the Webfooted Astronomer

Seattle Astronomical Society • February 2004

February Meeting

Speaker: Dr. Toby Smith

Using Impact Craters as Probes to Planetary Subsurfaces

Wednesday, February 18
7:30 p.m.

Physics-Astronomy Building
Room A102
University of Washington
Seattle

Come early at 7 p.m. for coffee and snacks and to visit with your fellow members!

February Meeting

Digging Deep — Using Impact Craters as Probes to Planetary Subsurfaces

Dr. Toby Smith is a faculty member at the University of Washington Astronomy Department. Dr. Smith teaches courses on the Solar System and Planetary Science. He is a regular lecturer at the Theodor Jacobsen Observatory, and was heavily involved in public outreach this past summer during Mars Madness. Dr. Smith's research interests include meteorites and terrestrial impact craters. In his talk this month he will discuss the importance of impact craters in the exploration and sampling of other worlds.

Find out more about terrestrial impact craters, page 12.

Find out more about how a father-daughter team used craters to help them learn about the original early crust of Mars, page 4.

Seattle Astronomical Society

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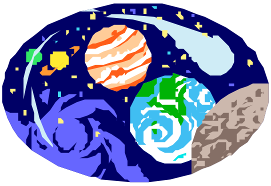


From the President's Desk…

by Stephen Van Rompaey

For those of you who were unable to attend this year's Awards Banquet, you missed a great event. The new restaurant, Rock Salt, provided excellent food and service. Ron Wodaski's talk on CCD astronomy certainly resonated with those club members who are already involved with imaging and provided a terrific overview of the complexities of CCD imaging to those of us who haven't tried it yet. I presented a Certificate of Appreciation to **Roger Steyaert** to recognize his contribution to the SAS this past year as our VP-Membership. It was also a pleasure to present **Burley Packwood** with two new observering certificates from the Astronomical League. I presented **Mike Langley** with the "Master and Commander of the Observatory Award" for his efforts at organizing our joint program with the University of Washington's Theodor Jacobsen Observatory. Finally, I presented **Kathy Steyaert**, our Banquet Committee Chair, with a Certificate of Appreciation to express our gratitude for her hard work organizing this event.

The last bulk mailing of the SAS newsletter will occur in March or April. If you want to receive the newsletter by mail you must explicitly "opt-in" by directly contacting the Treasurer.

The Banquet also included many great door prizes and it's important to recognize the companies and organizations that made generous donations:

- ★ Anacortes Telescope & Wild Bird
- ★ Astronomical Society of the Pacific
- ★ Captain's Nautical
- ★ Hardin Optical Company
- ★ Meade
- ★ Orion
- ★ Pacific Science Center
- ★ Sirius Optics
- ★ Starsplitter Telescopes

continued on page 4

President's Message: continued from page 3

I hope that you will consider patronizing these companies when you make future purchases of telescope equipment.

As you may recall from my article last month, the club was considering whether or not to switch to an electronic version of the newsletter that could be downloaded from the SAS website. In order to assess the impact of this change I asked for club members to contact me if they felt they would be adversely affected by not receiving the newsletter by mail. I hope that I communicated strongly that a decision on the newsletter was going to be based on the responses I received. I was contacted by fewer than 10 individuals who did not have Internet access or simply had a preference for receiving the newsletter by mail. Based on these responses the Board reviewed options at the January Board meeting. We decided that we will implement a two-tiered membership, where the basic membership dues will remain at $25 for those obtaining the newsletter electronically and $30 annually for those members who want to receive the newsletter by mail. The last bulk mailing of the SAS newsletter will occur in March or April. If you want to receive the newsletter by mail you must explicitly "opt-in" by directly contacting the Treasurer. We will begin changing brochures and membership applications to reflect this change.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Ghosts of Impacts Past: Ancient Hidden Craters on Mars Revealed

By Robert Roy Britt, Space.com Senior Science Writer
http://www.space.com/scienceastronomy/ancient_impacts_021105.html

This article from November 5, 2002, published at Space.com, discusses craters on Mars and how they give us clues to Mars' past.

A father-daughter science team has found what they say are the oldest known impact craters on Mars, ghostly structures that could only be discerned with special software and the latest elevation data.

Images obtained by SPACE.com reveal hints of circular outlines and subtle depressions that appear to be craters created during tremendous asteroid or comet impacts that pummeled the Red Planet's original crust 4 billion years ago or more. The features have since been mostly buried or eroded away.

continued on next page

If the entombed craters exist as suspected, then the current visible surface of Mars does not represent the original crust, as some scientists have thought.

The work began as a science fair project and was led by planetary geologist Herb Frey of NASA’s Goddard Space Flight Center. He and Erin Frey, his daughter and a junior at South River High School in Edgewater, Md., used altimeter data collected by the Mars Global Surveyor and ran it through newly developed computer software.

