Does the Red Planet have a Blue Past?

For decades, astronomers, scientists, and science fiction writers have speculated about water on the surface of Mars. Many hypothesized that distinct surface lines, visible through telescopes, were canals, dug by ancient alien civilizations to transport water across the planet. While this is obviously not the case, the search for water on Mars remains as active as ever. Polar ice caps have been directly observed for years, but proof of flowing water at lower latitudes on the Martian surface has continued to elude scientists. New research, however, is pointing to the historical existence of vast bodies of water including rivers, lakes, and oceans -all near the equator -and some of that proof lies right here on Earth.

A team of researchers from Trinity College Dublin has observed a section of Martian sand dunes that appears to have been flooded with water not too long ago. The evidence behind their discovery? These Martian sand dunes have traits that mirror desert areas in Africa and Australia with recent histories of flowing water. Geological patterns between dunes in the Namib Desert have been proven to be the result of evaporating groundwater, left behind as the dunes migrate across the surface of the earth. In a new article published in Geophysical Research Letters, Dr. Mary Bourke, of Trinity College, has shown that these same patterns are visible on the Martian surface. As she explains, “Scientists like to dig holes, but we can’t get to these places on Mars, so we have to look at photos.” All evidence of water on Mars, whether it exists underground, or millennia into the past, must be collected indirectly. Without the ability to test the soil by hand or remotely, the only way to learn new information is to compare the physical geography of the planet to our own, and assume that the forces of nature act on them both

similarly. Dr. Bourke and her team rely on images taken from orbiting spacecraft, and use proven information about the Earth to deduce new information about Mars.

Mars: Earth's Hibernating Twin?

Although Mars is very cold and dry today, the existence of large quantities of liquid water in its past suggest that it was once dramatically more earth-like. Dr. Nadine Barlow, an astrophysicist and professor at Northern Arizona University, specializes in the surface features of Mars, and explains that the planet, like Earth, cycles through periods of increased and reduced habitability, and that it was once home to significant bodies of liquid water: "We do have evidence that there was probably liquid water on the surface -even lakes that existed, maybe oceans. We do know that there's lots of wind… There's evidence that we've had glaciers in the past. Today, it's kind of cold and dry, but we do believe that it actually goes through periods of climate change every few million years, which allows those glaciers to come back." Mars is likely completely desolate today, but research suggests it may not stay that way forever. Since Mars interacts with Jupiter's gravitational field more than the Earth does, it experiences periods of drastic climate change as its orientation in space changes. In the future, as its axis returns to normal, it may redevelop a thicker atmosphere of water vapor and other gases, which could lead to significant snowfall, glaciers, and even liquid water.

The future of Mars is not the only -or the most important -thing we can learn through observation of the Red Planet. According to Barlow, the study of Mars could be profoundly beneficial to the current understanding of Earth. She explains that "By studying other bodies in our solar system, we gain a better understanding of Earth. When we look at Mars, we see evidence of ancient river channels, lakes, and possibly even oceans on the surface, which tells us

that Mars was much more Earth-like at one time in the past, and then something happened to make it the cold, dry place that we see today. And the question is what happened, and could something like that happen to the earth, and, if so, could we somehow keep it from happening?" Although continued study of Mars is important to the scientific community, it has a practical advantage for the entire human race: predicting and preventing catastrophic climate change. Dr. Bourke agrees, noting that the study of Mars forces us to study environments on earth that can reveal new information about the geological history -and, hopefully, future -of Earth.

Life on Mars?

Somewhat more exciting than possibilities of climate change, however, is the capacity these areas have for sustaining life. If liquid water existed near Mars' equator at a time when the atmosphere was thicker, conditions could have been ripe for the development of various life forms, and Dr. Bourke believes that her newly-discovered geographical phenomenon is the perfect place to begin the search: "The fact is that we have a new potential environment for life forms. This location is unique in that it was dry, became wet, and dried out again." Although these Martian dunes are relatively dry now, their history of flowing water (and the rapid transition between these two states) could have given rise to life forms which had the capacity to exist in harsh, rapidly changing environments.

