Mars: The Red Planet



Culpeper Astronomy Club Meeting January 22, 2018

Overview

- Introductions
- Mars
- Constellations: Auriga, Gemini, Taurus
- Observing Session (Tentative)

Percival Lowell and Mars

- Percival Lawrence Lowell (March 13, 1855 November 12, 1916) was an American businessman, author, mathematician, and astronomer
 - Founded the Lowell Observatory in Flagstaff, Arizona
 - Fueled speculation that there were canals on Mars
 - Began effort that led to the discovery of Pluto 14 years after his death
- For fifteen years after founding Lowell Observatory, he studied Mars extensively, and made intricate drawings of the surface markings
 - He published his views in three books: Mars (1895), Mars and Its Canals (1906), and Mars As the Abode of Life (1908)
 - Lowell popularized the long-held belief that these markings showed that Mars sustained intelligent life forms
- Lowell's greatest contribution to planetary studies came during the last decade of his life, which he devoted to the search for Planet X, i.e., Pluto
 - Lowell believed that the planets Uranus and Neptune were displaced from their predicted positions by the gravity of the unseen Planet X





"War of the Worlds"



First Edition, 1898





Percival Lowell, Mars Canals - 1906



Mars

- Mars was named by the Romans for their god of war
 - Because of its red, bloodlike color
 - Due to the rusty color of its soil, which is comprised of iron-rich minerals
- The fourth planet from the sun
 - At a distance of about 142 million miles (228 million km)
- One day on Mars takes just a little over 24 hours (the time it takes for Mars to rotate or spin once)
- Mars makes a complete orbit around the sun (a year in Martian time) in 687 Earth days
- Mars is a rocky body about half the size of Earth
 - Has a diameter of about 4200 miles





US Missions to Mars

- 1965: NASA's Mariner 4 sends world's first close-up photos
- 1976: Viking 1 and 2 land on the surface of Mars
- 1997: Mars Pathfinder lands and dispatches Sojourner
- 2002: Mars Odyssey begins to make global observations
- 2004: Spirit and Opportunity find strong evidence of long-term liquid water
- 2006: Mars Reconnaissance Orbiter begins returning high-resolution images as it studies the history of water on Mars and seasonal changes.
- 2008: Phoenix finds signs of possible habitability (occasional liquid water and potentially favorable soil chemistry)
- 2012: NASA's Curiosity lands in Gale Crater and finds conditions once suited for ancient microbial life on Mars





Mars Environment

- Mars is very cold with the average temperature of -80 degrees Fahrenheit
- Mars has clouds and wind just like Earth
 - Sometimes the wind blows the red dust into a dust storm
 - Tiny dust storms can look like tornados and large ones can be seen from Earth
 - Mars' large storms sometimes cover the whole planet
- Mars has about one-third the gravity of Earth
 - A person who weighs 100 pounds on Earth would only weigh about 37 pounds on Mars
- Mars' atmosphere is much thinner than Earth's
 - The atmosphere of Mars contains more than 95 percent carbon dioxide and much less than 1 percent oxygen
 - Earth's (78% nitrogen; 21% oxygen; traces of carbon dioxide)

Surface Features

- The surface of Mars is marked with more than 635K impact craters at least 0.6 miles wide
 - Most of these are to the south of the equator. They seem to have been made by meteorites crashing onto the surface
- Like Earth, Mars has a North and South Pole
 - The south polar permanent cap is much smaller than the one in the north
 - Mars' polar caps are a combination of water ice and frozen carbon dioxide
 - As the Martian seasons change, the carbon dioxide ice sublimates (vaporizes) in summer, revealing the surface, and freezes again in winter
- "River valleys" which don't resemble terrestrial counterparts
 - Tributaries are very short, about 100m long (the length of a football field), as if the running water ran out quickly



Mars' Moons

- Mars has two small moons, Phobos and Deimos
 - Phobos, is only 14 miles across (22 kilometers), while the smaller, Deimos, is only 8 miles (13 km), making them some of the smallest moons in the solar system
 - Potato-shaped; too little mass for gravity to make them spherical
- Phobos, the innermost moon, is heavily cratered, with deep grooves on its surface
 - A bit larger than Deimos, and orbits only 3,700 miles above the Martian surface
 - Orbits Mars three times a day
 - Is gradually spiraling inward, drawing about 1.8M closer to the planet each century
- Deimos has a smooth surface due to a blanket of fragmental rock, except for the most recent impact craters
 - Takes 30 hours for each orbit



