MARS

- Diameter 4200 miles (0.53 x Earth)
  Mass 0.11 x Earth, Density 3.94 x water
  Rotates every 24hrs 37min "Year" = 687 days
  Axis tilt ~25° to orbit → Seasons
  Receives 0.43 x Earth's irradiation from Sun.
  } "Earthlike"?

  Polar caps recede and grow with seasons.
  Light and dark areas, seasonal variations.
  Telescopic observations → canals?
  UFO sightings come when Mars is closest.
  Small satellites in "short-lived" orbits - artificial?
  } SIGNS OF "LIFE"?

- Mariner spacecraft →

  No canals (cratered). Canals a perceptual illusion
  Polar caps are "dry ice" (solid carbon dioxide), not water ice.
  Seasonal colour changes are due to light-coloured dust blowing around planet in huge dust storms - not vegetation growth.
  Atmosphere is only ~1% of Earth's, and is ~80% carbon dioxide
  Only traces of water in atmosphere.
  Satellites are natural, cratered.

  So: ALL "SIGNS OF LIFE" THOUGHT TO EXIST ON MARS BEFORE MARINER SPACECRAFT FLEW THERE WERE MISTAKES OR MISCONCEPTIONS.

Mars Mariner discoveries

MARINER 4 (1965)

Atmospheric pressure < 1% of Earth's, mostly CO_2.
(as much as 10% of Earth's had been predicted because Mars gravity ~ $\frac{1}{3}$ Earth's and Mars now cooler than Earth, so Mars <u>could</u> retain more gas than it <u>has</u>)

MARINERS 6 & 7 (1969)

Polar caps are solid CO_2 ("dry ice")
Chaotic terrain — internal activity?

MARINER 9 (1971)

Planet-wide dust storm, winds of hundreds of miles/hr.
Cluster of volcanoes 8-15 miles high, in same area of Mars as a 3000-mile long canyon, 50 miles wide, 1 mile deep, running round equator.

Evidence that Mars surface is being pushed and pulled by internal activity, around the volcanic region.

<u>BUT</u> much of surface is smoother, cratered plains.

QUESTIONS RAISED BY MARINERS:

Why is atmosphere so thin compared with Earth's?
Why is <u>part</u> of surface enormously volcanic, part a cratered plain?
Is Mars "mature" or "less mature" than Earth?
Could life exist on Mars?

The Martian Environment

- Thin atmosphere, mainly CARBON DIOXIDE.
  Vanishingly little OXYGEN
  WATER

Thin atmosphere → large temperature variations between day and night at equator.

Equator, summer noon ~ 70°F
Summer night ~ -100°F
Average surface temperature ~ -30°F

- No oxygen in atmosphere → no ULTRAVIOLET filter.

Solar ULTRAVIOLET → sterilising agent.

Man would suffocate
freeze
extreme sunburn
thirst

But microscopic Earth organisms survive in "MARS JARS"
Simple Earth organisms adapt to Earth extremes

STILL QUESTION: IS THERE LIFE ON MARS?

-

Could Martian astronomers discover life on Earth?

