MARS EXPLORATION – FROM ITS MOONS.

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The most effective way to explore Mars may be with a fleet of robotic rovers, tele-operated in real time from a manned base on Phobos (or Deimos). A fully equipped manned laboratory could examine (fresh) samples and immediately follow up on any interesting discoveries. It would be the quickest and overall cheapest method to explore the entire planet's surface and subsurface, including locations deemed too risky for single-rover missions. It would also be the most rewarding scientifically.

Of comparable importance is the scientific exploration of the Martian moons. Their origin presents a scientific challenge, whose solution would also illuminate the early history of the planet Mars. Analysis of the origin of Phobos and Deimos sheds light on development of a transient magnetic field, oceans and atmosphere –perhaps persisting long enough to permit evolution of life.

The chief clues we have to the origin of Phobos and Deimos are very few: their present near-circular, near-equatorial orbits. Significantly, Deimos is just beyond Mars' synchronous orbit. *Note: I no longer subscribe to origin by direct capture (of asteroids)* ***[1]*** *or by co-formation* ***[2]***.

My new hypothesis may sound improbable but does not violate any laws of physics. It involves the capture of a Mars-Moon (M-M), a massive, planet–sized body (6*10^20 kg, 0.1% of the mass of Mars) into a retrograde orbit around Mars, whose initial spin period then was 22 hours. [All numbers are illustrative of a particular scenario.] Phobos and Deimos are the remnants of this captured M-M body, which broke into pieces during capture while penetrating inside the Roche limit; the rest has been accreted to Mars by tidal friction.

Standard perturbation calculations, but using a frequency-dependent ("push-pull") tidal theory **[1]**, show how to transform the M-M body's (now a rubble-pile) initial retrograde, parabolic orbit into a near-circular, direct orbit **[3]** at a synchronous distance from Mars. The tidal energy dissipated within Mars' interior following capture is quite sufficient to cause melting and core formation (even if Mars had assembled cold).

I postulate that differential tidal effects on the core and mantle create and maintain a temporary magnetic field and magnetosphere. As a result, oceans and an atmosphere may be maintained long enough against exospheric escape and the eroding effects of the solar wind to permit the evolution of life forms on Mars.

There are several possible observational tests of this hypothesis:

Investigating a common origin for Ph and D, in spite of their different surface appearance

Possible close relationships (density, composition, petrology, cosmic-ray ages) of Ph and D

Dust-debris clouds/rings around Ph and D

Possible existence of tiny moonlets in circular, equatorial orbits between Phobos and Deimos

Evidence for ancient impacts in Mars' equatorial zone

Date of formation of Mars core (by Hf-W dating)

Decay of the protective Mars magnetic field, followed by evaporation of surface oceans

Discovery of paleo-life or krypto-life – without fear of contamination

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References:

[1] S.F. Singer. *Geophys. J. Royal Astron. Soc*. 15, 205-226, 1968; …"Origin of the Moon by Capture" in *The Moon* (W. Hartmann et al., ed.) LPI, Houston, 1986, pp, 471-485.
[2] S.F. Singer, "The Martian Satellites" in *Physical Studies of the Minor Planets* (T. Gehrels, ed.) NAS SP-267, 1971.
[3] H. Gerstenkorn. *Z. Astrophys*. **36**, 245-274 (1955); G.J.F. MacDonald. "Tidal Friction" *Rev. Geophys*. **2**, 467-544 (1964).

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