Curiosity Is a Game-Changer; Will There Be Future Missions?

EIR Technology Editor Marsha Freeman, who has written widely on the U.S. space program, and most recently about the Mars rover Curiosity mission, was interviewed on Aug. 22, by Liona Fan-Chiang of LaRouchePAC, on the historical significance of the Curiosity landing, and where we go from here. The interview was made available to EIR.

LaRouchePAC: What made the recent NASA Mars landing success possible?

Marsha Freeman: Curiosity is really the culmination of a 40-year, very methodical series of missions to Mars.

When we started out in the mid-1960s, we were very lucky if we got a rocket off the launch-pad without it exploding. And the first few missions to Mars were really just a matter of launching a spacecraft, throwing it out there, and heading it in the direction of Mars. We really couldn't control it very much, and we just hoped for the best. We didn't have rockets on board that could slow the spacecraft down, so we couldn't go into orbit around Mars.

So the first couple of spacecraft—these were Mariners—just flew by. On their way, as they came close to Mars, they were able to snap a few dozen pictures. And, of course, the spacecraft were moving pretty quickly, and it was 1960s photographic technology, not even what you have on your cellphone today; very far from it.

Those pictures were very disappointing. We saw sort of something fuzzy, kind of featureless, maybe some craters, but nothing that looked like the creatures that people writing science fiction had envisioned as living on Mars.

By the early 1970s, our rocket technology was better, and we could actually launch a spacecraft that would not just whizz by the planet, but that could actually go into orbit. So Mariner 9 in 1971 slowed down, got captured by Mars' gravity, and, for about a year, took pretty good pictures of Mars. Then, we began to see something very different: You could see mountains, craters, canyons, and large-scale geographic formations. So it became very clear that this was not a boring place; that it was a place that probably had changed over time, maybe over billions of years, but that definitely had changed. So this now became much more interesting.

The Viking Mission

One of the questions that posed itself from the very beginning was the question of life; not "little green men," and the things that science fiction imagined, but maybe microbes, maybe something even a little bit bigger, that might have lived on Mars in the past, or might even still be there today.

That drove the next series of missions. Could we go there and find life on Mars, or maybe fossils?

So, in the mid-1970s, we sent a pair of fabulous spacecraft. This was the Viking mission. It included two landers and two orbiters, so that while the landers would be looking at Mars on the ground, the orbiters would be providing a larger context for what they were looking for, by looking down from orbit.

The Viking landers did chemistry experiments, some atmospheric experiments, took a look around. They saw frost on the rocks on Mars in the morning, which gave us an interesting idea of how water that is trapped at the poles—the north and south poles of Mars—moves around and evaporates at certain times, and then freezes, and puts frost on the soil and the rocks.

There was a series of chemistry experiments on Viking, the life-science experiments: Would we find an indication of life? We didn't think that the cameras were going to see little things running around, but we figured that since all life on Earth involves carbon, in one way or the other, and organic compounds—would we find those?

Well, the instruments worked very well, they worked very hard, but when the results came back to scientists on Earth, there was disagreement. One of the primary experiments, called the Labeled Release experiment, actually indicated that there had been life—in the soil that was taken as a sample by the robot arm, and put into a little oven—they fed it with radioactive carbon, and they felt that if there were any organisms in the soil, the organisms would eat the carbon, and they would exhale the radioactive carbon, and we would be able to detect that.

The chief scientist on that experiment, Gilbert Levin, looked at the results, and he was convinced, and there were indications that that had happened. This was very, very exciting. The problem was that one of the other life-science experiments on the Viking lander showed no indication of organic material at all.

The scientists assumed that if there were no evidence of organics, there could not be any kind of living creatures. So, the evidence was contradictory. The scientific community—if you want to just make a whole group out of Mars scientists—decided that the Labeled Release experiment, which indicated that there might have been organics, was contaminated, and whatever it showed, did not show life.

For many years, the scientific community was willing to close the book on life on Mars. Gil Levin, however, the scientist, never gave up. He continued to do research; he continued to investigate his results; and in the years following that, some very, very interesting things were found.

One, they took the instrument that showed no organics on Mars, and they took it around to the Atacama Desert in Chile, which is very, very dry; hardly anything lives there. They took measurements of the soil, like they did on Mars, and this equipment could not find organics, had no indication of life. And the scientists said, if Viking had landed here in the desert in Chile, we would assume that this planet, Earth, had no life!

Well, that threw people for a loop! It just wasn't sensitive enough—and again, it was early 1970s technology.

The Phoenix Lander

Then, in the late 1990s, a small lander, called Phoenix, landed in the north polar region—not right on the polar cap, but a high-latitude region, which has a lot of water ice in the soil, almost like permafrost. And its mission was, again, to dig up some soil, which it had some trouble doing, and analyze it; and get a much better sense of what the water ice inventory is on Mars. And it did that very well.

It also made a very surprising discovery, which no one expected: It found, in looking at the chemical composition of the soil near the lander, a chemical called perchlorate, which is a chlorine compound.

Now, what is interesting about that: One, we know that liquid water, under the circumstances—what we know about the environment on Mars, the temperature, the pressure—we don't have liquid water on the surface now. There is plenty of evidence that there were lakes, that there were rivers; you see deltas, you see channels; but we don't expect to find liquid water on the surface now. It's too cold, for one thing.

Interestingly, perchlorate is a chlorine salt that lowers the freezing temperature of water. On Earth, we know that water freezes at 32°F, but on Mars, maybe it doesn't freeze until it goes down to 20°F or 15°F, in places where this chemical exists. That's very, very intriguing! Not just for the surface, but even underground. Maybe there is more liquid water underground than we can imagine, even where it's cold.

