 27,000-pound thing three stories up to the observing level of the dome, where it was seamlessly bolted to the telescope (see below). During all this heavy lifting, a Discovery Channel film crew was here getting everything on video and interviewing a number of us for Discovery’s first major DCT feature, which will air next year.

It saw our scientific staff regularly involved with the public on our summer meet-an-astronomer nights – always a hit with our visitors – and astronomer Lisa Prato traveled as far as Maine to give one of her engaging talks on celestial dust bunnies (a.k.a. star formation) at an event sponsored by several of our board members.

It involved some farewells, including Byron Smith, who oversaw the construction of a beautiful telescope and passed the commissioning baton in July to Bill DeGroff, and Bev Welling, who kept the company books under superb control for eight years. But it also saw some arrivals: we welcomed three outstanding astronomers – Evgenya Shkolnik, Kevin Covey, and Gerard van Belle – to the scientific staff, and electrical engineer Mike Sweaton joined the DCT team.

And as always, we saw the continued lovely mix of engineering and art that goes into making DCT a reality. Commanding some of the top bids at the silent auction at our June Friends event were signed, framed copies of Ralph Nye’s drawings of the DCT’s instrument cube and guider assembly. Ralph’s full-size drawings of the cube and the filter wheel – especially the filter wheel! – are spectacular, and as I write this, lots of parts are being carefully machined to his specifications by Steve Lauman and electronics assembled by Rich Oliver, and the impressive-looking cube is being assembled in our instrument shop. In all aspects of the DCT from its primary mirror to its complex guiding system and instruments, form meets function in singular fashion.

With all of this and more humming along, you won’t be surprised if I say that summer has disappeared in a flash, but that’s okay. May fall be equally quiet. ☨

DCT M1 Mirror Mounting

The DCT staff recently achieved a major construction and commissioning milestone. DCT project manager Bill DeGroff (pictured, right) oversaw the mounting of the primary (M1) mirror cell in early August. A big congrats to the DCT folks who made it happen!
Three New Astronomers

by Tom Vitron

Dr. Evgenya Shkolnik

When asked what she wanted to be while in the 7th grade, Dr. Evgenya Shkolnik said she wanted to be an astronaut. By the next year, the goal was even bolder: be the first person on Mars. Clearly motivated and not shy, Dr. Shkolnik instead became a highly skilled and respected astronomer and is now bringing her talent and expertise to Lowell.

Born in Kiev, Ukraine, Dr. Shkolnik grew up near Hamilton, Ontario. Fascinated with science, Dr. Shkolnik attended Dalhousie University in Halifax, Nova Scotia, where she received undergraduate degrees in math and physics. Wanting to work on MOST – Canada’s small space telescope designed for ultra-high-precision photometry of stars – Dr. Shkolnik switched coasts and enrolled at the University of British Columbia, a main partner in the MOST project. While she did her Master’s on that research, she switched to exoplanets for her PhD. “Exoplanets are what got me into astronomy,” she says, pointing to the discovery of the first exoplanet in 1996 as decisive for her. After completing her studies in 2004, she worked as a postdoctoral fellow at the Institute for Astronomy at the University of Hawaii at Manoa and as a Carnegie Fellow at the Carnegie Institution of Washington’s Department of Terrestrial Magnetism.

Dr. Shkolnik’s focus is characterizing exoplanets after their discovery. For almost 10 years, she’s been studying these newfound worlds for magnetic fields, atmospheric composition, tidal evolution, and any effect on the parent star. “I’m not yet a planet hunter,” she says.

Choosing to come to Lowell made perfect sense to her. “The ideal is what Lowell is putting together,” Dr. Shkolnik explains. Excited to join to Lowell’s expanding exoplanet group, she points to the freedom that Lowell offers to do the research you want to do. In addition, access to a four-meter telescope will be essential for identifying changes in stellar systems through star-planet interactions. “DCT is one of the reasons I came,” Dr. Shkolnik says. “Once DCT is equipped with spectrographs, it will be critical to see how things change in these systems, how stars and planets interact, both magnetically and tidally.”

As she settles into downtown Flagstaff with her husband Aaron and their three young children, Dr. Shkolnik is very impressed with the diversity of Flagstaff and feels welcomed. Coming to work at our historic institution seems like a great fit. “You get to spend your day in a way that benefits your research to the fullest possible extent,” Dr. Shkolnik says. “Being in a place like Lowell is perfect.”

Dr. Gerard van Belle

Los Angeles, Boston, Flagstaff... Wait, how does Flagstaff fit into this equation? “Flagstaff is a real cluster of scientific excellence,” says Dr. Gerard van Belle, pointing to the presence of Lowell, U.S. Geological Survey, the US Naval Observatory – Flagstaff Station, and Northern Arizona University. “People know what goes on in LA and Boston but Flagstaff is in the same sentence. We’re on the map.” Dr. van Belle recently joined the staff after four years at the European Southern Observatory (ESO) in Munich.

