South Downs Mercury

The monthly circular of South Downs Astronomical Society
Issue: 480 - December 2014 Editor: Roger Burgess

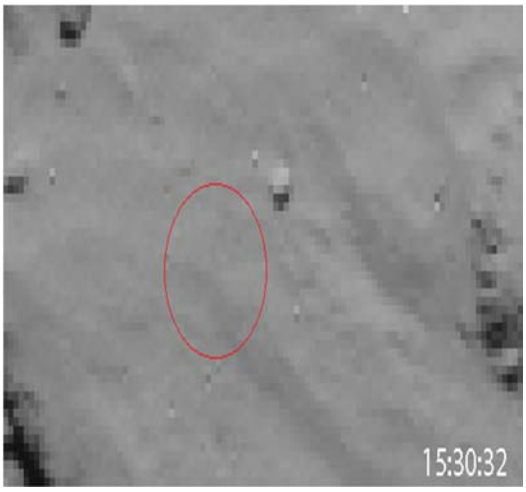
- Next meeting Friday 5th December Lecture room of the South Downs Planetarium, Chichester, at 7.30pm. Please support a raffle we are organizing this month to raise money to buy a Solar Telescope

- "**What's up" - Guide to the month ahead by SDAS member John Whittington**

- **Ray Howell "The Barringer Crater"**

- **Lights OUT for Philae BUT slumbering probot could phone home again as comet nears Sun**

Philae's final hurrah (for now at least) on Comet 67P/Churyumov-Gerasimenko ended with success, the mission's jubilant scientists confirmed late last night. The fridge-sized, plucky probot, which made the historic landing on the speeding, icy space-rock 300 million miles (or 500 million kilometres) from Earth on Wednesday, was drained of the last of its battery power in the early hours of Saturday morning. But that was only after Philae was able to return all of its housekeeping and science data to its Rosetta mother ship, which then beamed the information back to mission control in Darmstadt, Germany. As the lander's energy was increasingly being zapped, it continued to work through its various tasks feeding key measurement information from the targeted instruments, such as ROLIS, COSAC, Ptolemy, SD2 and CONSERT. Boldly and audaciously, Philae's scientists were able to push the probot up about 4 centimetres, before performing a 35 degree rotation in the hope of basking it in more sunlight. The craft is loaded with solar panels, which could bring Philae back into action at a later point as the comet nears our Sun, so the manoeuvre was critical in terms of attempting to extend the lander's incredible, cosmic-rock adventure. Scientists remain perplexed about the probot's final landing site. They are working hard to try to locate Philae's exact position. Meanwhile, Rosetta has moved back into a 30 kilometre orbit around the comet. It will return for a closer encounter with 67P on 6 December. DLR German Aerospace Agency lander boss Stephan Ulamec said: It has been a huge success, the whole team is delighted. Despite the unplanned series of three touchdowns, all of our instruments could be operated and now it's time to see what we've got. We still hope that at a later stage of the mission, perhaps when we are nearer to the Sun, that we might have enough solar illumination to wake up the lander and re-establish communication.



Philae's first touchdown seen by Rosetta's NavCam. *Image credit: ESA/Rosetta/NavCam*

Images from Philae's descent to the comet showed that it was covered by dust and debris, while panoramic snaps revealed

Contact us
Editor - by email at: **roger@burgess.gotadsl.co.uk**
Or by telephone: 01243 785325 Fax 01243 785092
Society - by email via: **www.southdownsas.org.uk**

"layered walls of harder-looking material." Scientists are now searching the data to see if any of 67P's material has been sampled with Philae's drill. "At the end of this amazing rollercoaster week, we look back on a successful first-ever soft-landing on a comet," said European Space Agency's Rosetta mission manager Fred Jansen. "This was a truly historic moment for ESA and its partners. We now look forward to many more months of exciting Rosetta science and possibly a return of Philae from hibernation at some point in time."

- **Philae: The bouncing baby space probe that gave itself another chance**

London (CNN) -- It flew for 10 years, crossed millions of miles of space, bounced over the surface of a comet and returned heaps of data ... and then quietly faded away. The little spacecraft Philae that has captured the imagination of thousands with endearing tweets to the comet-chasing mother ship Rosetta stopped transmitting when its batteries drained. "@ESA_Rosetta I'm feeling a bit tired did you get all my data? I might take a nap ..." The forlorn message was picked up by followers of @Philae2014 shortly before it fell silent. The Rosetta orbiter mission will continue to track Comet 67P on its journey around the sun in the coming months but after the final transmission from Philae, the lander mission appeared to be over.

But is it?

