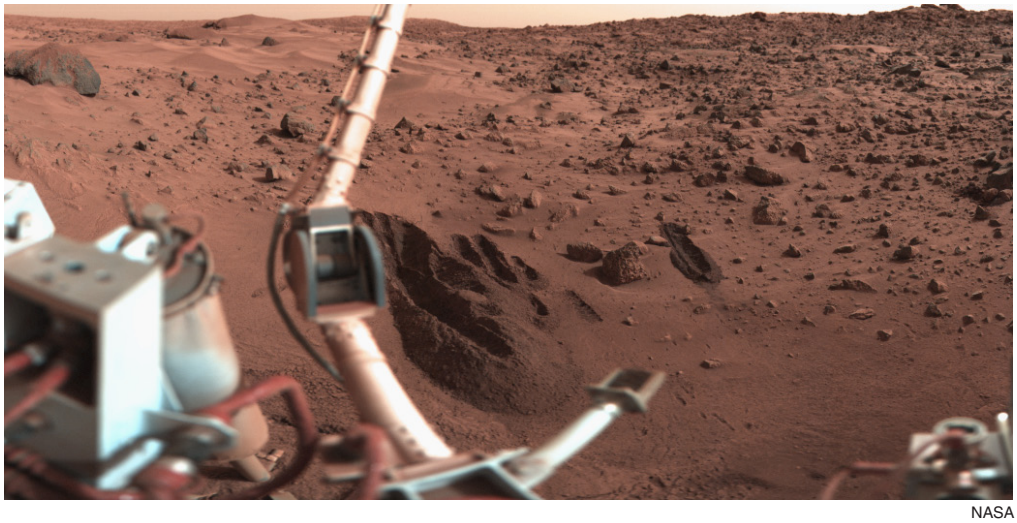


NASA

Picture of the Martian surface from the Viking 1 lander.

Practically Missing Mars

by Liona Fan-Chiang

From May 6–8, 2013, scientists, engineers, entrepreneurs, students and onlookers from a variety of different backgrounds gathered at George Washington University in Washington, D.C. at the Humans 2 Mars conference, sponsored by ExploreMars. They were there to present proposals and discuss how to get humans to Mars in the coming decades. What resulted was not a particular road-map which all agreed upon, but both a demonstration of the rich and vibrant history of a United States-led space exploration program, paired with boiling frustration, desperation, and demoralization caused by seeing that program diluted.

Fifty Years of Space

Visionaries such as Krafft Ehricke saw humans integrating the Earth into the rest of the Solar System, exerting increasing dominion over natural processes as we discovered their workings, building infrastructure in low Earth orbit and geosynchronous orbit, industrializing the Moon, building nuclear rockets to get to Mars, conducting science experiments on the Moon and Mars, planting instruments on several planets to see if there are Solar System-wide phenomena such as earthquakes or cosmic ray fluxes, and in general becoming a species which does not inhabit one or two planets, but which thinks of itself as a creative process in the universe, whose mind stretches far beyond its physical reach.

Among the over 25 panels at this conference, several old hands reminded us of what advances these dreams have created.

On an astrobiology panel, associate director of the National Cave and Karst Research Institute, in New Mexico, Penelope Boston, opened by presenting her continuing work on the extremely diverse life found in very distinct caves all over the world, which every day challenge how we define life and the conditions which support it. In order to show just how much we still do not know about life, she concluded with pictures of a mesh structure which has been found in caves all over the world of every rock type, but which is still completely unidentified, pointing out that on Earth we have enough trouble, even with access to microscopic imaging, biological, and chemical techniques, laboratories and scientists from around the world, in characterizing life. Imagine having to compact all of that equipment on to a one-ton Curiosity-sized laboratory!