Born in the U.S. to Dutch parents, Dr. van Belle received a bachelor’s degree in physics from Whitman College, a Master’s in physics from The Johns Hopkins University, and a PhD in physics from the University of Wyoming in Laramie, where he came to enjoy the high-altitude, small-town lifestyle. Eager to share that lifestyle in Flagstaff with his wife, Stephanie, and their three young boys, Dr. van Belle comes to Lowell with a wealth of expertise in near-infrared interferometry, or the group of techniques in which electromagnetic waves are superimposed in order to extract information about the source object. Aside from ESO, he previously worked at Jet Propulsion Laboratory (JPL) as an instrument architect for NASA’s Keck Interferometer and at Caltech’s Michelson Science Center (now the NASA Exoplanet Science Institute), where he participated in commissioning Georgia State University’s CHARA Array and the Palomar Testbed Interferometer. Using the latter, Dr. van Belle led a team that made the first direct measurement of stellar shape by studying the rapidly rotating star Altair. He also served as instrument scientist for various ESO interferometry instruments. Aside from shape, Dr. van Belle also studies the fundamental parameters of radius and temperatures for stars, stellar rotation, and other viable targets for interferometry.

He is also working on planetary detection through ground-based transit observations, or when a

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planet passes in front of its host star. As you might expect, part of the Lowell appeal is getting to utilize the DCT and its interferometry and visible-light capabilities. In addition, Dr. van Belle is confident that a possible upgrade to the NPOI would make it “a dominant player in the interferometry world,” he says.

Not wedded to the techniques, Dr. van Belle is focused on the science as he catches his breath and plans his next four papers. He is also taking account of where the field of astronomy is now and where it is headed, envisioning the instruments of the future including space-based mirror arrays.

For now, he is happy to make the transition back to American life, going through what he calls “reverse culture shock.” But here in Flagstaff, he remains on the global astronomy stage. “The work being done at Lowell is all cutting edge,” Dr. van Belle says. “People know Lowell worldwide.”

When Mars Hill gets draped in a thick sheet of snow this winter, don’t be surprised if you see Dr. Kevin Covey snowshoeing up the slope to work. While the Portland, Oregon native and his wife, Sarah, are keen to take advantage of Flagstaff’s outdoor culture, Dr. Covey comes to Lowell ready to build upon an already impressive research resume focused on low-mass stars and star formation. After graduating with a bachelor’s degree in physics from Carleton College (just like Lowell deputy director Dr. Ted Dunham), he went back to the Pacific Northwest and worked on his PhD at the University of Washington. He was then awarded two prestigious post-doctoral positions: a Spitzer Fellowship at the Harvard-Smithsonian Center for Astrophysics, and a Hubble Fellowship at Cornell University.

Dr. Covey’s interest in stars began when he participated in a summer Research Experiences for Undergraduates (REU) program at Bucknell University. Like most astronomers, his passion extends beyond a specific area of research but he is now a low-mass star expert. He examines very young and very old low-mass stars, both of which lend themselves to observation at redder wavelengths, explains Dr. Covey. He utilizes a wide range of observational data in his research, piecing together a global portrait of a star’s surface and environment from the different types of light that each component emits. He is currently using multi-epoch images from Palomar to measure rotation rates for stars. “Once you have a star’s rotation rate, you can then look at its spectra to study how that rotation affects the strength of its magnetic field.”

Coming to Lowell not only means access to world-class instruments like the DeVeny Spectrograph (currently in use at the Perkins Telescope) and the DCT’s Large Monolithic Imager, it also means access to star-research cohorts. “Though Lowell is still very active in solar-system research, it has also assembled a strong core of astronomers who study stars and exoplanets,” Dr. Covey explains. “Usually, an institution needs to be huge to have five or six people all working in that research area. Lowell’s ability to sustain that level of scientific expertise, without sacrificing the collegial environment that makes the Observatory so special, is one of the institution’s most attractive features.”

Your continued support is appreciated and is critical to our success!
Dr. Ted Bowell Retires

by Tom Vitron

To many in attendance, the easel appeared out of nowhere, suddenly occupying a spot in the nearby lawn. More intriguing yet, a large, painting-like object veiled in a black cloth sat on the easel. Attendees of Lobsterfest 2011 who saw near-Earth object expert Dr. Ted Bowell (assisted by machinist Steve Lauman) walk in with the easel knew he must be the mastermind behind this mystery. Like so often before, this gentleman from London would soon shed light on another important and memorable contribution to Lowell Observatory, as the Lobsterfest marked his official retirement from the scientific staff after an illustrious career.

