the Webfooted Astronomer
News from the Seattle Astronomical Society
June 2008

So many planets, so little time

The search for life beyond our solar system

by Greg Scheiderer

Astronomers have discovered 286 planets orbiting other stars in the galaxy. Prof. Victoria Meadows is trying to figure out if any of them could support life. Meadows, a planetary astronomer and astrobiologist with the University of Washington and NASA's Astrobiology Institute, spoke at the Seattle Astronomical Society meeting May 21.

"Without direct contact with an alien civilization, or traveling to the nearest solar system, the only way we're going to find life in the universe is by looking for global changes in the atmospheric surface of the planet," Meadows explained. "These signs of life we're looking for are called astronomical biosignatures; they're signs of life that can be seen with a telescope."

Meadows said a habitable planet will have particular characteristics of mass, atmospheric composition, radiation protection, orbit, and location.

Mass. To be habitable, a planet must be massive enough to support and hold an atmosphere, and to support plate tectonics, which helps moderate the presence of carbon dioxide in the atmosphere. The smallest possible size for a planet to be habitable would be about a third the size of Earth. The upper limit is about 10 times Earth. "Once you get to 10 Earth masses, you end up accreting a whole bunch of gas from the nebula, and you end up being Jupiter in no time at all," Meadows said.

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NEXT MEETING

June 18 — 7:30 p.m.
University of Washington Physics/Astronomy Building, Room A-102

Member show and tell at next SAS meeting

The June meeting will feature another of the popular "show and tell" nights during which SAS members will talk about what they've been up to. As of press time the lineup includes:

David Dorais with a DVD movie on cosmic collisions.

Rubie Sanborn Johnson will show us a 6" reflector kit built for kids that has some amazing features, such as fixed alignment of optics.

Burley Packwood will give us an account of his trip to Whipple Observatory in Arizona.

Jingchun Chen will talk about some (weird) stuff in his two ATM experiences.

SAS Calendar

June 18 — 7:30 p.m.
Seattle Astronomical Society Meeting
Guest speaker: Member show and tell.
Details on page 1.

June 18 — 9 p.m.
UW Observatory — Public viewing night

June 21 — 6:30 p.m.
Amateur telescope makers SIG meeting
Contact: atm@seattleastro.org

June 28 — 9 p.m.
Tiger Mountain Star Party (members only)

July 2 — New Moon

July 2 — 9 p.m.
UW Observatory — Public viewing night

July 6
Moon, Mars, Saturn, and Regulus in close pairing

July 9 — Jupiter at opposition

July 12 — 7 p.m.
Seattle Astronomical Society Star Parties
- Green Lake, Seattle
- Paramount Park, Shoreline

The Webfooted Astronomer is the monthly publication of the Seattle Astronomical Society (SAS). All opinions expressed herein are those of the contributors and not necessarily those of SAS. Advertising display rates: full page (7" x 9.5") $50; half page (7" x 4.75") $30; less than half page: $5 per page inch (1" x 5"). Personal ads are published free to current paid members of the SAS. For all others, 10 cents per word, 50 word minimum charge. Submit article ideas to Editor, The Webfooted Astronomer, PO Box 31746, Seattle, WA 98103, or e-mail to editor@seattleastro.org.

Editor: Greg Scheiderer

The Phoenix rises to Mars

by Ron Hobbs

"Altitude: Forty meters."

"Thirty meters."

"Twenty-seven meters."