But the other thing, in terms of the Viking life experiment, that was very intriguing, is, first of all, perchlorate can be a food for microbes! There are certain microbes that we have found in extreme environments on Earth, that actually can take this chlorine compound, and ingest it and metabolize it, and use it as food.

The other very, very interesting thing is that they found that if you heat perchlorate to certain temperatures, it will oxidize other chemicals. Let's just take an example out of the air, so to speak—carbon dioxide. Perchlorate will pull the oxygen out of the carbon dioxide, and oxidize the chemical.

Well, this means that if there were perchlorate where

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In the mid-1970s, the Viking mission sent two landers and two orbiters to Mars, so that, while the landers looked at the planet up close, the orbiters would provide a view of the larger context. Shown: an artist's impression of the Viking orbiter releasing the lander descent capsule.

the Viking experiment took the sample, when they put the Viking sample into an oven and raised the temperature, the perchlorate may have destroyed any organics, meaning carbon-oxygen compounds. We wouldn't have found them.

This raises a lot of questions.

Now, the Viking instruments did not find perchlorate where Viking landed. But Viking was not a rover; it could not move. All it could do was to take samples and pictures, and examine the area right around it, so that's a very small sample. Again, if you landed in the desert on Earth, you would think there was no life. So, you can't take the two landers of Viking, and say that what they found characterizes the whole planet. That wouldn't make any sense.

LPAC: If you landed in the polar regions around Earth, you would find similar circumstances?

Freeman: Yes. I mean, this is a planet, not like Earth, but one that, in a similar way, has weather, has climate, has geologic changes, had volcanoes; it still has Mars-quakes. It's changing.

The wonderful thing about the way NASA engineers these programs, is that a spacecraft that is supposed to last two years, lasts ten years. And the Mars Odyssey, which has been in orbit now for 11 years, has been able, actually, to see Mars change. It has seen landslides. It has seen the sides of craters crumble, and sand dunes move, and dust devils whirl around. It's like having, not just a snapshot, but a moving picture, over 11 years.

These more recent results, after Viking, have really thrown the question open again.

Now, Curiosity—regardless of what people say—is not looking for life. What it is looking for is an environment that would make life possible; evidence of there having been running water. The Gale Crater site, where Curiosity came down, was chosen because there are layers in the side of the mountain, which we know contain chemicals, and clays, and minerals, that form in water. So, the site was picked to send a rover with just "A+" amazing equipment to take a very close look, an "in situ" look, right there on the ground.

And if we find more evidence, there is going to be continued re-evaluation of the Viking results. So, everything we thought we knew maybe 30 years ago, maybe we didn't know at all!

Will Obama Be Allowed To Kill the Space Program?

LPAC: What's next?

Freeman: There had been a very well-thought-out plan, that Mars scientists had worked on for many years. In a certain sense, you do plan future missions based on what you learn, and we've always done that.

NASA

Curiosity landed at the Gale Crater site, chosen for its proximity to the layers of rock on the side of Mount Sharp (as shown in this NASA photo from Curiosity), which contain chemicals, clays, and minerals that form in water, which the rover can examine.

In another sense, we've always known that until we can bring samples of soil and rock from Mars back to Earth, there are questions we really will not be able to answer. And life is probably one of them.

So, forever, it's been the goal of scientists to have a series of missions which culminate in bringing something back. You know, Curiosity weighs a ton; it has wonderful chemistry, weather, and all kinds of other experiments, but one thing that is very interesting about it is how limited it is. One ton is really not that heavy when you consider that you have science instruments, you have power supply, redundant computers; you have to put an awful lot of stuff on that machine to make it work, so you have less than a couple of hundred pounds of scientific equipment.

Think about what you have at a laboratory on Earth, with the X-ray diffraction, and all kinds of magnificent equipment. So, the culmination of our unmanned Mars exploration, the goal, has always been to bring samples back. And Curiosity will definitely push forward our knowledge of where to go, what to look for, and help along that path.

But what you bring up is a very important question, because all of the Mars planning missions for the U.S. were thrown into complete chaos, starting over a year ago, and made very definite in February of this year, when the Obama Administration released its proposal for NASA's budget for the fiscal year that starts this October, FY2013. The Mars programs for the future had been cut 40%!

That is life-changing. That's not a little trimming here, or, you know, "we'll take a mission, and we'll cut off one instrument, but we'll fly it"—that is a complete assault on any future missions for Mars!

There is one mission called "Maven" [Mars Atmosphere and Volatile Evolution Mission]. It's an orbiter, not a lander. It will launch next year, in 2013, and it will give us important information—largely, a very detailed view of the atmosphere, and therefore, the hydrology of Mars. That will be done from orbit, and that will be important.

But the follow-on missions, to launch and land more robots, even series or groups of smaller robots that will carry out missions and coordinate with each other—the missions that Europe is going to do, which we were supposed to be part of, and then pulled out of—all of these things are now completely up in the air.

So that's where we stand. The Mars scientists are furious. The Congress is furious. And there are hopes that this Curiosity mission, which got 2.3 billion hits on the Internet, and brought down NASA's servers on the night of the landing—that the excitement that we've seen all over the world, from people watching it in Times Square (and this was at 2 o'clock in the morning), to people watching in South Africa at the Radio Astronomy Facility; to all of the countries that participated: Russia, Spain, Canada, Italy; France built the laser—that the excitement about this is global, and its reach is to all of mankind.

And there is hope on the part of some Congressmen, and definitely on the part of the scientists; and absolutely in terms of what the LaRouche Political Action Committee is doing, to make this really the leading edge of the fight for what has to be the policy for the future.