SPECIAL FEATURE: MARS EXPLORATION ROUNDTABLE

By: Andrea Cosentino, Editor-in-Chief
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One year ago, on November 26, 2011, while the majority of Americans were recovering from Thanksgiving Day's feast and football, the NASA launch team for the Mars Science Laboratory (MSL) was in its final stages to launch a mission that would hopefully bring about answers to longstanding questions and new discoveries previously unknown to man.

Nine months and 350 million miles later, the MSL team would approach the most crucial stage of the mission, landing the Mars rover "Curiosity" into Gale Crater. This landing had a lot of things that could have gone wrong. You had a team flying an unmanned spacecraft, carrying a 2,000 pound rover, into Mars' thin atmosphere at 13,000 miles per hour, which would reach a maximum of 1,600 degrees Fahrenheit!

It was an engineering challenge that attracted a worldwide audience. Everyone watching the historical event held their breath during the "seven minutes of terror", as it was dubbed by NASA's Jet Propulsion Lab, which was the delay in time it would take for the signal to transmit back to Earth. Those seven minutes were agonizing for so many people because 420 seconds would determine whether the $2.5 billion mission was a success or failure.

The human fascination of Mars is easy to understand. The two planets have so many similarities that to understand Mars, helps to understand ourselves. Exploration of Mars provides us with a control set when we're trying to understand the processes of climate change, geophysics and the potential for life beyond our own planet.

Earth and Mars have roughly the same amount of land surface area and the atmospheric chemistry is relatively similar, specifically when comparing our own planet to the other bodies of the solar system. Both planets have large, sustained polar caps and the current thinking is they're both largely made of water ice. They both have or had magnetic fields, although Mars' is a thing of the past. And in terms of topography, Mars and Earth have some fascinating volcanic features. Most notably is Olympus Mons, a Martian volcano so large that its own peak reaches above most of the Martian atmosphere. The volcanic giant rises a little over 14 miles from the surrounding plains. Earth too has numerous volcanic structures. Due to gravity, however, the closest thing resembling the massive land feature of Olympus Mons are the Mauna Loa and Mauna Kea peaks on Hawaii, which rise about 6 miles from their base on the floor of the Pacific Ocean.

With a generally similar planet so close, we become even more tantalized by the question: what type of life could (or does) exist in the solar system and what findings might be unveiled on our "sibling" planet to prove so? Until more information can be gleaned from Curiosity, we must rely on experts to provide insight and expertise to the most difficult questions.

As a small organization, the Planetary Studies Foundation is so fortunate to have such a robust membership with leading experts in a variety of fields. When we came up with the idea for a panel specific to issues regarding the exploration of Mars, we didn't have to look very far to find heavy hitters in the areas of planetary science, geology and geochemistry to answer our questions and share with us their expertise in these respected fields.♦