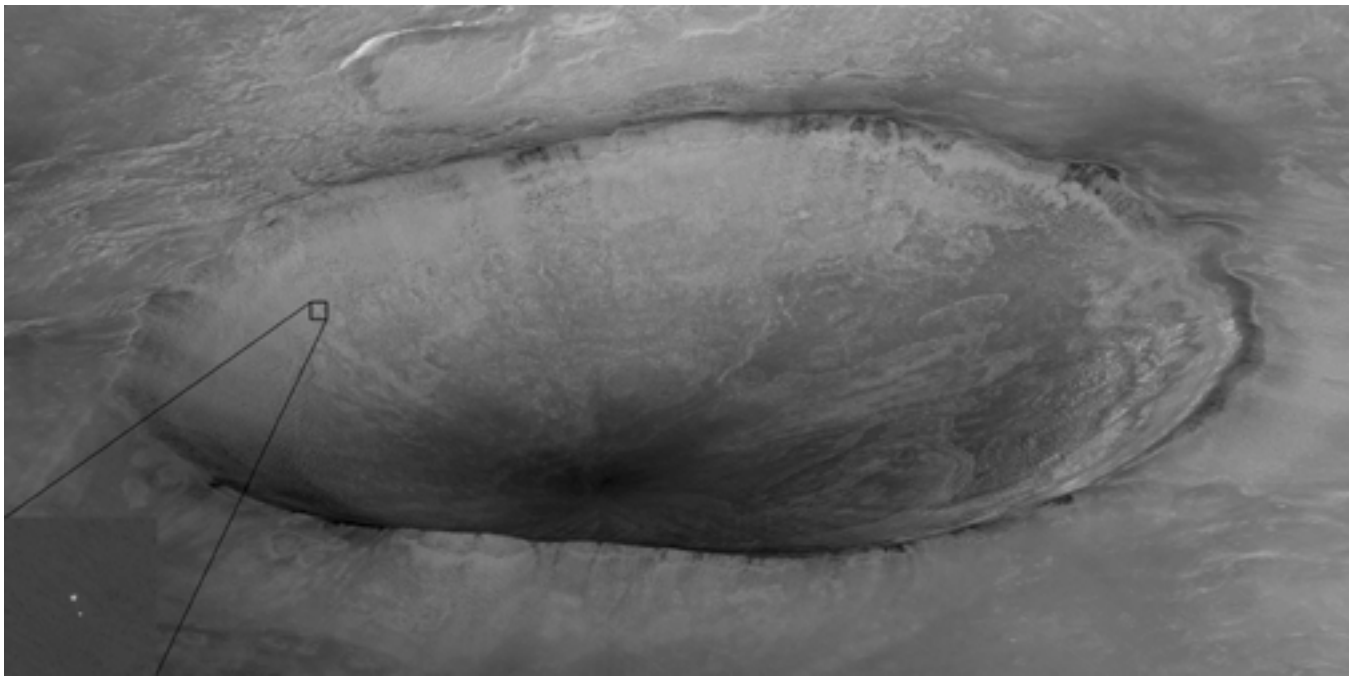
"Twenty meters."

"Fifteen meters. Standing by for touchdown."

"Touchdown signal detected."

As I sat with a capacity crowd in the Allen Theater at the Museum of Flight, listening to the Flight Controller at the Jet Propulsion Laboratory call out the descent of the Phoenix spacecraft, I found myself holding my breath. I was reminded of the first human landing on the Moon; now I think I know what they meant about "a bunch of guys about to turn blue." I began breathing again as the room erupted with applause and cheers (as did doubtless many around the world) as the signal arrived that Phoenix had survived its "seven minutes of terror" and had settled onto the Vastitas Borealis.

It came as a bit of a surprise that we were able to receive altitude data all the way to the surface; we had been warned that we might not know for a while if the landing had been successful. But NASA seems to have learned the lessons of failure well. Eight and a half years ago a similar crowd had assembled in the Allen Theater to follow the entry, descent and landing of the Mars Polar Lander. By design, there were to be no signals during EDL. However, when the time came for the probe to have landed there was silence, a



Mars Reconnaissance Orbiter's High Resolution Imaging Science Experiment (HiRISE) camera acquired this image of Phoenix hanging from its parachute as it descended to the Martian surface. Shown here is a 10 kilometer (6 mile) diameter crater informally called "Heimdall," and an improved full-resolution image of the parachute and lander. Although it appears that Phoenix is descending into the crater, it is actually about 20 kilometers (about 12 miles) in front of the crater.
Image Credit: NASA/JPL-Caltech/University of Arizona

silence unbroken to this day. The exact cause of the loss of MPL is still debated. For Phoenix, though, a wealth of data was sent during the landing phase, adding to the drama of the landing.