Areas with a history of surface water, or the presence of current subsurface water systems, are known in the scientific community as Special Regions. As Dr. Barlow explains, "Special Regions are areas where Martian life, if it exists, could actually be there today, or, if we were to introduce terrestrial microbes, they would be able to survive and propagate." For years, these Special Regions were often zones around craters, typically caused by meteorite impact.

Upon impact, groundwater would be ejected onto the surface, creating areas of sufficient heat and moisture for habitation. Now, however, with the discovery of low-latitude bodies of water in Mars' history, the qualifications for these Special Regions have changed. If we intend to look for life on Mars, Dr. Bourke's new type site will be the standard location for searching

Getting There

Sadly, despite the terrific potential of Martian exploration, missions to the Red Planet are rare, so scientists like Dr. Bourke and Dr. Barlow are restricted to the use of orbiter and rover photographs. When asked for the primary frustration in their field, both scientists remarked that the lack of funding is a tremendous hindrance to the continued study of Mars. According to Dr. Bourke, rovers are relatively inexpensive and robust, but cannot traverse the environments where we hope to find life forms. Craters, sand dunes, and walls cut out by glaciers are steep, and provide little traction. She advocates the use of flight-based missions, where aircraft could circle the planet looking for promising areas with watery histories. Both manned and aerial missions, however, are prohibitively expensive and complex, at this point. With funding to institutions like NASA being cut, plans for government-sponsored missions to Mars (despite the potential advances to climate research and astrobiology), are in jeopardy.

Where, then, does the future of space exploration lie? Both researchers indicate that subsequent missions will probably be funded by private companies and organizations, and that the first successful human missions to Mars will rely on the cooperation of the private and public sectors. "Oh my gosh, just watch what's going to happen. In ten to fifteen years, there will be a complete revolution," says Bourke. Her opinion is that the privatization of spaceflight will result

in cheaper, more ambitious missions to Mars and beyond, and that the economic potential for corporations will accelerate our progress toward consistent Solar System exploration. Dr. Barlow agrees: “We continue to have more interest from the private sector. They come up with creative ways to do these missions that NASA, as a federal agency, has its hands tied on...By including privatization in space exploration, we can actually bring down costs dramatically.” Companies like Elon Musk’s SpaceX pursue inexpensive, safe ways to reach space, without wasting materials like fuel tanks and rocket fuselage, and are driven by the limitations to their own funding.

Unfortunately, the corporate path to Mars is not without its drawbacks. While private enterprises might reach Mars first, they are not bound by international regulations. One of the most serious risks to the Red Planet is contamination by insufficiently sterilized spacecraft. Barlow explains, “We want to sample areas and see if there is Martian life there, but on the other hand, we don’t want to come in and actually contaminate samples before we have a chance to analyze them.” Government bodies are bound by so-called “Planetary Protection Guidelines,” which prohibit them from endangering the natural environment of other Solar System bodies. Dr. Barlow has been active on the committees that determine these guidelines, and worries that, since private companies are not bound to international policy, they may not adhere to proper protocol, and may risk contaminating areas, in an effort to save money or get there first.

Despite the limitations of funding, technology, and bureaucracy, scientists remain enthusiastic about the study and exploration of the Red Planet, as well as other solar system bodies, such as the icy moons of Jupiter and Saturn. Although Dr. Bourke’s research is limited to images and telescopic observation, she does not feel frustrated by these restrictions. Instead, she

explains that her excitement stems from the fact that we are constantly at the frontier of discovery in planetary studies. Dr. Barlow shares the same enthusiasm, and believes that further space exploration will continue to yield thrilling and meaningful results. She concludes: “I consider this to be the golden age of planetary exploration. We’ve got so much going on in the Solar System, and we are learning so many cool things, things we didn’t even expect. It’s an exciting field to be involved in, and a great time to be involved in it.”

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