

Tuesday 6th June 2017: "*Fear and Dread*" - John Rosenfield (HAS)

John's main purpose was to invite us on a journey to the planet Mars without fear or dread. Viking images of Mars show ice caps, dark patches and a red surface, which is due to iron in the rocks. However, over the years the red planet, accompanied by its moons Phobos and Deimos (meaning fear and dread), has symbolised war with the mythological god Mars/Ares, noted for being aggressive and courageous – ready to fight any battle.

Patrick Moore had this to say in his writings about Mars and its 'canals': "Lowell was convinced that the Red Planet supported an advanced technical civilisation, and that the canals represented an irrigation system to carry water from the polar snows to the deserts of the equator. Lowell's views met with considerable opposition even in his own lifetime, though he remained unshaken up to the time of his death in 1916. The idea of intelligent Martians was regarded as distinctly dubious. On the other hand the idea that the dark areas were due to vegetation met with strong support, and up to 1965 very few astronomers doubted it". Phobos and Deimos are tiny moons at 27 km and 12.5 km respectively. (1).

(1)



To put this into perspective, New Horizons is currently on its way to visit a Kuiper Belt object just 40 km across, which although very small is nevertheless larger than Mars' moons. Phobos orbits just 6000 km above the planet's surface and is slowly spiraling inwards where at some point in the future it will break up, forming a ring around Mars before some of the bits crash into the surface.

Deimos is slowly moving away from the red planet and may one day escape Mars' gravity completely. In July 2016, there was an international conference devoted solely to these two moons, which suggests they are important. Two of the craters on Deimos are called Swift and Voltaire.

(2)

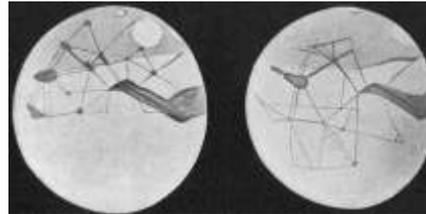


Writers' imaginations were taking us beyond the Earth to the other planets, but what is most astonishing is that Phobos and Deimos were discovered in 1877 many years after these stories were written. There were three astronomers who should have known better. The first was Lowell, who built the Flagstaff Observatory in Arizona (3).

(3)

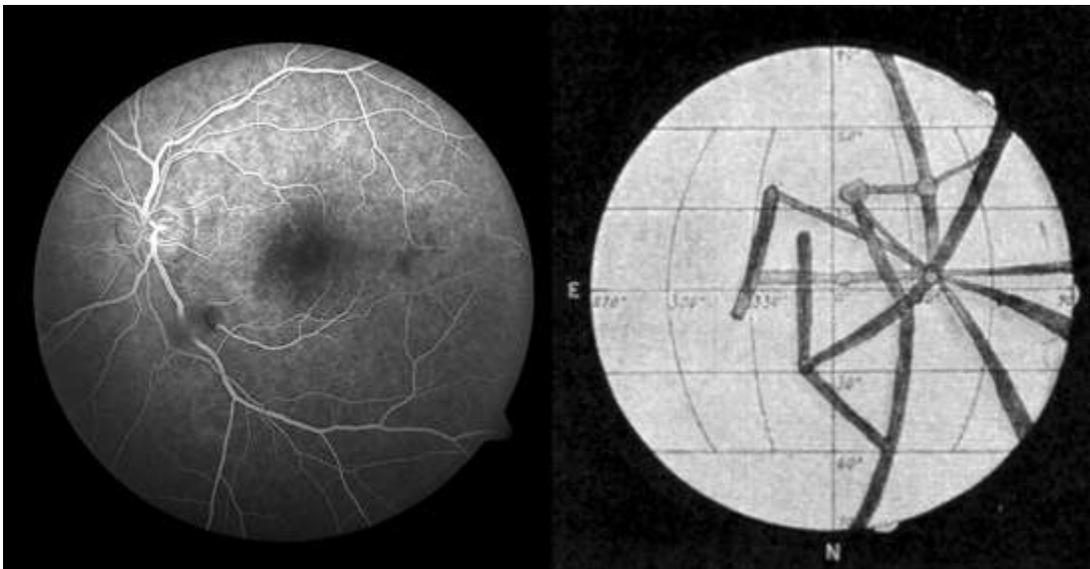


(4)



He undertook a 15-year study of Mars, making numerous drawings of dark patches and straight lines (4). At the time, it was thought the most likely reason for the dark patches was that these were gardens growing food for the Martians. He also studied Venus and saw spokes radiating outwards.