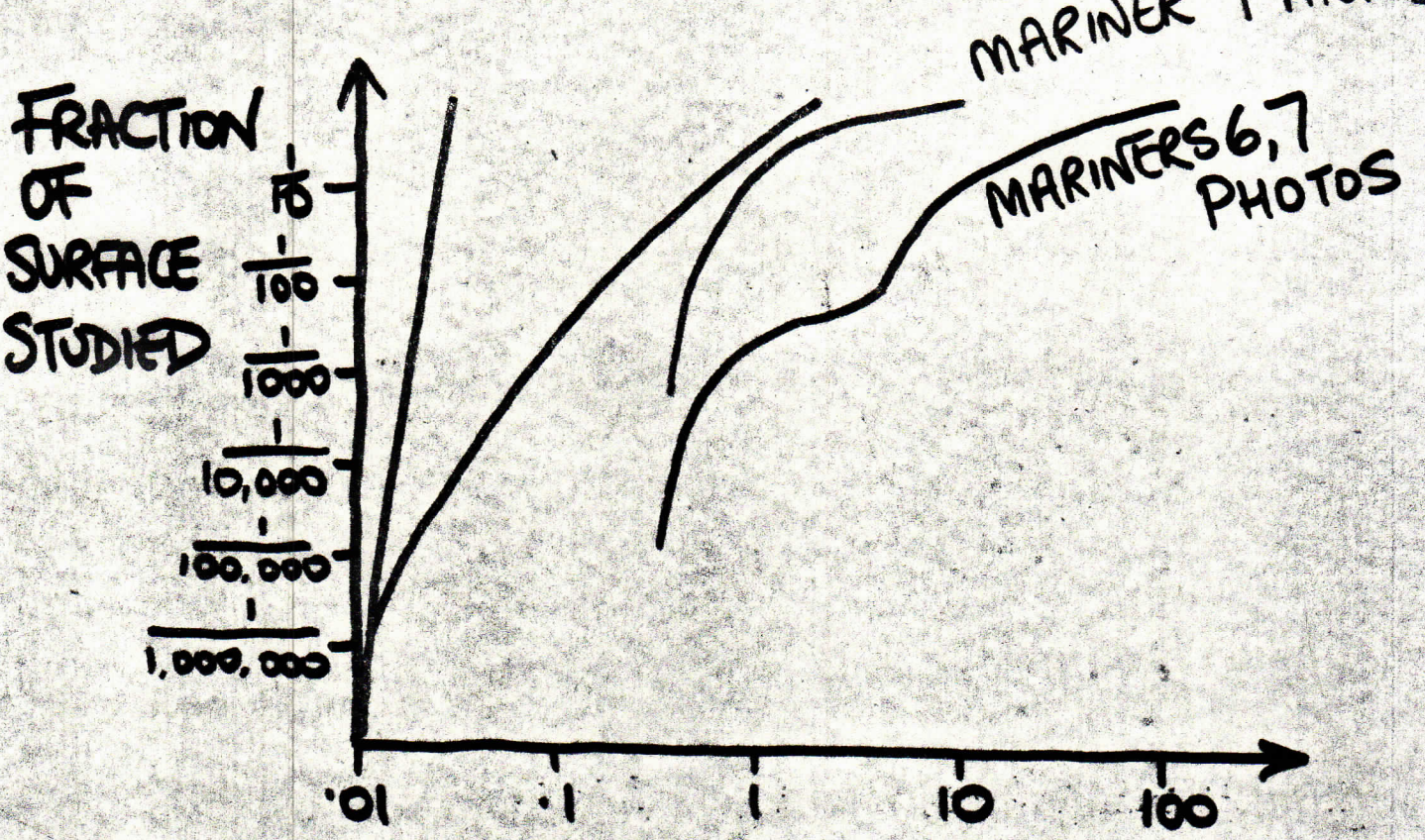
- Weather satellites photograph Earth with surface resolution of ~ ¼ mile.
  NO SIGN OF CITIES (haze blurs detail) - except lights.
  FREEWAYS (too narrow)
  Thousands of weather satellite photos show only:-
  # pattern of snowfall on lumber project near Cochrane, Ont.
  Great Wall of China
  Long wake of ship in Red Sea
  One jet contrail, few roads, some farmland.
- Reconnaissance has to be much closer to surface (e.g. "spy planes" to show direct signs of human activity regularly

Atmospheric pollution detectable spectrographically, but less than volcanic activity.

RADIO EMISSION = TV, FM
Radar
Microwave communications

easily detectable. Best radio telescopes on Earth now could detect taxicab at distance of Mars.

- Earth would be BRIGHT radio source, strongly patterned, variable signals



— Coverage needed to reveal Man's civilisation on Earth

— Coverage needed to reveal other Earth life.

Present photography of Mars, if applied to Earth, would not reveal signs of Man's life necessarily. But next Mars missions would begin to place real constraints (!)

The Moons of Mars ((DEIMOS and PHOBOS)

Jonathan Swift - "A Voyage to Laputa and Japan" (part of "Gulliver's Travels" (1726):-

"(The Laputan astronomers) have discovered two lesser stars, or satellites, which revolve around Mars, whereof the innermost is distant from the centre of the primary planet exactly three of the diameters, and the outermost five; the former revolves in the space of ten hours, and the latter in twenty-one and a half."

Also described by Voltaire in "Micromegas" (1752)
First actual observation of moons of Mars was by Asaph Hall in 1877 - 150 years later than Swift's book!

PHOBOS Distance from Mars 0.69 diameters of Mars
Orbit time 7 hours 39 minutes (faster than planet).

DEIMOS Distance from Mars 1.73 diameters of Mars
Orbit time 30 hours 17 minutes

Reasoning dates back to Kepler (1610) after Galileo's discovery of 4 moons of Jupiter. Then known were:-

Venus	-	No satellites
Earth	-	One
Mars	-	? Kepler guessed two
Jupiter	-	Four

Mars' unseen moons had to be close to planet in order to be unseen. Then Kepler's Laws → rapid orbital motions.