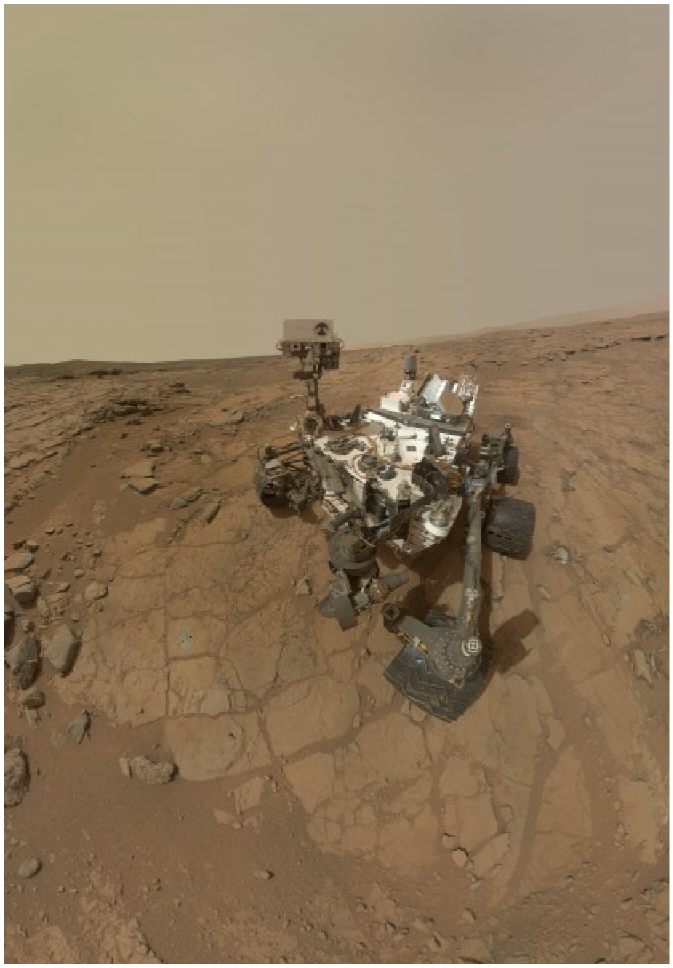

***Image:* [*NASA/JPL-Caltech/Malin Space Science Systems*]**

MEET THE EXPERTS

William "Bill" Hartmann, Ph.D.
Scientist, Writer and Painter
Dr. Hartmann has done extensive research in the origin and evolution of planets and planetary surfaces, as well as the small bodies of the solar system. He has authored three college level textbooks in astronomy and planetary science and is also a space artist. He has been commissioned twice by the NASA Fine Arts Program.

Anthony "Tony" Irving, Ph.D.
Geochemist, Meteorite Expert and Professor - University of Washington
Dr. Irving is an Australian-born geochemist who spent his early career working with lunar fragments from the Apollo missions. He is a Lunar and Martian meteorite expert

and is highly recognized for the sheer quantity of Martian meteorites he has analyzed. He also works as a geology professor affiliated with the University of Washington.

Harrison "Jack" Schmitt, Ph.D.
Geologist, Astronaut - Apollo 17
Dr. Schmitt participated on the last lunar mission, Apollo 17, as Lunar Module Pilot in 1972. As the only geologist of the crew, he collected rock samples which have been called "without doubt the most interesting sample returned from the Moon" by NASA's Lunar Sample Compendium. In 1975, He resigned from NASA to seek election to the U.S. Senate representing the state of New Mexico for one term and was the ranking Republican member of the Science, Technology and Space Subcommittee. In addition, he is an adjunct professor of the University of Wisconsin-Madison, chair of the NASA Advisory Council and published author.

Paul P. Sipiera, Ph.D.
Adjunct Curator of Meteorites – Field Museum, PSF Founder
Dr. Sipiera is President and Chief Executive Officer of the Planetary Studies Foundation. He is professor emeritus of geology and astronomy at William Rainey Harper College in Palatine, IL. He currently serves as Adjunct Curator of Meteorites at the Field Museum of Natural History in Chicago at the Robert A. Pritzker Center for Meteoritics and Polar Studies. In addition, Dr. Sipiera is a renowned meteorite expert having gone on numerous missions to Antarctica in search of meteorite specimens.

PSF QUESTION: Concerning Mars exploration, do you think more can be gained from human exploration than robotic missions?

Bill Hartmann: Yes, if either could be delivered to Mars easily. Of course the problem is that humans are much harder and more costly to get there. The day will come…

Tony Irving: I think both have value, but judging from the history of geological discoveries on Earth by humans, it will eventually be necessary to have real time human involvement on the surface of (or at least in orbit around) Mars.

Jack Schmitt: Ultimately, trained and experienced field geologists, biologists, and geophysicists will gain far more knowledge through field exploration than will robots. This has always been the case when new environments become accessible to humans. Robots are valuable in gathering data in environments not accessible to humans and in helping to plan future field exploration where humans can follow. Also, robots can follow-up human field exploration to gather new data not previously recognized as important.

Paul Sipiera: The Apollo moon missions proved the value of having "in situ" human participation for their ability to immediately recognize unusual specimens and to make quick decisions to change the "game plan" when the need arises. On the other hand, robots can go places where no humans can survive. Humans should return to the Moon and continue our exploration where Apollo left off, and our deep-space robotic missions should continue to amaze us with their magnificent findings.

PSF QUESTION: Beginning in the 1960's, there was a lot of national support behind the Apollo program. What do you think it will take to change the country's current attitude towards the continuation of human exploration of space?

Tony Irving: I think there actually is a lot of public support for space exploration, because people are intrinsically curious. With regard to Mars, I would like to see the scientific goals expanded beyond the "follow the water" theme.

