

Chapter 5: Mars, Alive (pre-1965).



Figure 7, Mars,
(Image courtesy JPL, NASA, and University of Arizona
<http://Phoenix.lpl.arizona.edu>)

At 74 years old, grey hair and frail, Dr. Earl Slipher still looked at Mars with as much enthusiasm as he had back in 1908. It was 1954 and Dr. Slipher was one of the premier astronomers in the world. Most of his life was spent in the Lowell Observatory in Flagstaff, Arizona. Many cold, dark, lonely nights were rewarded with some of the best view of Mars ever witnessed by man. His drawings, photographs, and measurements of Mars resulted in critical new discoveries about the Martian atmosphere, the cloud patterns and the snow covered polar caps. This year would also bring something special.

In 1954, Dr. Slipher went on an expedition to an observatory in Bloemfontein, South Africa, sponsored by the National Geographic Foundation. 1954 was a year when Mars would make a very close approach to Earth – a mere 39 million miles. Having a good telescope was only part of making great observations – the other parts are location and dedication. Dr. Slipher had spent his lifetime observing Mars and making important discoveries – he obviously had the dedication. But, in 1954, location was the key. Due to its slightly inclined orbit, during that close approach to Earth, Mars would not rise very high in the sky when viewed from the United States or Europe. When a telescope is aimed at a low elevation, the thick atmosphere of Earth distorts the view. From South Africa in 1954, however, Mars would rise almost to zenith – directly overhead. Here the telescope would see through the thinnest part of Earth’s atmosphere – so the view of Mars would be the best on Earth.

Dr. Slipher had to deal with the numerous logistic problems for this expedition – shipment of equipment, rigors of travel, etc. - but in the end, it was all rewarded. Slipher had already observed the seasonal color changes on Mars for decades. From his measurements, he knew that roughly 3/5 Mars stayed the desert color (he called ochre), and the other portions were divided between the brilliant white icecaps and blue-green areas. He was sure the blue-green areas were life, because he watched them change color throughout the Mars seasons. As the polar ice cap in the hemisphere approaching Martian summer would melt, it released water vapor that would invigorate the blue-green areas. As the warm season ended, the blue-green areas would turn brown. Just like plants on Earth!

When Dr. Slipher finally got all the equipment he needed, he and a few other astronomers drove up a dirt road to the mammoth observatory in Bloemfontein. He couldn’t help but have noticed the herds of Antelope-like creatures roaming the plains outside the observatory in Africa – and on the dirt road itself. Much was different than in Arizona.

Mars was different, too. As the sun set, he waited for his first glimpse of Mars during this close approach. He would be watching astronomy’s premier show – the approach of Mars – with the best seat on the whole of planet Earth. The massive tube of the telescope stretched up from him towards the slit in the darkened observatory dome. Knobs and levers that would look at home in Frankenstein’s lab controlled every aspect of the

telescope. He peered into the eyepiece, adjusted the aim, fought the focus knobs, and then he saw it. A huge new blue-green area. He quickly calculated the size – 2 million square miles – larger than Texas! – *no longer desert*. At all Mars’ previous close approaches, that area was the ochre color of the Mars desert – now it was blue green. Even the Mars deserts could come back to life.

What must the life on Mars be like? How could it survive so well on such scant moisture? He picked up some photographic plates and went back to work. Science only allows a few moments of daydreaming. Slipher was already 74 years old; he had spent his life taking many tens of thousands of photographs of Mars. Every fascinating image preserved by him became the knowledge base for future generations of astronomers who would be left to solve these riddles. Slipher spent 6 months in South Africa, making over 20,000 photographs of Mars. When he finally returned to the United States, he was greeted by a few reporters. Slipher’s conclusionⁱ:

“Mars is alive. It has to be.”