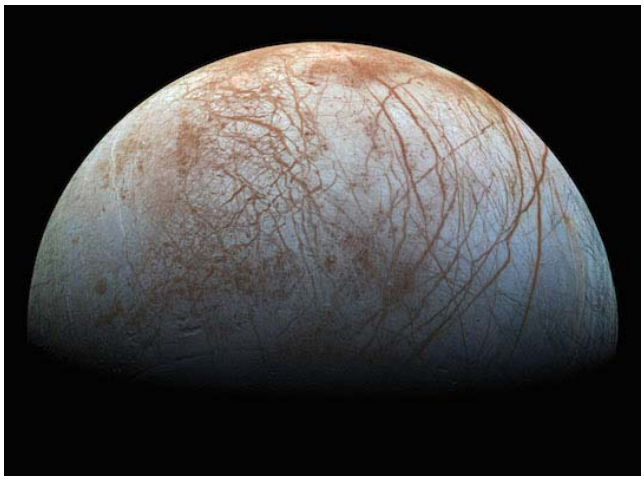
Scientists from the European Space Agency (ESA), which is leading a consortium that includes NASA to find out more about the composition of comets and how they interact with the sun, say there's still a good chance that Philae will revive. And the malfunction that caused the probe to bounce in the very weak gravity might actually turn out to be a blessing. "It's good luck through bad luck," said lander system engineer Laurence O'Rourke. "Yep, we're stuck against a wall. But when you look at the original location of where we were supposed to land -- it's a beautifully flat area -- we would never have seen the images and the structures of the comet wall unless we landed where we did. We'd have been in a dust field," he told CNN. "We've had a number of happy accidents. Its bad luck that we bounced but the good luck is that all the instruments were on ... so what you have is a major scientific benefit -- results from two different locations when we were only expecting one." Lander problems started when a thruster and harpoons designed to anchor the small probe to the comet failed. Philae bounced away from the original target touchdown area and appears to have settled under the face of a cliff. Project scientists are still not exactly sure where, even though the lander performed its experiments and sent back data. O'Rourke said the team are still searching for it and that the location will be key to estimating when a new signal might come from the spacecraft. He explained that the final resting place of Philae did not allow enough sunlight to fall on the solar panels so the probe ran out of power. It was able to complete its original mission, operating on the comet from the initial battery charge. But before Philae closed down, engineers managed to rotate the probe so a larger solar panel would be exposed to sunlight and they believe this will be enough to automatically restart the spacecraft when the comet's orbit takes it closer to the sun. Again, scientists think this shadowy spot on the comet might be another stroke of luck. The original landing zone would have exposed Philae to temperatures that would have burned out the electronics -- probably after about three months. "The lander has the ability of keeping itself warm but doesn't have the capability to cool itself down," O'Rourke told CNN. "The current environment benefits the lander because we're not worried about it overheating any more. We can keep it warm if we get enough power," he said. O'Rourke believes that if the lander comes back online there's a high chance it will survive until the comet's closest approach to the sun in August next year. So how does Philae come back from the dead? O'Rourke explained the sequence:

- If enough sunlight falls on the solar panel, Philae will reboot
- It then needs more energy to warm the batteries
- Once warmed, the batteries will start recharging
- When it has enough power Philae will try to contact the orbiting Rosetta -- for two minutes every 30 minutes.
- If it fails to make contact, Philae will power down the transmitter and try again 30 minutes later

The power it needs is tiny -- roughly equivalent to the output of two or three domestic AA batteries -- but it will be enough to restart the lander mission. When the Rosetta team find Philae they will then be able to estimate the point at which enough sunlight falls on the solar panel to expect a transmission from the probe, announcing that it's still alive. As long as it doesn't get too cold there's still hope. In a statement, lander project manager Stephan Ulamec said he was confident that contact could be resumed -- probably in the spring of 2015. In the meantime, scientists are sifting through the data from Philae's 10 instruments to see what they may have already discovered. "When you look at what Philae's done -- it's been quite extraordinary," said O'Rourke. "A little satellite placed on a comet so far away -- you're always rooting for it. To give it that extra chance to have more power felt really good," he said.

- **NASA revisits Europa with modern image-processing software**

NASA has re-issued a famous image of Jovian moon Europa, after subjecting it to “modern image processing techniques” for the first time. The 1.6km-per-pixel, 2300x1700 image is actually a composite of several captured by the Galileo probe during the craft's first and fourteenth orbits through the Jupiter system, in 1995 and 1998, respectively. Previous versions were “a mosaic with lower resolution and strongly enhanced colour”.



NASA's new view of Europa. This time around, NASA has combined “Images taken through near-infrared, green and violet filters”, corrected them for “light scattered outside of the image, to provide a colour correction that is calibrated by wavelength.” “Gaps in the images have been filled with simulated colour based on the colour of nearby surface areas with similar terrain types.” The images have also been re-arranged “into a realistic colour view of the surface that approximates how Europa would appear to the human eye.” The result, the agency says, is a better look at features so that “areas that appear blue or white contain relatively pure water ice, while reddish and brownish areas include non-ice components in higher concentrations.” “The polar regions, visible at the left and right of this view, are noticeably bluer than the more equatorial latitudes, which look whiter. This colour variation is thought to be due to differences in ice grain size in the two locations.” NASA's released the image to accompany a new video explaining the theory that a liquid ocean lurks beneath the moon's icy crust, making it a very fine exploration prospect as humanity searches for habitable worlds beyond our own. And perhaps inhabitants of such worlds.