A graphics program turned elevations into different colors. By shifting and stretching the colors to study various ranges of elevation change, the researchers spotted faintly detectable features they call quasi-circular depressions, or QCDs. The Freys figure these depressions are craters from early times before the Noachian period, which may date back about 4 billion years and is Mars’ oldest identified geological time period.

“We are talking about crust that’s actually older than what’s seen at the surface,” Erin Frey said. “We can’t assign absolute ages because we don't know how far back these subsurfaces go.”

Mars, Earth and the other planets are thought to have formed about 4.5 or 4.6 billion years ago. A period of heavy bombardment likely ensued, as countless rocks were cleared from the fledgling solar system. A record of the bombardment remains on the Moon, where little erosion or geologic activity takes place.

But on Mars and Earth, figuring out what happened more than about 3 billion years ago is very, very difficult. Until now, there was little firm evidence about the original early crust of Mars.

Erin Frey’s work focused on a region near the Hellas Basin of Mars, considered by previous studies to be old. It suggests an intense period of asteroid and comet impact preceded the Noachian period. Most of the evidence was covered over by later impacts and billions of years of geologic processes.

Herb Frey looked at the entire planet. He found large depressions, all more than 125 miles in diameter, buried under dust, volcanic material and other sediments in the relatively crater-free northern lowlands of Mars, as well as in the visibly cratered southern highlands. He said it’s “a very squirrelly business” trying to assign ages to the features they’ve seen.

For the rest of this article go to http://www.space.com/scienceastronomy/ancient_impacts_021105.html

NASA's Space Place

Flying in Formation

By Patrick L. Barry

You can almost see the tabloid headlines now: "Mid-west farmer spies UFO squadron flying in formation!" "First signs of imminent alien invasion," the subtitle will read.

If only this fictional farmer had been keeping up with NASA's Space Place column, he would have known better. The string of white dots moving in formation across the pre-dawn sky were satellites, not alien spaceships.

Beginning next year, a series of challenging, high-precision launches will insert four satellites into orbits with just the right altitude, position, and orbital inclination to follow in lock-step behind NASA's Aqua satellite (launched in May 2002). Scientists have dubbed this squadron of satellites the "A-Train." Along with Aqua, the celestial parade will include Cloudsat, CALIPSO, PARASOL, and Aura.

The string of white dots moving in formation across the pre-dawn sky were satellites, not alien spaceships.

In April 2004, NASA will launch CloudSat, an Earth-observing satellite with unique cloud-measurement abilities. These measurements will fill an important role in our understanding of global climate change, making long-term climate change scenarios more accurate and dependable.

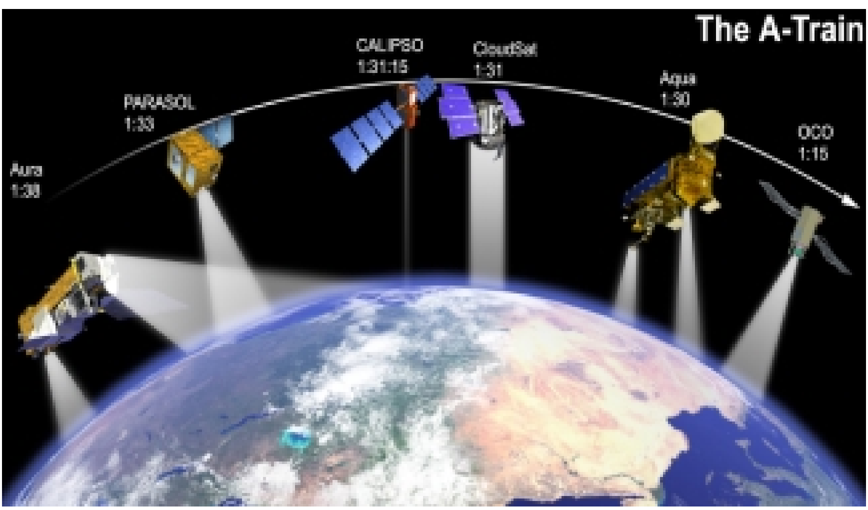
So why bother flying in formation? By passing over the same swath of land within seconds or minutes of each other, the satellites will give scientists snapshots of essentially the same scene using a total of 14 different measuring instruments. CloudSat alone carries only one: a millimeter-wavelength radar sounder.

This sounder — the first of its kind put into orbit — lets scientists see a vertical "slice" of the atmosphere that shows clouds, water, and ice between the ground and 30 km altitude, with a vertical resolution of 0.5 km. Even by itself, this instrument would provide an important and unique view of Earth's atmosphere, since the accurate portrayal of clouds is one of the glaring weaknesses with current simulations of climate change.