Of course, Slipher had fellow astronomers around the world who also pondered and explored the mysteries of Mars. Some of the lesser known names were Gerard de Vaucouleurs, Dr. Kuiper, and Dr. A Dolfus. Others astronomers, by then a part of history, had already made important discoveries. These included Christiaan Huygens, who was first able to observe the bands of color across Mars, and Giovanni Cassini, who determined the length of a day on Mars by watching the colored areas move, and Friedrich Herschel, who first observed the Mars polar caps. To attribute any one discovery to a single person is probably unfair to the selflessness that they all showed in sharing images and data with each other. In fact, most of the discoveries were made because the individuals had or developed better telescopes. Every time the telescope was improved, more discoveries followed. By the mid 1900’s, these astronomers were all legends (in their small way).

In the mid 1950’s, to prepare for these close approaches to Mars, the International Mars Committee was formed to coordinate international research and observations among the current batch of dedicated astronomers.ⁱⁱ Including men like Slipher, Vaucouleurs, Kuiper, and Dolfus, they were a team dedicated to solving the mysteries of Mars. They met in Flagstaff, Arizona, in 1953, and the capital of the western world,

Washington D.C, in 1954. Coordinating their efforts globally, they maximized the observations during the closest approaches of Mars in 1954 and 1956. Unfortunately, the committee was disbanded by the time the 1960's arrived. The era of the astronomer was ending, and the era of the "space scientists" was beginning.

Prior to 1965, astronomers could only view Mars from a distance through telescopes, but they developed ingenious techniques to deduce more facts about it. One method was to observe and to photograph Mars through different color filtersⁱⁱⁱ. This would allow features too faint to be observed without filters to come into clear view. Another method was to record the intensity of light at specific wavelengths. Spectral information derived in this method was used to identify some chemical compounds on Mars, since specific chemical bonds will reflect light at specific frequencies. A variation of the use of spectral information was to measure the temperature of specific Mars regions through a telescope recording "radiometric" measurements^{iv}. A third method was to measure the polarization, or "twist" of light, using polarized filters on the telescope; certain known materials and shapes produce certain types of polarization, and the measurements of regions on Mars could be compared with polarization measurements of things here on Earth. Whatever the scientific technique being employed, it usually came down to a combination of dedication and luck as to whether successful results could be obtained. The following was the state of the knowledge of Mars prior to 1965.^v

MARS IN GENERAL

Mars is the fourth planet from the sun, and so is the next planet after Earth. Mars is only slightly larger than half the size of Earth, with a diameter of 4,200 mile. Being smaller, Mars' gravity is also less. A 200 lb. person on Earth would weigh only 76 lbs. on Mars. A Mars day is about the same as an Earth day (a little over 24 hours), but a Mars year is almost two Earth years long. Mars is tilted like the Earth, and has polar caps and seasons. Each season is about twice as long as the season on Earth.

MARS ATMOSPHERE AND CLOUDS

Mars has an atmosphere, much thinner than Earth's, and is reported to contain mostly carbon dioxide, though it is now known to have some water vapor and some methane. Several different types of clouds have been observed in the atmosphere, include clouds of ice crystals, clouds of dust particles, and perhaps, at times, even clouds of frozen carbon dioxide over the winter pole.

MARS SURFACE

Prior to 1965, the surface of Mars was grouped into three major features – the bright orange (ochre) areas, thought to be deserts, the blue-green areas (the majority of which seasonally changed to the desert color - ochre), thought to be plant life, and white polar ice caps. The temperature estimates (made by thermocouples attached to large telescopes) suggested that the range of mid-day temperatures at the equator could approach 80 degrees Fahrenheit – almost bathing suit weather!^{vi} At night, though, with such a thin atmosphere to hold in the heat, the temperature plunges to well below zero.

MARS BRIGHT ORANGE (OCHRE) AREAS

The bright orange areas were thought to be desert areas consisting of strongly oxidized sandy formations – Fe_2O_3 , also called hematite.^{vii} Some astronomers speculated that the oxygen locked up in the rusty desert areas was at one time produced by plant life on Mars, so that the deserts themselves gave some proof that early Mars life was even more plentiful than what they saw.