Jack Schmitt: National leaders that recognize and can articulate the importance of American geopolitical leadership in all major areas of human endeavor. That leadership remains necessary to the protection of human freedom on Earth and eventually in the Solar System and beyond.

Paul Sipiera: The culture of the 1960's was based on the previous generation's hard work and sacrifice. The biggest difference between today and the 1960's can be attributed to our problems with the economy and our loss of the "can-do" spirit that was so evident during World War II and into the "Cold War". Human exploration beyond our planet will once again become popular when the United States sets itself a realistic, achievable goal based on a technologically sound plan to achieve that end. For the present, Mars rovers and images from deep-space probes will continue to fuel the human imagination.

Bill Hartmann: Unfortunately, it probably needs a perceived competitive challenge from other countries. More ideally, it would be a move to express our humanity by a truly global venture with many nations cooperating.

PSF QUESTION: Do you think human exploration of Mars will be through government, private sector or both?

Jack Schmitt: The American government will need to lead the initiative at the outset, however, the technological and resource foundations created by the private sector in the development of lunar Helium-3 fusion energy will greatly reduce the difficulty and cost of early visits to Mars. Eventually, as with the Moon, economic possibilities for settlements on Mars may result in a shift from government to private leadership.

Paul Sipiera: I feel that the private sector is in a very good position to take over from government-run space programs, especially with human space flight. Private corporations have the ability to "cut-through" most of the bureaucracy and "red-tape" associated with governmental programs and probably will get the job done cheaper and faster in the process. Two good examples can be found in Richard Garriott's flight to the International Space Station and Elon Musk's success with his Space X Corporation.

Bill Hartmann: I suspect it will be a communal adventure organized by several nations. I am very concerned, however, about the concept of private companies, international corporations or nations following a 16th century model and trying to establish ownership of the resources in space. Do we really want whichever corporate entities happen to have the most money in the mid-21st century of human development to end up "owning" the best Martian sites or asteroidal resources - thus destabilizing Earth even more with the gulf between the "have" and "have not" nations?

Tony Irving: I would hope that both would be involved. Rather than competing, I feel that each of these sectors has different expertise, and we need all the expertise we can get.

PSF QUESTION: Do you think the fastest and most economical way for humans to get to Mars is by way of the Moon?

Paul Sipiera: No, but I think that would be the most logical and technologically correct way to do it. I believe that either various governments or the private sector will choose the more spectacular approach like Project Apollo was for the Moon and go with a Mars-direct mission to cultivate both public interest and financial investors.

Bill Hartmann: No. Tom Paine's Presidential Commission on Space in the 1980's discussed establishing an infrastructure involving permanent space-station like ships in solar orbit between Earth and Mars, with aphelion somewhat beyond Mars. These would be "hotels" with support facilities, amenities for passengers, shielded refuges against solar storms, etc. Light, fast ships would deliver Martian explorers direct to such stations and depart when the station reached the Mars vicinity at predetermined intervals. This seems like a better long-term scenario than trying to involve landings and take-offs from the moon.

Tony Irving: Not necessarily. It would be nice to have further human exploration of different areas on the Moon, but I think we should "keep our eye on the prize". I favor a series of direct missions into Mars orbit culminating in a "locally" managed landing party of geologists to select samples. This scenario has aspects of the Apollo missions, but because of the higher gravity, it would be necessary with current propulsion methods to have a staging platform from which to launch an experienced crew with sufficient fuel to actually allow them to return to the orbiting craft.

Jack Schmitt: Once resource production settlements exist on the Moon, the primary resources of the Moon (water, oxygen, hydrogen and food) can vastly lower the cost of going to Mars and establishing initial bases there. As the Moon is only a few days away from Earth, development and testing of exploration equipment, sampling techniques, operational procedures, and autonomous human exploration during lunar exploration and settlement will greatly lower the risks of Mars exploration. Large quantities of lunar water will provide the radiation protection necessary for round trips to Mars. The heavy lift launch vehicle and long duration habitats necessary for lunar settlement meet most of the requirements for Mars transit and settlement and can be paid for by private investment in lunar Helium-3 fusion fuels. Those launch vehicles can be used to test Entry and Descent concepts in the upper atmosphere of Earth (Note: we do not know how to enter, descend and land a 40 metric tonne spacecraft on Mars.) Finally, the successful development of Helium-3 fusion systems for terrestrial power applications will enable fusion rocket technology necessary to significantly shorten trips to and from Mars.