Dr. Bowell came to Lowell in 1973 after meeting Dr. Bill Baum, the director of Lowell’s Planetary Research Center, at a NATO workshop in Istanbul. The two hit it off and Dr. Baum offered him a job on Mars Hill, making the assumption that he had a PhD, though he did not. After graduating from London’s University College, Dr. Bowell had taken a job studying the Moon’s surface at l’Observatoire de Meudon near Paris and was employed there when he met Dr. Baum. To further his career and qualify for the job at Lowell, Dr. Bowell completed “the fastest PhD ever” in a six-week process which took into account his existing research findings at l’Université de Paris 6.

Bowell’s thirst for discovery and passion for asteroids solidified when Lowell legend Henry Giclas invited him to see the process of exposing photographic plates at the Pluto Telescope (the astrophotograph now at the end of the Pluto Walk on Mars Hill) and using a Zeiss blink comparator to examine the plates. “Henry let me blink a couple of plates and I immediately found an asteroid,” recounts Dr. Bowell. “I was hooked. Discovering an unknown body as big as 100 km in diameter gave me quite a charge. It occurred to me that we had all the equipment here—the telescopes, plate-scanning machine, computers—to revolutionize the discovery of relatively nearby bodies.” But why do this? “Because we didn’t know much about the overall structure of the solar system in 1980.” Dr. Bowell and Dr. Larry Wasserman developed a process to discover and track asteroids. “It took more than two decades,” says Dr. Bowell. “It came from a simple idea. When and how often do I observe an asteroid so as not to lose it? The thought became a major suite of research.” Collaborators from the University of Helsinki, including Dr. Kari Lumme and Dr. Karri Muinonen, were essential to the effort. Bowell’s work on asteroids has also extended to the international arena: between 2006 and 2009 he was president of Division III of the International Astronomical Union.

However, no one influenced Dr. Bowell’s seminal work as much as geologist Eugene Shoemaker, the iconic observer who encouraged him to orient photographic asteroid work to look for near-Earth asteroids. “Shoemaker single-handedly developed that subject and brought to the world its importance. He was the one-man band on this subject for decades,” explains Dr. Bowell. Thanks to Shoemaker, there is a congressional edict to search for near-Earth asteroids. (Shoemaker’s widow, Carolyn, serves on Lowell’s advisory board.)

After years of careful planning and grant writing, the Lowell Observatory Near-Earth Object Search (LONEOS) began in 1998 with Dr. Bowell at the helm, assisted by Dr. Bruce Koehn and research assistant Brian Skiff. The program continued for 10 years, searching for Earth-approaching asteroids and comets using a fully automated 0.6-m Schmidt telescope at Lowell’s dark-sky site at Anderson Mesa. LONEOS discovered 289 near-Earth asteroids and 42 comets, taking some 450,000 individual exposures of 130,000 regions on the sky. (For more on LONEOS, look in the Spring 2008 Observer.) “Lowell is a perfect place for large-scale and long-lasting surveys, in part because of the facilities, the support, and the freedom,” says Dr. Bowell.

Though Dr. Koehn is now managing the successor to LONEOS, the Near-Earth Asteroid Photometric Survey (NEAPS, see cover article), Dr. Bowell says he will still be coming in on a daily basis. He sees the DCT era

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and the growth it is spurring as very positive things for the Observatory. “Expansion has been good for Lowell because of the quality and variety of research, much of which is world class,” he explains.

Before revealing the mysterious veiled object he brought to the Lobsterfest, Dr. Bowell received several gifts in honor of his distinguished work and camaraderie, including a limerick written and recited by trustee Bill Putnam. Shortly thereafter, the time came for Dr. Bowell to share one final gift: thirteen asteroids named after staff members not already so honored (see picture). Though his groundbreaking career took him to the heights of his profession, this jovial gentleman never forgets to honor the people and spirit of Lowell.

John Radway

by Tom Vitron

Cultivation is at the heart of John Radway’s life. Born in Hawaii and part Hawaiian, he graduated from Punahou High School, made famous by President Obama, and Stanford. John then pursued a career in law after serving in the Army. Driven to find a better lifestyle for he and his wife, Claire, John gave up law after five years and the pair purchased a citrus and banana farm on Oahu. Though John loved those crops, he and Claire moved to the Big Island to run a Macadamia orchard, one of first planted in early 1940s. After 12 years, they sold their farm as prices of land rose and relocated to Arizona. They briefly lived in Camp Verde, then moved Wickenburg to avoid allergens.

His early interest in science centered on agronomy and then, like so many, he watched Carl Sagan’s TV series “Cosmos” and became interested in the heavens above. More recently he has followed developments in the field of neuroscience as a result of Claire’s epilepsy. Fortunately, being in Arizona gave them access to the Mayo Clinic in Scottsdale. (Claire passed in 2010.) He fostered his interest in astronomy by joining the Astronomical Society of the Pacific (ASP). When ASP members received a letter from Lowell Observatory, he discovered our rich history and exciting future, and joined the Friends of Lowell. “I’m mainly interested in cosmology but I love it all,” says John. As an honorary member of the board of advisors, John has generously supported the Observatory for many years and is proud to help cultivate interest in Lowell.