MARS POLAR ICE CAPS

Prior to 1965, Mars had been observed for over a century to possess an ice cap at each pole, just like Earth. There was some speculation early on that the ice caps might be frozen carbon dioxide – but that was disproved by the spectrum measurements made by scientists in the 1950's. Dr. Kuiper compared the reflection spectrum of frost at low temperatures with the spectra of the Martian polar caps – and they matched!^{viii} Dr. Vaucouleurs independently came up the same conclusion. In 1954, Vaucouleurs wrote:

“The polar caps are without the slightest doubt layers of crystallized water – probably more like white frost than solid ice or snow.”^{xix}

Dr. Slipher and others also observed an atmospheric feature they called the polar hood – which was a mist or clouds and may consist of frozen carbon dioxide. Nevertheless, the bulk of the traditional Mars ice caps were known to be frozen water.

As stated before, Mars has seasons like Earth, just longer. The polar cap which is more tilted towards the sun (the hemisphere experiencing summer) actually melts (actually sublimates - goes from solid to vapor). In the case of the Northern Hemisphere, it disappears completely every season. As the one ice cap melts, the other expands – suggesting to pre-1965 astronomers a movement of water vapor through the atmosphere. Other effects were even more unusual; these are described next.

MARS DARK OR BLUE-GREEN AREAS

Astronomers had observed dark or blue-green areas on Mars for centuries. They were first thought to be seas, then marshes. But logic told them this was not possible, because no bright reflection of sunlight was ever observed. The most fascinating aspect of the dark areas was that they experienced seasonal changes. As the Mars pole shrank, the blue green areas became darker over time. Starting at the pole, the blue-green areas would darken over the following weeks, and the darkened area would expand progressively further away from the pole, until the dark areas reached and crossed the Martian equator. This phenomenon was called the “wave of darkening”, and to astronomers it appeared as if plant life was being invigorated by water vapor freed up by diminishing polar cap^x.

Astronomers speculated that the blue green areas must be plant life – but their spectroscopic measurements did not detect chlorophyll (the chemical plants use to turn sunlight into energy). Either the technique was too weak to detect the chlorophyll on Mars from Earth, or Mars’ plants used a different substance than chlorophyll to convert sunlight into energy. Other

astronomers studying the issue did identify some organic (carbon molecule) bands in the Martian blue-green areas. Dr. Sinton, in 1961, carefully measured the infrared spectrum of light reflected from the dark areas of Mars, and identified spectrum absorption features at 3.43, 3.56, and 3.67 microns. The spectral signature at 3.43 microns was known to be present in the spectra of all terrestrial plants, but the band at 3.67 microns required some investigation. It turned out that 3.67 micron signature was similar to that shown by a type of *algae*.^{xi}

One of the more fascinating predictions was made by Dr. A. Dolfus in 1961. After making careful polarization measurement of the seasonally changing blue-green areas, *he predicted that blue-green areas are covered with small opaque granules that change shape and size with the different Martian seasons*. “This idea would agree well with what would be expected if the dark areas were covered with microscopic living organisms of some kind. Alternatively, the same impression might be given by larger organisms made up of microscopic sub-units.”^{xii}

Another interesting fact about the blue-green areas is that they appeared to form a collar or a ring around whichever Mars polar cap was receding^{xiii}. Astronomers also took this as a strong indication that the life in the regions adjacent to the polar caps was being invigorated by the released water vapor. It was also considered possible that darkening in the band around the polar caps was caused by a darkening of the soil by moisture. Either way, astronomers had cause to believe that Mars supported life.

MARS VIOLET LAYER AND THE “BLUE CLEARING”

Some features just described would show up best in specific color filters. Red filters enhanced fine surface detail, and some clouds showed up best in blue filters. One fascinating fact that astronomers deduced in the 1900s was that Mars surface features could normally *not* be seen though a blue filter. This meant some widespread particles in the Martian atmosphere were blocking the shorter wavelengths of light – blue and ultraviolet. To make the story even more fascinating, at rare times the Martian atmosphere would apparently clear, because the surface markings (the dark areas) *would* be visible through a blue filter. These times – known as the “Blue Clearings” happened most often when Mars was in opposition – that is, more or less directly opposite the sun, when Earth was between the two^{xiv}. This event has still not been adequately explained, but some astronomers of the day did

suggest that, at the very least, it was due to some microscopic particles in the Martian atmosphere. This meant Mars surface had *some* protection from ultraviolet light.