But this cloud data is even more valuable when combined with measurements from the other satellites in the A-Train — for example, air temperature, trace gases, and radiation into and out of the atmosphere. Scientists can then see connections between, say, temperature and the resulting behavior of clouds. A better understanding of these connections is one of the most sought-after goals of climate research, because changes to global cloud cover would, in turn, have a feedback effect on global temperatures.

The real story of this satellite squadron may not make the tabloid headlines, but at least there's evidence that the imminent threat of climate change is real, which is a lot more than you can say for alien invaders!

Learn more about CloudSat and the A-Train at cloudsat.atmos.colostate.edu. Kids (and grownups) can do interactive cloud picture scrambles and learn "Cloudspeak" (the names of different kinds of clouds) at The Space Place, spaceplace.nasa.gov/cloudsat_puz.htm.



CloudSat, to be launched in November 2004, will take its place as part of the "A-Train" of satellites flying in formation to take closely timed snapshots of essentially the same scene using a total of 14 different measuring instruments.

February 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4 UW Public Viewing Night 7 p.m.	5	6	7 Amateur Telescope Makers SIG Meeting 6:30 p.m.
8	9	10	11	12	13	14 New Member Orientation
15	16	17	18 UW Public Viewing Night 7 p.m. Monthly SAS Meeting UW Room A102 7:30	19 Pac. Science Center, Dr. Thomas Quinn, UW "Planetary Formation," 7 p.m.	20	21 Tiger Mountain Star Party 7:00 p.m.
22	23 SAS Board Meeting 7 p.m.	24	25	26	27	28 Green Lake & Paramount Park Star Parties
29						

March 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3 UW Public Viewing Night 7 p.m.	4	5	6 Amateur Telescope Makers SIG Meeting 6:30 p.m.
7	8	9	10	11	12	13
14 Astro-photography/ Imaging SIG Meeting 2 p.m.	15	16	17 UW Public Viewing Night 7 p.m. Monthly SAS Meeting UW Room A102 7:30	18	19	20 Tiger Mountain Star Party 7:00 p.m.
21	22 SAS Board Meeting 7 p.m.	23	24	25	26	27 Green Lake and Paramount Park Star Parties
28	29	30	31			

January Banquet Minutes
CCD Astronomy

by Thomas Vaughan

Speaker: Ron Wodaski

Talk: CCD Astronomy

Our guest speaker for the Banquet was Ron Wodaski, author of "The New CCD Astronomy." Ron's talk was a combination of his experiences as a CCD astronomer, and advice for amateur astronomers who are interested in CCD imaging.

Ron also has a world-class automated observatory in New Mexico, which anyone can use over the Internet. He is currently building another, more advanced version. He claims that setting up a functional automated observatory is "only slightly less complicated than a Mars probe." See Ron's site at http://www.newastro.com/ for more information. You can also order copies of his book there, which has the details on everything his talk covered.

When asked "what does a beginner need to become a CCD Astronomer?," Ron answered that there are four main areas to master:

★ Hardware — Telescopes, mounts, cameras.
★ Software — Software for managing the camera, and image processing.
★ Technique — Getting images is only 10 percent of the time and effort. The other time is spent manipulating the raw images to get a good final result.
★ Mindset.

Ron addressed Mindset first. He said you need an addictive personality to get into CCD astronomy, otherwise "consider getting a dob."

In Ron's estimation, the mount is more important than the telescope, especially for a beginning CCD astronmer. He recommended investigating mounts carefully, looking for periodic errors in their tracking, and their weight bearing capacity.

For a telescope, there is a balance between resolution, depth, and effort. And, "oh yes, optical quality matters too." But again, Ron said that optical quality was usually good enough that resolution and depth of field were more important considerations.

For cameras, the main considerations are pixel size and quantum efficiency. A camera with high quantum efficiency will be much more sensitive, and pixel size affects resolution. Ron said that there are several good cameras to be had for around $1K, less used.

For software, Ron said there were several programs one should consider. Ron recommended sofware for the following areas:

- ★ Camera control
- ★ Astro-specific image processing
- ★ Data reduction & calibration
- ★ General image processing

For Technique, Ron pointed out several basic data reduction strategies, mainly for removing background noise. Through various processing techniques, you can remove noise due to dark currents, camera bias, and even light pollution (although optical filters are a good first step here).

Ron also mentioned several "advanced techniques" in passing, which he covers in more detail in his book:

- ★ autoguiding
- ★ periodic error
- ★ photometry/astrometry
- ★ FITS file format
- ★ polar alignment
- ★ color imaging
- ★ bit depth

In general, Ron claimed that CCD imaging now is like owning a car in 1903: you have to turn the crank, deal with flats, tune the engine, and so on. But you can be rewarded with some great images without spending a whole lot of money.