All three of the spacecraft on orbit at Mars were overhead as Phoenix descended. Odyssey had the primary relay duties, but Mars Reconnaissance Orbiter contributed in a spectacular fashion. In an unprecedented feat, MRO's HiRise instrument, the largest telescopic camera ever sent to another world, managed to catch an image of Phoenix on its parachute. The image, as it was originally released, was tightly focused on the parachute and backshell; it was assumed that the background was just the vast expanse of the northern plains. However, the following day when the HiRise folks took a step back, they realized that behind the spacecraft appeared the 10 kilometer wide crater unofficially known as "Heimdall." The image is now being described in some circles as one of the signature images of the space age.

The news media appear to be unable to remember the history of the space age; for instance, George Stephanopoulos reported on ABC Nightly News that Phoenix was the "fifth" Mars lander. For the record, Phoenix is the sixth successful landing on the Martian surface, following the two Viking Landers, Mars Pathfinder, and the two Mars Exploration Rovers. NASA has now succeeded six times in seven attempts (86%), not a bad record for such a difficult enterprise. Beyond all expectation, there is now an unprecedented human presence at Mars; three functioning landers spread across the globe and three spacecraft studying the planet from orbit. And by the time this piece is printed, we may have confirmation that we touched water ice on Mars for the first time. ★

The Solar System Ambassadors Program is a public outreach program designed to work with motivated volunteers across the nation. These volunteers communicate the excitement of JPL's space exploration missions and information about recent discoveries to people in their local communities. Ron Hobbs, a member of SAS, has been an Ambassador since 2001.

Table Mountain Star Party registrations open

Registration is now open for the 2008 Table Mountain Star Party, scheduled for the weekend of July 31 - Aug. 2.

Some registration fees have increased over last year. The base fee is now $60, while the fees for a second adult ($40) and students ($15) remain the same. Kids six and under are still free. In addition to these fees, some larger vehicles are subject to a $20 surcharge.

For details, and to register on-line, visit the party Web site:
www.tmspa.com

SAS planning informal parties at Table Mountain

SAS President Jon Bearscove announced at the May meeting that he'll be heading up some informal observing sessions at Table Mountain again this summer.

At last report there was still quite a bit of snow at the site, and rangers were doubtful that it would be accessible until late June at the earliest. With a New Moon on July 2, the last weekend in June or the July 4 holiday weekend would be likely dates for observing if conditions permit.

Announcemtnts of observing sessions will be posted to the SAS Google Group:
groups.google.com/group/Seattle_Astro

So many planets....

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Atmospheric composition. The atmosphere should, naturally, be breathable. It also serves to regulate the climate, and should reflect some energy away and have enough greenhouse gases to keep things warm, but not too warm.

Radiation shield. Surface life needs protection from UV radiation. This protection can be in the form of ozone. A magnetic field can be helpful as well.

Circular-ish orbit. A planet need not have a precisely circular orbit, but it should be close. If the orbit is too eccentric, then there will be wide temperature swings on the planet. Life won't like that.

Location, location, location. As always seems to be the rule with prime real estate, the planet should be close, but not too close, to a suitable parent star. "This is a star that has to live long enough to support the evolution and development of life and – this is a clearly biased astronomer's view – it must support

Astrobiologist Victoria Meadows spoke about the search for life beyond our solar system at the May 21 SAS meeting. (Photo by Greg Scheiderer.)

that life for long enough for it to build up enough of a signature that I can see it with a telescope," Meadows said. It should be a stable, mature star between half and 1.5 times the size of the Sun. The "habitable zone" around a star is the sweet spot where liquid water can exist on a planet. For our solar system, that's a swath from 0.93 to 1.37 astronomical units from the Sun. Earth just made it, but there's a catch: as the Sun brightens, we'll find ourselves outside the zone in 500 million to 900 million years.