CANALS

No discussion of Mars is complete without a discussion of the canals. In 1965, astronomers, to varying degrees, all accepted the existence of some of the thinner dark markings which were called canals. The Italian astronomer Schiaparelli was the first to use the name “canali”, Italian word meaning “channels”, which was then carried into English as canals. Popularized by astronomer Dr. Lowell in the early 1900’s with claims of intelligent Martian ditch-diggers, most astronomers preferred to remain strictly scientific about the topic. One thing is clear – in 1965, most dedicated astronomers did see, sketch, and even photograph what they termed “canals”^{xv}. The arguments of the day between serious astronomers were whether the *finest* features claimed by some were true Martian features, or were a type of optical illusion.

In 1963, Dr. Slipher, then 83 years old, had just completed a study of Mars under contract to the U.S. Air Force. In the book produced for the U.S. Air Force, Dr. Slipher included a pasted-in print of a set of photographs revealing the canals as real features. On page 162, he wrote:

“Photographs have recorded traces of so many of the canals and oases in the same position, form, and character as drawn on the Lowell and Lick Observatory maps of the planet that they should remove all doubt of the reality of this class of markings. . . . While there is room for difference of opinion as to the interpretation of the canals, their existence as true markings on the planet has been clearly established.”^{xvi}

What might the canals have been? Only a few science-fiction oriented astronomers were pushing the idea that canals were dug by intelligent Martians. Most thought the formations were natural; one theory of the time which should draw some attention is the canals are the result of sub-surface ice melting and causing the ground to slump in long, crack like formations^{xvii}. This theory was proposed by Soviet astronomer Dr. Davidov in 1960; it should be remembered that in 1960, there was no evidence yet of

extensive sub-surface ice. In March 2008, this is a known fact, substantially raising the possibility that his theory is correct.

THE PROSPECTS FOR LIFE ON MARS

In 1965, almost every dedicated astronomer expected life to be discovered on Mars by space probes. Dr. Slipher's conclusion in his 1963 report to the Air Force was that:

“Considering these points, which are the result of many kinds of observations, we see that the cumulative evidence suggests that....some form of vegetation exists.

...The evidence is in the blue-green areas and the changes in their appearance. Vegetation would present exactly the appearance shown, and nothing we know of but vegetation could. The seasonal change that sweeps over them is metabolic; that is, it shows both growth and decay and proclaims an organic constitution such as only vegetation could produce. The blue-green lapses into ochre and revives again to blue green just as vegetation does on Earth at the proper season under the stimulus of the Sun and the advent of water.”^{xviii}

More than a decade before Slipher's published statement above, Dr. Kuiper had also concluded that some plant akin to lichen grow on Mars. He listed several supporting reasons, then added the warning that the life there did not need to be identical to lichen. The was because “...it would be surprising if similar species had developed on Mars as on the Earth.”^{xix}

So, back in the 1950's and early 1960's, astronomers had concluded life existed on Mars. This would be one of the great discoveries of mankind – so other scientific specialties needed to get involved. This was a question of *life*, and the study of life needed the work of biologists. At the suggestion of a U.S Air Force Aerospace Medical Division scientist, biological laboratory tests started about 1957 to determine if any terrestrial organisms could survive, and possibly grow, in Martian conditions.^{xx}

The first serious effort of biologists to study the possibility of life on Mars was the invention of a miniature Mars climate on Earth, called “Mars jars”,

to see whether some Earth life could survive conditions on Mars^{xxi}. The biologists familiar with bacterial life and lower forms of plant life created these glass laboratory containers with Mars conditions. A “Mars jar” is a chamber containing an atmosphere of mostly carbon dioxide and some nitrogen at a very low atmospheric pressure, to which one added dried limonite powder to simulate Mars soil, a tiny amount of water vapor, and finally some Earth microorganisms or other low form of life. The chamber was then subject to freeze-thaw cycles (-70 C to + 30 C) to simulate the daily change in temperatures on Mars, while the chamber was lit with light stronger in the ultraviolet to replicate the worst conditions on Mars. The biologists then sat back to see what survived.^{xxii}

Microorganisms *did* survive.