Deimos

size 12 x 16 km



Phobos 0.319 days 9378 km

Deimos 1.263 days 23459 km

Mars Moon's Origins

- Because of their odd shapes and strange composition, scientists thought for a long time that both moons were born asteroids
 - Stable, nearly circular orbits of the moons make such a birth appear unlikely
 - Captured bodies tend to move more erratically; Mars atmosphere too thin to have slowed the pair down and settled them into their present-day orbits
- Alt 1: Could have formed from debris left over from the creation of Mars; gravity could have drawn the remaining rocks into the two oddly shaped bodies
- Alt 2: Moons could have spawned from a violent birth, much like Earth's moon
 - A collision, common in the early solar system, could have blown chunks of the red planet into space, and gravity may have pulled them together into the moons
 - Similarly, an early moon of Mars could have been impacted by a large object, leaving Phobos and Deimos as the only remaining bits
- Latest proposal combines the two a collision once scattered debris into a ring around Mars that "accreted" the young moons

The Quest for water on Mars



Eridania Lake – 530 Miles Diameter



"This graphic shows what the sea might have looked like. The volcanos which may have been home to alien lifeforms can be seen at the bottom" - The Mars Reconnaissance Orbiter captured this image showing an avalanche of dusty snow racing down the weakened side of an eroded slope on Mars

- The snow is made up of dry ice (frozen carbon dioxide); however, researchers recently found similar slopes elsewhere on Mars with massive deposits of pure water ice



Life on Mars - Speculation?



Future Mars Missions

- There are several proposed missions to the moons, most particularly to Phobos:
 - The NASA Innovative Advanced Concepts program which funds far-out ideas that could take decades to fly – has a proposal to explore Phobos' surface with hedgehog-like rovers
 - In 2024, the Japan Aerospace Exploration Agency (JAXA) plans to launch the Mars Moons eXploration (MMX) mission to visit both Phobos and Deimos. MMX will land on the surface of Phobos and collect samples to be returned to Earth in 2029.

Constellations

- The Winter Circle or Hexagon
- Orion can be used to locate several Winter constellations
- Will explore three this evening
 - Auriga, The Charioteer
 - Gemini, The Twins
 - Taurus, The Bull



Auriga, "The Charioteer"

- Brightest star is Capella, the Goat Star
- To its right, a small, narrow triangle of 3rd and 4th magnitude stars known as "the Kids" that form an asterism with Capella
- Several Open Star Clusters; young Blue Dwarf Stars
 - M36, M37, M38
- Flaming Star Nebula (IC 405)



Gemini, "The Twins"

- Gemini is associated with the Greek mythological characters Castor and Pollux; twin brothers born of the same mother but different fathers
- Significant objects:
 - Castor a six star system with three binary stars orbiting around each other
 - M35 Open Star Cluster
 - Eskimo Nebula, NGC 2392



Taurus, "The Bull"

- The red eye of Taurus (Aldebaran) glares at Orion as it guards the Seven Sisters (Pleiades) from Orion's advances
- Larger of two open star clusters is the Hyades
 - V-shaped consisting of over 100 bright and many faint stars
 - Measures about 5 degrees in diameter
- More famous open star cluster is the Pleiades (M45)
- Crab Nebula (M1) Result of Supernova that occurred in 1054



Meteor Showers

- Some of the best are listed below along with dates when the most meteors are visible
 - Quadrantids, January 3-4 (Comet 2003 EH1)
 - Lyrids, April 22-23 (Comet Thatcher)
 - Perseids, August 12-13 (Comet Swift-Tuttle)
 - Orionids, October 20-21 (Halley's Comet)
 - Leonids, November 17-18 (Comet Tempel-Tuttle)
 - Geminids, December 13-14 (Asteroid 3200 Phaethon)
 - Ursids, December 23-24 (Comet 8P/Tuttle)
- The name of each shower refers to the constellation to which the meteors trace their apparent paths



Upcoming Events

- Next Meeting: February 26, 2018
 - Primary Topic: The Moon
- Agenda for 2018
 - Star types (Doubles, Variables, Stellar Evolution)
 - Deep Sky Objects (Star Clusters, Nebula, Galaxies)
 - The Early History of Astronomy
 - Astronomical Tools and how to use them