Meadows said most of the known exoplanets don't pass this habitability test. "The trouble with all of the planets that we found is that they are too big," she explained. "The small, rocky, Earth-like planets that we really want to find around good parent stars are still very difficult to find."

There are a handful of them, though, and Meadows said the key to figuring out if the planets support life is to examine the spectrum thrown off by the planet. It's a technologically challenging process, because the planets are small, faint, distant, and close to bright stars. But the effort is worth it.

"The spectra turn out to be incredibly powerful," Meadows said. "They can tell us whether we have carbon dioxide and a terrestrial planet, whether we have water vapor in the atmosphere which means it's likely to have water on its surface, whether there are signs of a UV shield." A key, she added, is the presence of carbon dioxide. "It turns out carbon dioxide is one of the most observable features in a planetary atmosphere, and it's not found in Jovian planet atmospheres, so if we see that carbon dioxide even if we don't know the mass of the planet or anything about it, chances are it's a terrestrial planet."

Meadows quoted Giordano Bruno, a 16th century Italian monk, philosopher, and cosmologist, who contended that "the countless worlds in the universe are no more and no less inhabited than our earth."

"He was so prescient and so right in so many ways," Meadows noted. "Whether or not he was right is the thing that I base my science on. We're trying to understand if there are more worlds out there that are like the Earth."

★

Build your own planet, or 101 ways to kill a cow

At our March meeting Chris Brook gave us the "recipe" for making our own galaxy. Having heard from Prof. Victoria Meadows, can you design a habitable planet?

A NASA Web site will let you give it a try. Check out Astro-Venture at

astroventure.arc.nasa.gov

When you get there, click on "Design a Planet" and then choose the star type and other characteristics of your planet, then see how things work out. SAS President Jon Bearscove tried it out before the meeting, and the results were disastrous. The site is aimed at middle-school students, but adults can have fun with it, too.

Meadows is a fan of the atmospheric science training module on the site, which she calls "101 ways to kill a cow." Mess with the levels of oxygen and other elements in the atmosphere and see what happens!

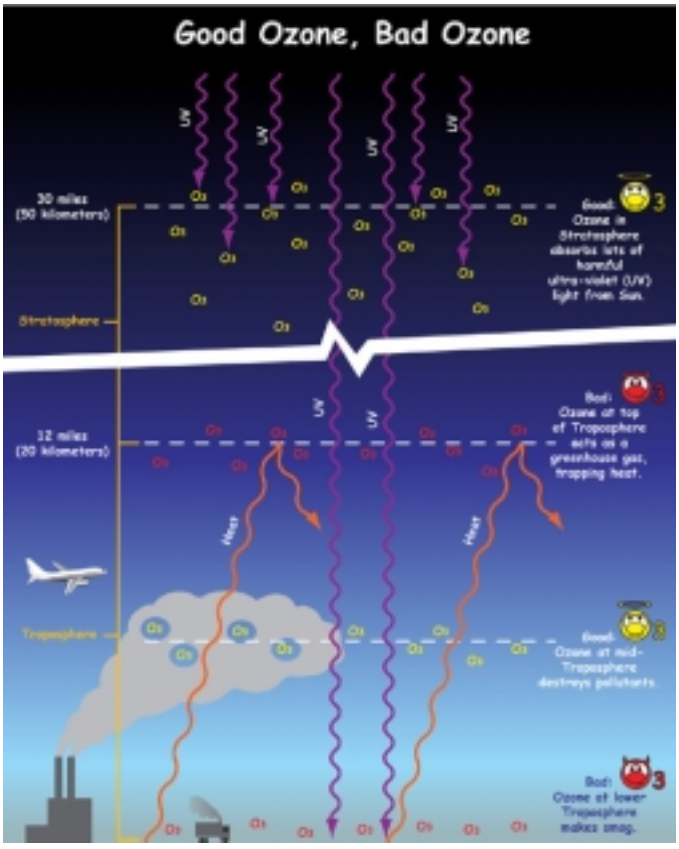
Ozone, the greehohuse gas

We all know that ozone in the stratosphere blocks harmful ultraviolet sunlight, and perhaps some people know that ozone at the Earth's surface is itself harmful, damaging people's lungs and contributing to smog.