On the same panel was Gilbert Levin, a scientist with an experiment on the Viking mission, who reminded some, and revealed to many, his original results: that Viking, with its Labelled Release experiment, had in fact found evidence of life on Mars, in 1975. After explaining how the Labelled Release experiment worked, and the many precautions they took to confirm the validity of the results, he posed the obvious paradox:

> the data were extremely compelling, but not accepted. Wouldn't you think that when you get a positive response that confirms a hypothesis, you go back and confirm that response and then expand on that technological beachhead? However, for the 37 years since Viking, no life detection experiment has ever been sent to Mars.

This was followed by an enumera-

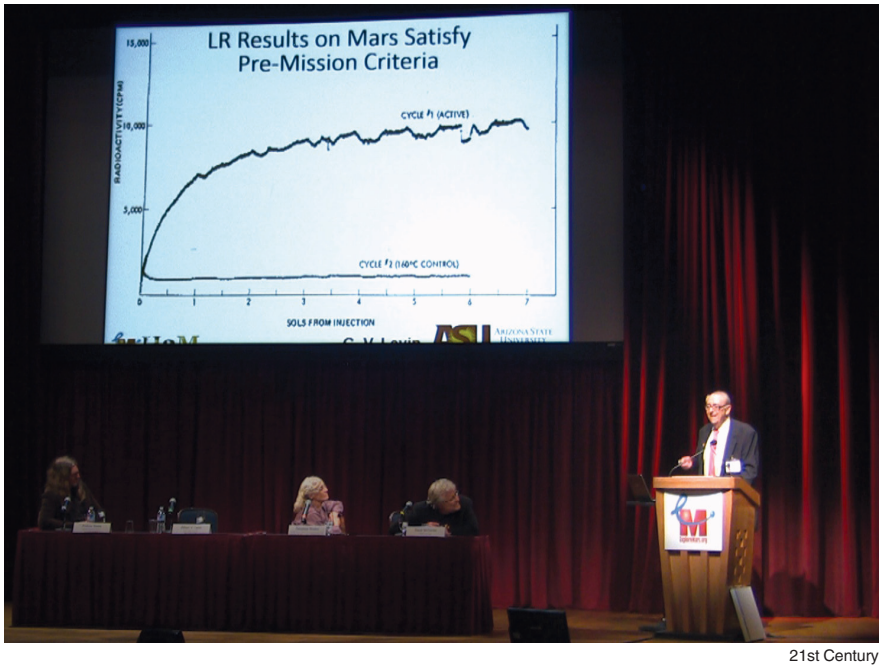
tion of the many objections raised about his results:

> The ultimate challenges leveled against us are that there is no liquid water on Mars, no liquid water meaning no life, that Mars is covered with a strong oxidant that destroys organic matter including life, and finally, the instrument on Viking sent to identify organic matter reported zero organics. We showed over the years that that was not so.

In fact, each new mission sent up since Viking has only dispelled many of those criticisms and upheld his results. He concluded by proposing a follow-up experiment, which was actually the original desired experiment for Viking, weight allowing: a chiral release experiment, which would have two separate instruments. Together they could be able to determine whether a preference was given to left-handed amino acids and right-handed carbohydrates, a preference which is characteristic of life on Earth.

> If we got back from Mars that only the left-handed amino acids produced a response, the right-handed one did not, no one would deny that this confirms that we had found life on Viking. If, on the other hand, we get back that only the right-handed amino acids responded, that's amazing, because that tells us we are not related to Martian life. That's a new kind of life. So, this experiment would begin comparative interplanetary biology.

Levin has stood his ground these many years while fierce resistance to taking his results seriously has slowly diminished. Although tension still exists between a now-habitual reference to looking for "conditions for previous life," and Levin's assertion that extant life exists on Mars, his presentation met with fascination rather than skepticism.



21st Century

Gilbert Levin presenting at the Humans 2 Mars conference.