- **A distant planet may lurk far beyond Neptune**

Out beyond Neptune, the solar system resembles the deep ocean: dark, remote and largely unexplored. To an Earth-bound observer, even the brightest objects, such as Pluto, are 4,000 times as faint as what the human eye can see. An undiscovered planet could easily lurk out there unnoticed, a possible fossil from a time when the giant planets jockeyed for position 4 billion years ago, scattering planets and asteroids in their wake. But even the largest telescopes would struggle to find such a faint spot of light. Most likely, the clues would be entangled in the distorted orbits of faraway ice boulders tumbling around the sun. Astronomers Chad Trujillo and Scott Sheppard provided a hint about how such a world might reveal itself last March when they announced the discovery of a 450-kilometer-wide dwarf planet just outside the Kuiper belt — the icy debris field past Neptune. Their find, designated 2012 VP_{113}, is on a course that loops around the sun in a vastly elongated orbit far from the known planets. It has thousands of neighbours but shares its odd trajectory only with Sedna, another dwarf planet, discovered in 2003. “They’re kind of in a no-man’s-land,” says Sheppard, of the Carnegie Institution for Science in Washington, D.C. “These

objects couldn't get out there with what we currently know." Something had to drag the two dwarf planets from their original, smaller orbits. Except nothing is close or massive enough to take the credit. At least, nothing astronomers are aware of. The discovery of 2012 VP_{113} confirmed that Sedna is not a fluke but is possibly the first of a large population of icy bodies distinct from others in the rest of the solar system. So Trujillo and Sheppard continued to poke around the Kuiper belt, and the mystery deepened. They noticed that beyond 150 astronomical units (150 times the distance from the sun to the Earth), 10 previously discovered objects, along with Sedna and 2012 VP_{113}, follow orbits that appear strangely bunched up. "That immediately piqued our interest," says Sheppard. Could an unseen planet, a Planet X, be holding the orbits of all these far-out bodies in place? "The idea's not crazy," says David Jewitt, a planetary scientist at the University of California, Los Angeles. "But I think the evidence is slim." The trail of bread crumbs leading to an undiscovered planet is sparse: just 12 chunks of ice lead the way. But it's enough to get some researchers wondering about a ninth (or 10th, depending on your attitude regarding Pluto) planet roaming the outer solar system and how it might have arrived there.

Kuiper belt clues

"The exciting thing for me is that 2012 VP_{113} exists," says Megan Schwamb, a planetary scientist at Academia Sinica in Taipei, Taiwan. "Whatever put Sedna on its orbit should have put a whole bunch of other objects out there." The enormous, stretched orbits of Sedna and 2012 VP_{113} are unlike anything else in the solar system. Both are too far from Neptune to feel its effects. And they're too far from the Oort cloud, the distant shell of ice boulders thought to envelop the solar system. Their trajectories could be a relic of a passing star, or the changing influence of the Milky Way's gravity as the sun moves around the galaxy — or of a massive planet, long-gone or yet to be detected. The case for an additional planet got stronger when Trujillo and Sheppard realized that Sedna and 2012 VP_{113} had something in common with 10 other objects. All the objects beyond 150 astronomical units come closest to the sun, a point known as perihelion, at nearly the same time that they cross the plane of the solar system. There's no reason for these perihelia to bunch up like that. Billions of years of evolution should have left the perihelia scattered, like the rest of the Kuiper belt — unless something was holding the perihelia in place. Trujillo and Sheppard estimated that a planet about two to 15 times as massive as Earth, at a distance of 250 astronomical units (about eight times as far from the sun as Neptune) could explain why these 12 perihelia were bunched together. But the astronomers admit that's not the only possibility. A closer planet as massive as Mars would have the same effect as a Neptune-mass body much farther away. "A few years ago everyone thought that nothing relevant other than just plain asteroids and comets inhabited that region," says physicist Carlos de la Fuente Marcos. "Now the observational evidence indicates that probably we were wrong." He and his brother Raúl, both at the Complutense University of Madrid, took a closer look at the orbits. The brothers claim, in the Sept that not one but two planets are needed to explain the perihelion clustering. Around the same time, physicist Lorenzo Iorio at the Ministry of Education, Universities and Research in Bari, Italy, offered a different take. He says that the planet proposed by Trujillo and Sheppard, if it exists, must be much farther out — at least twice as far as the original prediction. By looking at gradual changes in the orbits of a few of the known planets, Iorio calculated that a planet twice as massive as Earth must be at least 500 astronomical units from the sun. Others are more cautious. "The outer solar system can be full of all sorts of unseen and interesting things," Jewitt says, "but the argument ... for a massive perturber is a bit puzzling." First, 10 of the 12 bodies with peculiar perihelia dive far enough into the Kuiper belt to possibly feel Neptune's gravity. And, second, he says, 12 objects is a tiny sample — the apparent perihelion clustering may just be an illusion caused by where researchers point their telescopes. The recent speculation about additional planets has a familiar ring, says Jewitt. In the late 1800s and early 1900s, astronomers relied on apparent hiccups in Neptune's motion and a handful of comets to kick off a search that eventually led to the discovery of Pluto. "Not much has changed since then," he says. In fact, musings of a planet beyond Neptune have been around since before anyone knew Neptune existed.

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