There were several questions at the end. One question concerned cooling. Ron answered that there are many types of cooling for CCD cameras, the most common being thermoelectric and water coolers. When asked about CCD imaging in light-polluted areas (i.e., anywhere near Seattle), Ron answered that you should look at a CCD camera with high quantum efficiency and a large well depth (so it can handle long exposures). That gives you the sensitivity you need to capture an image, and then remove the pollution from the image when processing.

2004 SAS Awards

Burley Packwood earned two Astronomy League awards: the Binocular Messier Certificate, and the Caldwell Observing Award. Congratulations, Burley! Roger Steyaert and Kathy Steyaert received Certificates of Appreciation. Mike Langley was presented the "Master and Commander of the Observatory Award." Many congratulations and thanks to all!

Terrestrial Impact Craters

from http://www.solarviews.com/eng/tercrate.htm

Impact craters are geologic structures formed when a large meteoroid, asteroid or comet smashes into a planet or a satellite. All the inner bodies in our solar system have been heavily bombarded by meteoroids throughout their history. The surfaces of the Moon, Mars and Mercury, where other geologic processes stopped millions of years ago, record this bombardment clearly. On the Earth, however, which has been even more heavily impacted than the Moon, craters are continually erased by erosion and redeposition as well as by volcanic resurfacing and tectonic activity. Thus only about 120 terrestrial impact craters have been recognized, the majority in geologically stable cratons of North America, Europe and Australia where most exploration has taken place. Spacecraft orbital imagery has helped to identify structures in more remote locations for further investigation.

Only about 120 terrestrial impact craters have been recognized, the majority in geologically stable cratons of North America, Europe and Australia.

Meteor Crater (Barringer Crater) in Arizona was the first-recognized terrestrial impact crater. It was identified in the 1920s by workers who discovered fragments of the meteorite impactor within the crater itself. Several other relatively small craters were also found to contain impactor fragments; for many years, these remnants were the only accepted evidence for impact origin. However, scientists have come to realize that pieces of the impactor often do not survive the collision intact.

In massive events caused by a large impactor, tremendous pressures and temperatures are generated that can vaporize the meteorite altogether or can completely melt and mix it with melted target rocks. Over several thousand years, any detectable meteoritic component might erode away. In some cases, nonterrestrial relative abundance of siderophile elements can be detected in the impact melt rocks within large craters — a chemical signature of the meteorite impactor.

Since the 1960s, numerous studies have uncovered another physical marker of impact structures, shock metamorphism. Certain shock metamorphic effects have been shown to be uniquely and unambiguously associated with meteorite impact craters; no other earthly mechanism, including volcanism, produces the extremely high pressures that cause them. They include shatter cones, multiple sets of microscopic planar features in quartz and feldspar grains, diaplectic glass, and high-pressure mineral phases such as stishovite. All known terrestrial impact structures exhibit some or all of these shock effects.

Impact craters are divided into two groups based on morphology: simple craters and complex craters. Simple craters are relatively small with depth-to-diameter ratios of about 1:5 to 1:7 and a smooth bowl shape. In larger craters, however, gravity causes the initially steep crater walls to collapse downward and inward, forming a complex structure with a central peak or peak ring and a shallower depth compared to diameter (1:10 to 1:20). The diameter at which craters become complex depends on the surface gravity of the planet: The greater the gravity, the smaller the diameter that will produce a complex structure. On Earth, this transition diameter is 2 to 4 kilometers (1.2 to 2.5 miles) depending on target rock properties; on the Moon, at one-sixth Earth's gravity, the transition diameter is 15 to 20 kilometers (9 to 12 miles).

The central peak or peak ring of the complex crater is formed as the initial (transient) deep crater floor rebounds from the compressional shock of impact. Slumping of the rim further modifies and enlarges the final crater. Complex structures in crystalline rock targets will also contain coherent sheets of impact melt atop the shocked and fragmented rocks of the crater floor. On the geologically inactive lunar surface, this complex crater form will be preserved until subsequent impact events alter it. On Earth, weathering and erosion of the target rocks quickly alter the surface expression of the structure; despite the crater's initial morphology, crater rims and ejecta blankets are quickly eroded and concentric ring structures can be produced or enhanced as weaker rocks of the crater floor are removed. More resistant rocks of the melt sheet may be left as plateaus overlooking the surrounding structure.

Large terrestrial impacts are of greater importance for the geologic history of our planet than the number and size of preserved structures might suggest. Most researchers now believe that a large asteroid or comet hit the Earth at the end of the Cretaceous Period 66 million years ago. An environmental crisis triggered by the gigantic collision contributed to the extinctions. Based on apparent correspondences between periodic variations in the marine extinction record and the impact record, some scientists suggest that large meteorite impacts might be the metronome that sets the cadence of biological evolution on Earth — an unproven but intriguing hypotheses.

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