Terrestrial anaerobic (non-oxygen breathing) bacteria and spore forming bacteria survived. Even though scientists suspected that any life on Mars would evolve to be better adapted to the harsh conditions there, finding life on Earth that could survive the Martian conditions was all the proof some needed that the concept of life on Mars had to be taken seriously. And taking life on Mars seriously meant at least three things.

- 1) Avoid contamination of Earth if any Mars organisms are returned here.
- 2) Avoid contamination of Mars by microbes that may hitchhike from Earth on space probes.
- 3) (For the germ warfare scientist), determine if it has any bearing on germ warfare, from an offensive or defensive point-of-view. After all, if the U.S. could eventually retrieve a sample, so could the arch-rival Soviets.

The first two areas are called “Planetary Protection” and are dealt with by government and scientific committees. The third, germ warfare, is that shadowy business that would be banned by President Nixon within a few years after 1965.

In the 1960’s, the possibility of reaching Mars with space probes became real to space scientists and national leaders. As the implications of what it meant to find, study, and sample true extraterrestrial life became evident, the top minds in the field of space science, biology, and the government took

over from the aging group of astronomers who had spent their lives observing the red planet.

Who were these newcomers?

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- ⁱ “New Study of Planet Mars Shows Evidence of Life”, Reno Evening Gazette, November 3, 1954, page 10/18
- ⁱⁱ “Exploring Mars”, Robert S. Richardson, McGraw-Hill Book Company, 1954, page 20
- ⁱⁱⁱ “Mars, The Photographic Story, Earl C. Slipher, Northland Press, Flagstaff, Arizona, 1962, page 98
- ^{iv} “Mars, The Photographic Story, Earl C. Slipher, Northland Press, Flagstaff, Arizona, 1962, page 24
- ^v “Mars, The Photographic Story, Earl C. Slipher, Northland Press, Flagstaff, Arizona, 1962, information on Mars throughout
- ^{vi} “Mars, The Photographic Story, Earl C. Slipher, Northland Press, Flagstaff, Arizona, 1962, page 24
- ^{vii} “The Book of Mars”, Samuel Glasstone, NASA, 1968, page 110
- ^{viii} “The Book of Mars”, Samuel Glasstone, NASA, 1968, page 104
- ^{ix} “The Book of Mars”, Samuel Glasstone, NASA, 1968, page 103
- ^x “The Book of Mars”, Samuel Glasstone, NASA, 1968, pages 117-118
- ^{xi} “Life on Mars”, Francis Jackson and Patrick Moore, W.W. Norton and Co., 1965, page 53
- ^{xii} “Life on Mars”, Francis Jackson and Patrick Moore, W.W. Norton and Co., 1965, page 55
- ^{xiii} “The Book of Mars”, Samuel Glasstone, NASA, 1968, page 103
- ^{xiv} “Mars, The Photographic Story, Earl C. Slipher, Northland Press, Flagstaff, Arizona, 1962, page 39
- ^{xv} “Mars, The Photographic Story, Earl C. Slipher, Northland Press, Flagstaff, Arizona, 1962, page 162
- ^{xvi} “Mars, The Photographic Story, Earl C. Slipher, Northland Press, Flagstaff, Arizona, 1962, page 162
- ^{xvii} “Life on Mars”, Francis Jackson and Patrick Moore, W.W. Norton and Co., 1965, pages 37-38
- ^{xviii} “Mars, The Photographic Story, Earl C. Slipher, Northland Press, Flagstaff, Arizona, 1962, page 69
- ^{xix} “Physics of the Planet Mars”, Gerard de Vaucouleurs, Faber and Faber Limited, London, mcmliv, page 268
- ^{xx} “The Book of Mars”, Samuel Glasstone, NASA, 1968, pages 218
- ^{xxi} “Intelligent Life in the Universe”, I.S. Shklovskii and Carl Sagan, Dell Publishing Co., New York , 1966, page 268
- ^{xxii} “Intelligent Life in the Universe”, I.S. Shklovskii and Carl Sagan, Dell Publishing Co., New York , 1966, page 268