Among others at this conference who have participated in the impressive accomplishments in space over the past two decades, Greg Gentry, who has been working on the International Space Station's Environmental Control and Life Support Systems (ECLSS) since its inception, reviewed a parallel development which has been trekking steadily alongside advances in planetary science: human life support systems on both the International Space Station and the retired Space Shuttles. After quickly showing some of the equipment, and advances which have made supporting human beings in microgravity for increasingly longer durations possible, Gentry highlighted a few of the humbling challenges which have been, and are being, faced along the way. "We had a water separator in our airlock common cabin air assembly that got clogged up because we weren't using our airlock. When we weren't using it we turned it off, which is something the designers never really thought about." Despite much incredible engineering, there will be instances which "the designers never really though about," which is why everything must be tried, not just tested. For example, although they had tested the urine processing system with several urine samples, they hadn't expected, and therefore hadn't designed the system to handle, high calcium content urine. In another situation, they found little washer-shaped zinc oxide particles clogging up a screen. "We don't know where they came from, we don't know how they got formed, or why they were there." Concluding, Gentry warned, "Let us be emboldened by our successes, but hopefully tempered by our mistakes."

Practicality Sets In

This event took place in an environment shaped by a jostled long-term space program and a volatile political and economic climate. Following the cancellation of Constellation, and the plan to return to the Moon and later move on to a manned mission to Mars, the only identified mission announced by the Obama administration has been to send humans to a yet-to-be-identified asteroid.

Keynoting the conference, NASA Administrator Charles Bolden outlined the new plan to identify, cap-

ture, relocate, sample and visit an asteroid in the 2020s. This, he said, would be the most reliable, and indeed the only way to get to Mars in the 2030s.

> We think we are on a path that will get us there in the 2030s, but that's a path we've got to follow. If we start straying from that path, going to an alternative plan, where we decide we are going to go back to the Moon and spend a little time developing the technologies and the systems we need, we're doomed. We will not get to Mars in the 2030s, if ever, to be quite honest. Not in your and my lifetime.

Ultimately, he argued, the plan is "affordable, realistic and sustainable." In other words, this is all NASA can afford.

Revealing the conflicts caused by an attempt to adapt to the "practical" situation was the response to a provocative question, during the first panel following Bolden's speech, posed by the former head of the United States Space Nuclear Propulsion Office, Harold Finger, who asked, "why not talk about upgrading what we had developed four decades ago when we said, let's start planning for Mars landings with humans, going with the advanced propulsion based on that technology?" Former astronaut and current head of NASA's Science Mission Directorate, John Grunsfeld, immediately answered:

> I agree with you 100%. It's very clear to me that in the long term, if I look out 100 years, or 200 years, if we are really going to go out and explore the Solar System, we need nuclear propulsion of some kind in space to reduce the amount of time to get places with the amount of mass. But I also know, if we are going to have nuclear propulsion, whether fission, fusion, or anti-matter, looking out into the future, that unless you invest in it, it will never happen. I see through our mission directorate, for the first time in a long time, investment into some of those nuclear technologies.

This was, however, followed by NASA Technology Mission Directorate Michael Gazarik, who said, "we have for the past number of decades done a lot of studies and are trying to move beyond that... it takes a considerable amount of money and time to develop and mature it. We don't have the money and the time right now."

Nuclear propulsion came up in smaller discussion several times during the conference. The necessary next step, in order to redefine our relationship to the Solar System, is, and has been, nuclear rockets, along with the associated nuclear research requisite to refine our understanding, and use, of matter. "Of course we need nuclear" is a gut reaction among many. However, several proposals explicitly left out developing nuclear technology because at this point, it is almost a completely new technology, having been abandoned when plans for manned missions to Mars were cancelled, following the success of Apollo.

These included an insane proposal by MarsOne, which perhaps was the quintessential expression of demoralization about changing the current economic, and moral, paradigm, to get around the technology hurdles posed by the return trip from Mars by not facing them at all; that is, by sending astronauts on a one-way trip to Mars! Similarly, at times, an expression of extreme practicality could be heard throughout the conference, even as a qualifier for the validity of a proposal, in the phrase "no new technologies." No new technologies means no new tests, no new development cycles, all of which means less money and less time.

Exploring the Solar System and recreating it as a "garden for mankind" is still the dream. But it will never be fulfilled by being "practical."