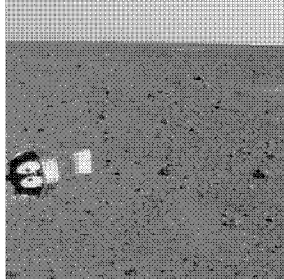


Friday, October 29  
Life on Mars (?)



Problem set #2 will be due on Monday.

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Life on Mars (?)  
Key Concepts

- 1) Speculation about intelligent life on Mars lingered into the 20<sup>th</sup> century.
- 2) Evidence for present or past single-celled life on Mars has been inconclusive.
- 3) Future Mars missions will look closely for signs of life.

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The idea of intelligent life on Mars is common in popular culture.



War of the Worlds  
1898



1917



1950



1948



1961

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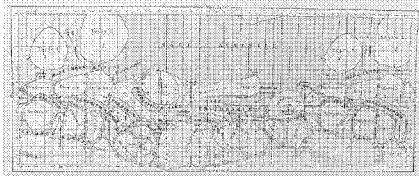
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Giovanni Schiaparelli (Italian astronomer) made extensive telescopic observations of Mars.

In 1877, he claimed to see linear features he called *canali* (channels).

He thought of them as natural features, but others saw them as artificial canals.



Schiaparelli's 1877 map

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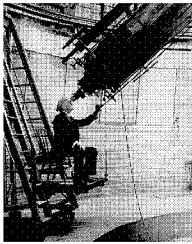
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Percival Lowell was among those who thought *canali* were artificial canals.

In 1894, he built an observatory near Flagstaff, Arizona (chosen for the clarity & stability of its air).



Lowell spent two decades mapping the surface of Mars.

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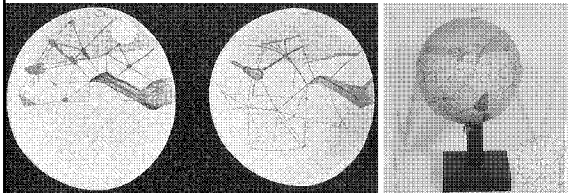
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Lowell mapped extensive canal systems that he thought were present on Mars.



Lowell's writings popularized the idea of intelligent life on Mars; most professional astronomers thought he was mistaken.

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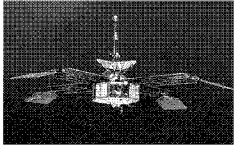
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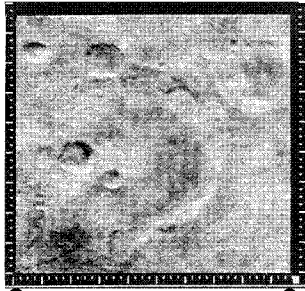
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The first spacecraft to visit Mars showed it to be a dry, cold desert planet with **no canals**...



Mariner 4  
(Flyby 1965)



250 km

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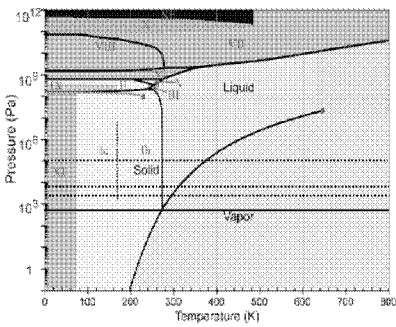
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The Martian atmosphere proved to be too low in pressure for liquid water to exist.



Liquid water is *unstable* on Mars – solid or vapor only.

1 Atm (Earth)  
early estimates  
Mariner 6/7 (1969)

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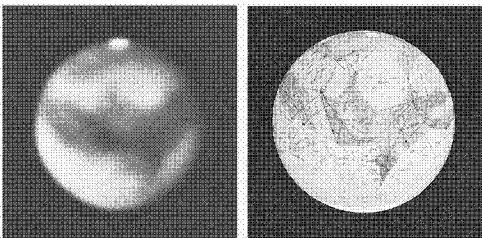
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What were the canals? Optical illusions.

The human brain is good at picking out patterns - even when they aren't necessarily there.



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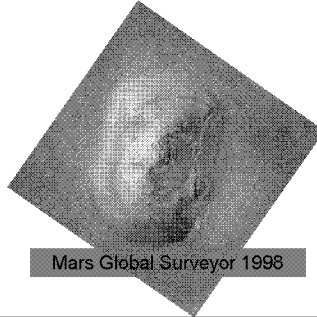
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The human eye and brain are particular quick to pick out the human face.

This explains the famous "face on Mars".



Viking Orbiter 1976



Mars Global Surveyor 1998

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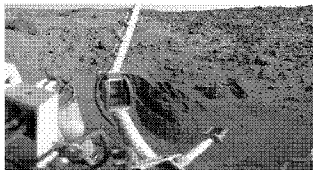
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The two Viking landers (1976) were designed specifically to look for simple life.

4 experiments onboard:

- Carbon assimilation
- Gas exchange
- Labeled release
- Mass spectrograph



First 3 searched for uptake of carbon when soil samples were heated or sprinkled with nutrient solutions.

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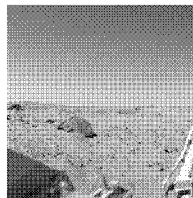
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Results from the Viking landers were conflicting. Scientists were confused.

Results could have been the consequence of biological or non-biological activity.



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**ALH 84001** is a meteorite that was found in the Allan Hills of Antarctica in 1984.

It has the same composition as Martian rocks, contains bubbles full of Martian air, & has a radiometric age younger than most meteorites.



**Conclusion:** It was blasted from the surface of Mars by the impact of an asteroid.

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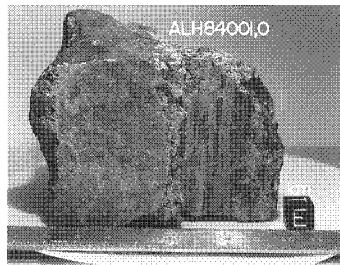
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ALH 84001 contains carbonate grains that were deposited as the rock soaked in liquid water.

Further analysis suggested it may contain signs of fossil microbial life...

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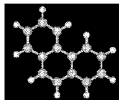
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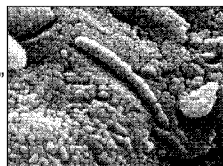
**Evidence for possible biological activity in ALH 84001:**

The presence of polycyclic aromatic hydrocarbons and amino acids.



Magnetite crystals like those produced by Earth bacteria.

Shapes resembling "nanobacteria" (the smallest Earth bacteria).



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On the other hand....

The meteorite sat in Antarctica for 13,000 years; contamination can't be ruled out.

Complex carbon compounds & magnetite crystals can be made by non-biological processes.

If something is **shaped** like a nanobacterium, that doesn't mean that it **is** a nanobacterium.

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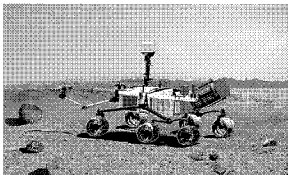
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Future missions to Mars will carry out extensive biochemical searches.

Mars Science Laboratory Mission (to launch Nov 2011):



It will land at a site with evidence of past water flows.

Experiments will search for organic compounds, look for byproducts of metabolism, and do detailed surface mineralogy.

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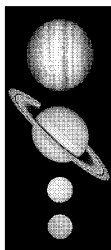
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Monday's Lecture:

Jovian planets

Next Week's Reading:

Chapters 9 & 10



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