In 2003, Sky and Telescope magazine wrote a defence of Lowell's findings wondering if he had stopped down his telescope so much that the small exit pupil might have cast shadows of the blood vessels on the retina (5).



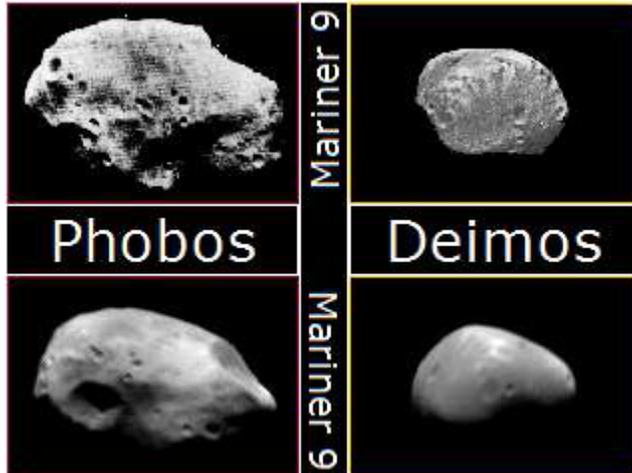
(5)

In the 1920s, Lowell asked Percy Rives whether it was possible to intercept signals from Mars. In 1944, Rives was scathing about the belief in canals on Mars, saying that many astronomers never even looked at the planet through a telescope. However, the dark patches were considered to be vegetation up until

1965. The second astronomer was V. G. Perminov who, in 1960, said that Swift knew about the two moons of Mars because he had translated ancient documents left behind by the Martians.

The third astronomer was Iosif Shklovsky who thought the moons were hollow, and put into orbit by the Martians. The true nature of Mars became known in 1965 when photographed by Mariner 4, (6) revealing a barren and heavily cratered surface, and instruments showed no air for the Martians. Mariner 9 was the first to photograph Phobos and Deimos.

(6)

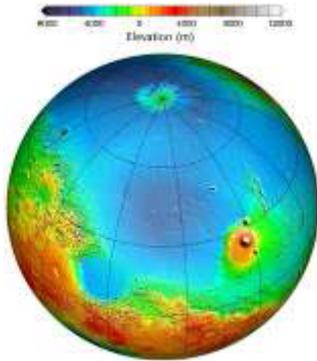


Apparently the data from this mission is still being downloaded! Most recent photographs are from the Trace Gas Orbiter that reached Mars last year but, Mars Express and Mars Reconnaissance Orbiter have also taken images.

The conference devoted to Phobos and Deimos spent a lot of time looking at the two different types of solar system body – inner rocky planets and the outer gas planets and wondering whether any other solar systems resemble ours. The delegates think that Phobos and Deimos may have the answers, which is why their study is so important. There was also a question about the comet, Churyumov-Gerasimenko, which has carbon dioxide ice the size of a football pitch and numerous patches of water ice. We know water is abundant in the solar system and P67 also carried organic molecules, and yet life is only found on one planet. We really need to understand the composition and origin of Mars' two small moons.