New Horizons Workshop

The New Horizons project science team, including Lowell’s Dr. Will Grundy, met on Mars Hill August 30 and 31 to discuss icy surface processes. Even though the spacecraft is still four years from its rendezvous with Pluto, much work and preparation is required along the way. For example, the discovery of a fourth moon around Pluto (currently known as P4) presents a twist. In fact, the team recently received time with the Hubble Space Telescope to look for more satellites around Pluto.

Departures:
Sydney Barnes, assistant astronomer
El Hadji Cisse, grounds assistant
Emily Clough, grounds assistant/supervisor
Chris Crockett, predoctoral fellow
Lorrie (Whorton) Hardy, public-program educator
Megan (Jackson) Johnson, predoctoral fellow
Dagmara Oszkiewicz, predoctoral fellow
Mary Jane Peters, public-program educator

Arrivals:
Sam Crump, video intern
James Davis, public-program educator
Michael Gary, public-program educator
Lauren Hill, graphic design intern
Helen Horstman, library volunteer
Dave Shuck, grounds assistant
Aubrey Tamietti, public-program educator
William Willis, accounting intern

Note: These are people not mentioned elsewhere in the newsletter.
In Memoriam  
by Dr. Amanda Bosh

Lowell Observatory remembers two key HIPO team members who passed away in the few months before the first flight: James Elliot and James Darwin. Over the years, Lowell Observatory astronomers have worked closely with MIT astronomer Jim Elliot, who was a co-investigator on the HIPO project, was also on the Lowell staff and would spend summers working at Lowell Observatory. Dr. Elliot passed away in March 2011, less than a month before the group received word that the Pluto occultation had been approved for SOFIA. Jim Darwin, Lowell’s machinist for many years, fabricated most of HIPO’s components. Jim retired in 2005 and passed away this June, less than a month before the commissioning flight.

Uncle Percy’s Adventures in Space

Coming this fall, the first four episodes of an 11-part, Lowell-produced animated kids series about the solar system. Geared to kids aged 2 to 7, Uncle Percy’s Adventures in Space introduces kids to astronomy and related scientific concepts during voyages to the objects in the solar system. Percy and his robotic assistant, Miss Kitty, travel in a spaceship version of Big Red, Percival Lowell’s 1911 Stevens-Duryea automobile. Created with elementary school science standards in mind, the series will be available online. An accompanying workbook produced by NAU’s College of Education will also be made available to teachers and parents. Now, explore the solar system with your kids and get them excited about science!

Acronym list

ASP: Astronomical Society of the Pacific
CHARA: Center for High Angular Resolution Astronomy
DCT: Discovery Channel Telescope
ESO: European Southern Observatory
HIPO: High-speed Imaging Photometer for Occultations
JPL: Jet Propulsion Laboratory
LONEOS: Lowell Observatory Near-Earth Object Search
MIT: Massachusetts Institute of Technology
MOST: Microvariability & Oscillations of Stars
NASA: National Aeronautics and Space Administration
NAU: Northern Arizona University
NEAPS: Near-Earth Asteroid Photometric Survey
NPOI (now) NOI: Navy Prototype Optical Interferometer (now) Navy Optical Interferometer
REU: Research Experiences for Undergraduates
SOFIA: Stratospheric Observatory for Infrared Astronomy
USNO: United States Naval Observatory
REGULAR PUBLIC HOURS: November & December
M/W/F/Sat Noon-9:30 p.m.
T/Th/Sun Noon-5:00 p.m.

Upcoming meteor shower nights (Leonids 11/16, Geminids 12/12)
Upcoming Flagstaff Nights (Weds. 11/2 & 12/7)

NOVEMBER
FRI 26, SAT 27  Thanksgiving Celebration
9:00 p.m. - 9:30 p.m.
Lowell Observatory will extend our open daytime hours and offer indoor programs and building tours.

DECEMBER
2,3,5,7,9,10,14,16,17,19,21,23
Star of Bethlehem
9:00 a.m. - 9:30 p.m.
At 7:00 p.m. we will discuss the astronomical interpretation of the Star of Bethlehem. Telescope viewing and other multimedia indoor programs will also be available.

26-31  Winter Holiday Celebration
9:00 a.m. - 9:30 p.m.
Lowell Observatory will extend our open hours and offer indoor programs and special tours during the day. After dark, numerous telescopes will be set up for viewing celestial objects. Note we will close at 5:00 p.m. on the 31st.

Dates CLOSED:
11/24, 12/24-12/25