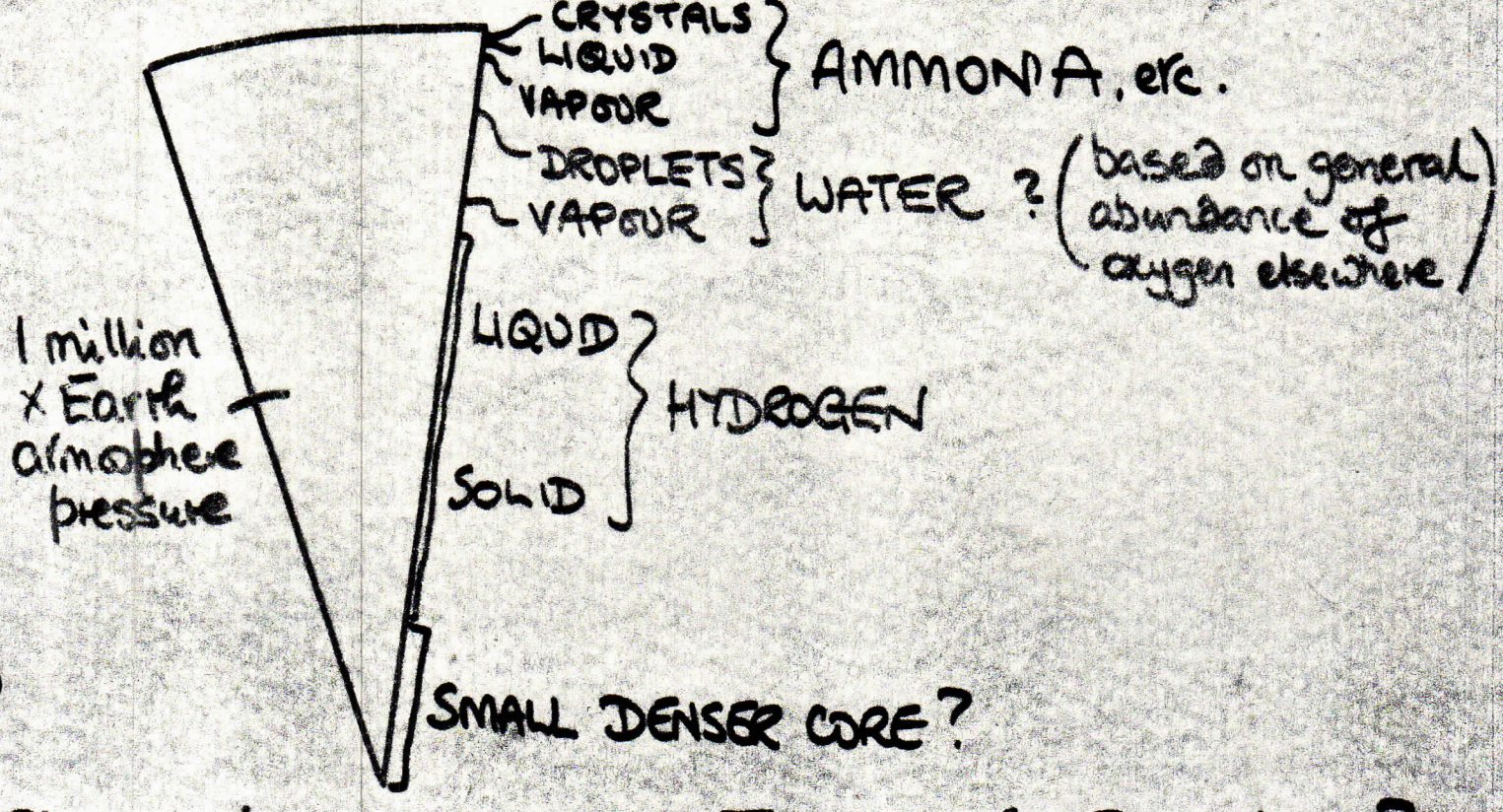
Jupiter, Saturn, Uranus, Neptune

- Masses 15 - 318 x Earth mass
  Radii 3.7 – 11.2 Earth radii
  Densities 0.7 – 1.6 x water

Temperatures of visible layers −350°F To −250°F
(N.B. Surfaces may be much warmer than this).

Major atmospheric constituents: { HYDROGEN, HELIUM
+ ACETYLENE (C_2H_2) METHANE (CH_4)
ETHANE (C_2H_6) AMMONIA (NH_3)

- THEORETICAL MODEL OF JUPITER:



Physical properties of inner Jupiter satellites ~ Moon?

Satellites of Jupiter, Saturn

Warmer than planets themselves

UNUSUAL PHENOMENA

Great Red Spot of Jupiter

Elliptical feature seen in atmosphere since 17th Century, 30,000 miles across. Remains at constant latitude but rotates at different rate from surroundings or irregular rate.

Radio emission of Jupiter

"Storms" of radio 'static' and background of steady radio radiation. Comes from localised sources that rotate with planet. Sharply focussed 'beams'. Appears to be 'triggered' by position of innermost satellite.

Rings of Saturn

171,000 miles across, ~½ mile thick. Tidally disrupted satellite?

Variable light of Iapetus (Saturn satellite #9)

Satellite is 5 times brighter at one extreme of orbit around Saturn than at other.