PSF QUESTION: Based on what we know now, what kind of geology/mineralogy may be discovered in Gale Crater?

Bill Hartmann: It looks like Gale Crater may have had massive sedimentary deposits, which have been partly removed, exhuming old sediments, so we may be able to understand what kind of fluvial, sedimentary, and proto-biological activity happened there.

Tony Irving: We already know now that there are sedimentary conglomerates in a purported alluvial fan deposit. But what are the pebbles composed of? I presume that these are volcanic rocks, but it will be fascinating to find out and compare them to Martian meteorites.

Paul Sipiera: Gale Crater appears to be a large impact crater that could have deep-seated igneous rocks in its central peak (Mt. Sharp). If so, these rocks may be similar in composition to the apparent "Martian-meteorites" found on Earth. Also, the crater floor appears to be filled with sediment that may provide evidence of a past wetter Mars and possibly fossils from that era.

PSF QUESTION: Given the fact that all the Martian meteorites found on Earth are various forms of igneous rock and the recent rovers have identified sedimentary rocks and minerals on Mars, when will we (if ever) find a sedimentary Martian rock on Earth?

Tony Irving: Remote sensing data suggest that the majority of rocks at the Martian surface are igneous rocks (albeit mostly covered with ancient red-brown dust). The selection of landing sites visited so far is biased towards regions with evidence for flowing water or hematite-rich mineral deposits. So I think the chances of finding and confirming a Martian sedimentary meteorite are very low, especially given that so far we have only 65 specimens in total.

Jack Schmitt: I suspect that an ejected near surface breccia fragment may be found someday; however, such fragments will have a difficult time surviving transit through the Earth's atmosphere. Looking closely at very small meteroritic debris in the Antarctic ice might show some clues as to a sedimentary origin now that we understand better what to look for.

Bill Hartmann: It's a great question that I've been asking meteorite experts for some years. The problem is: if a meteorite collecting team, say in Antarctica, picks up a Martian meteorite that is an obvious sedimentary rock, would it be recognized as a meteorite? I did an abstract some years ago with Derek Sears (U. Arkansas) and one of his students, suggesting that such "Martian sediment meteorites" would have fusion crusts, but possibly of somewhat different appearance or color than the fusion crust on the normal meteorites.

PSF QUESTION: In honor of the curiosity theme, is there something you are curious about?

Jack Schmitt: To stand much of a chance of finding extent life on Mars, we probably need to drill to the subsurface horizon where fluid water replaces ice. This horizon has been stable, although probably geologically mobile in depth, through Martian time, at least since complex organic precursors to life formed prior to 3.8-3.5 billion years ago. If simple, replicating life forms appeared on Mars (as they did in a similar aqueous, impact and clay dominated environment on Earth), then this water-ice horizon would have been a stable environment for their survival and possible limited evolution. That is something to be curious about until that horizon can be sampled. At times when the water-ice horizon may have intersected the surface of Mars, life forms may have been at that surface; so, at those locations, fossils might be found. Will Gale Crater turn out to have been one of those places of intersection?

Paul Sipiera: I am most curious about finding definitive evidence for either past or present life on Mars. For over forty years I have been a true believer that there was or is life on Mars based on its many similarities to Earth. I'm sure it won't be "little green men" but some nice microbes would be just fine.

Bill Hartmann: Lots! But in particular, how, and how often, did biological activity get started in the solar system, and what was the role of liquid water? Were there multiple starts that were then wiped out by giant, basin-forming, atmosphere-disrupting impacts every hundred million years or so during the first 600 M.Y.? And thus, the larger scale question: what is the role of life in the universe as a whole?

Tony Irving: I'd REALLY like to hold a sample from the summit caldera of Olympus Mons to see what type of volcanic rock it is.

NOTE FROM THE EDITOR

I want to give a special thank you to Bill, Tony, Jack and Paul. These topics are so timely and all of them were extremely gracious with their participation and quick turnaround to get this newsletter out in time for the fall! For any comments, questions or suggestions for future roundtables, please do not hesitate to email me at amcplanets [at] gmail [dot] com.

- Andrea Cosentino, Editor-in-Chief