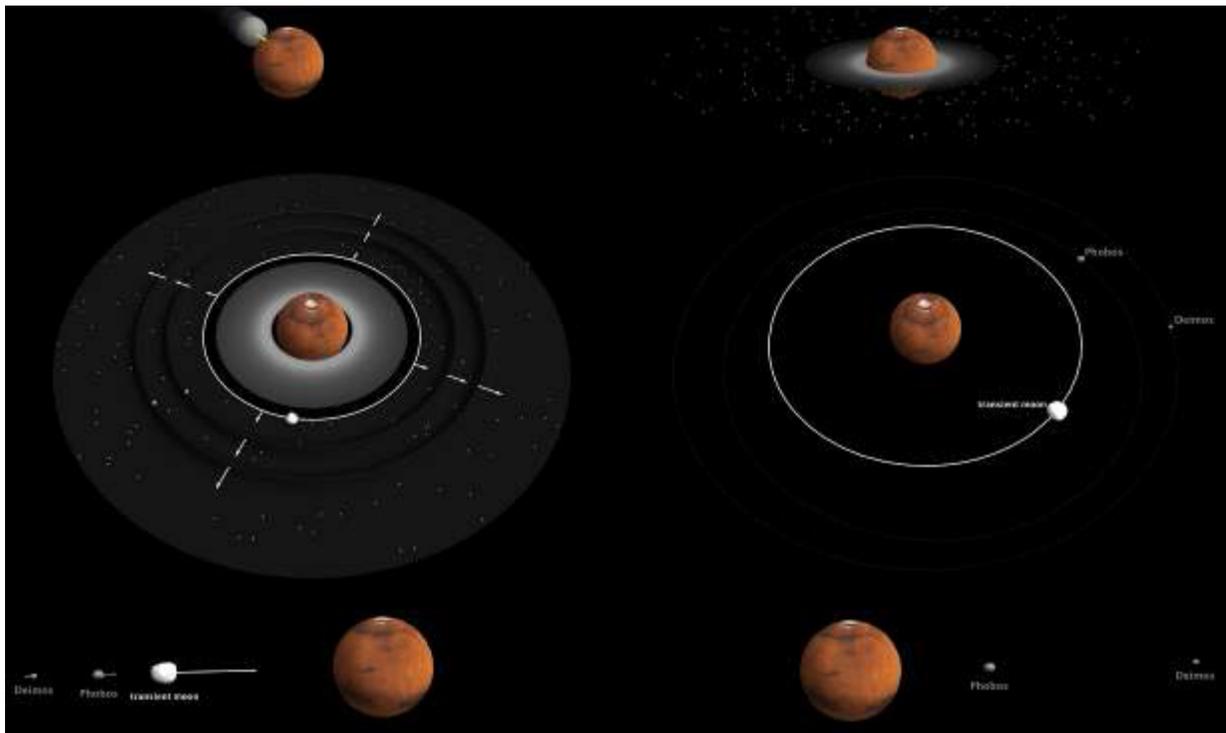
It is thought that a large impact may have created the Borealis basin, (7) which now forms the northern lowlands of Mars, and may have ejected a large amount of material into a ring around Mars.

(7)



Computer models show that over time the inner part of this debris ring containing most of the rocky material would have clumped together to form a moon, the outer part only contained a small amount of material not enough to form a moon (8). However, it was found that gravitational tugs from the inner rocks could have stirred up rubble in the outer ring and may have pushed rock together to form Phobos and Deimos, the larger inner pieces eventually crashing into the surface.

(8)



Another theory is that they are captured asteroids, but their circular orbits around the equator of Mars would suggest otherwise. ESA's Gaia mission may help to shed light on the formation of the Galaxy and

also help us to understand the asteroids in our solar system where it hopes to study about 350,000 of them, some of which are as yet unknown.

In April it was announced that Japan and France have teamed up to launch a probe in 2024 to bring back a piece of Phobos for analysis. This is known as the Martian Moons Exploration project. At the Phobos and Deimos conference there was a great deal of discussion on how deep they should drill into Phobos, and the conclusion was that it should be between one and two metres deep.

John expressed the hope that during the Mars opposition of 2018, we would look at the planet without fear and dread. Although we cannot see these two tiny moons because of their size, we now know a little more about them and await with anticipation their final strange and wonderful story as perhaps they may reveal the origins of our solar system.