But did you know that ozone also acts as a potent greenhouse gas? At middle altitudes between the ground and the stratosphere, ozone captures heat much as carbon dioxide does.

In fact, pound for pound, ozone is about 3000 times stronger as a greenhouse gas than CO_2. So even though there's much less ozone at middle altitudes than CO_2, it still packs a considerable punch. Ozone traps up to one-third as much heat as the better known culprit in climate change.

Scientists now have an unprecedented view of this mid-altitude ozone thanks to an instrument aboard NASA's Aura satellite called the Tropospheric Emission Spectrometer—"TES" for short.



Most satellites can measure only the total amount of ozone in a vertical column of air. They can't distinguish between helpful ozone in the stratosphere, harmful ozone at the ground, and heat-trapping ozone in between. By looking sideways toward Earth's horizon, a few satellites have managed to probe the vertical distribution of ozone, but only to the bottom of the stratosphere.

Unlike the others, TES can measure the distribution of ozone all the way down to the heat-trapping middle altitudes. "We see vertical information in ozone that nobody else has measured before from space," says Annmarie Eldering, Deputy Principal Investigator for TES.

The global perspective offered by an orbiting satellite is especially important for ozone. Ozone is highly reactive. It is constantly being created and destroyed by photochemical reactions in the atmosphere and by lightning. So its concentration varies from region to region, from season to season, and as the wind blows.

Data from TES show that ozone's heat-trapping effect is greatest in the spring, when intensifying sunlight and warming temperatures fuel the reactions that generate ozone. Most of ozone's contribution to the greenhouse effect occurs within 45 degrees latitude from the equator.

Increasing industrialization, particularly in the developing world, could lead to an increase in mid-altitude ozone, Eldering says. Cars and coal-fired power plants release air pollutants that later react to produce more ozone.

"There's concern that overall background levels are slowly increasing over time," Eldering says. TES will continue to monitor these trends, she says, keeping a careful eye on ozone.

Learn more about TES and the science of ozone at tes.jpl.nasa.gov/. Kids can get a great introduction to good ozone and bad ozone at spaceplace.nasa.gov/en/kids/tes/gases.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Article on light pollution featured in June issue of *Seattle Metropolitan*

The June issue of *Seattle Metropolitan* magazine includes an article, titled "Give Back the Night," about light pollution in Western Washington and the efforts being made to combat it. Penned by the magazine's news editor Eric Scigliano, the article opens with the author's visit to the SAS lunar eclipse viewing party at Green Lake in February, and includes comments from several members of the group working on light pollution issues.

Content of Seattle Metropolitan is not available on-line, but the magazine is carried at most newsstands and bookstores. You can subscribe on the magazine's Web site at:

http://www.seattlemet.com/

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We promise you the Sun, the Moon, and the stars... and we deliver!

The Seattle Astronomical Society is an organization created and sustained by people who share a common interest in the observational, educational, and social aspects of amateur astronomy.

Established in 1948, the SAS is a diverse collection of over 200 individuals. A variety of programs and activities is presented by the SAS throughout the year. Monthly meetings feature speakers on a wide range of topics, from the Hubble Space Telescope to electronic imaging to personal observing experiences. The club holds public observing "star parties" at Green Lake and Paramount Park every month, dark sky observing parties outside Seattle, plus such activities as meteor watches, public telescope and astronomy displays, National Astronomy Day, and an annual Awards Banquet.

NEXT MEETING
June 18
Member show and tell
Details, page 1

The Webfooted Astronomer
Seattle Astronomical Society
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