

## THE DISCOVERY AND EXPLORATION OF PHOBOS AND DEIMOS. S. J. Dick<sup>1</sup>

From Johannes Kepler in 1610 to *Gulliver's Travels* in 1726, the moons of Mars played a role in the scientific imagination long before their discovery. Numerous attempts were made to find Martian moons, to no avail until the Mars opposition of 1877. Asaph Hall's actual discovery of Phobos and Deimos on August 17 of that year – using the new 26-inch refractor of the U. S. Naval Observatory in Washington, D.C. – is a story full of unexpected drama, including a crucial intervention by his wife, Angeline Stickney Hall. The discovery was made because Hall came to doubt the conventional wisdom that "Mars has no moon," and because he searched much closer to the planet by keeping Mars itself just out of the field of view [1]. The moons were discovered only 85 and 34 arcseconds from Mars, with the inner and outer satellites at magnitudes 10 and 12 respectively. The news took both the public and the astronomical world by storm. In subsequent days much smaller telescopes spotted the two moons. Hall continued his observations of the satellites until October 31; these observations alone gave enough data for a good determination of their orbits. Photometric observations at Harvard indicated the diameter of the outer moon was about six miles, and that of the inner moon seven miles.

Prior to the space age, studies of the Martian moons were largely limited to their orbital motion. During the 1939 opposition U.S. Naval Observatory astronomer Bevan Sharpless – using the world's first operational Ritchey-Chrétien telescope (the 40-inch also located in Washington), reported a secular acceleration in the longitude of the satellites. Russian astrophysicist I. S. Shklovskii used this data and others to argue that the Martian moons might be hollow and therefore artificial. Sharpless's secular acceleration results of Phobos were confirmed at about 1/3 his value; this acceleration is now considered to be due to gravitational interaction with Mars, known as "solid tides."

The detailed nature of the satellites, including their elongated potato shape and numerous craters, was revealed by Mariner 9 in 1971 and 1972. The earliest names for the surface features on the Martian moons were chosen by the IAU subcommittee on Phobos-Deimos Nomenclature, chaired by Carl Sagan and adopted in 1973. Phobos features were named after individuals involved with its discovery and exploration, including the craters Hall, Stickney and Sharpless. Deimos features were named after literary and artistic allusions, including Swift and Voltaire [2]. Further observations were made by the Viking Orbiter cameras in 1977, the Soviet Phobos 2 mission in 1989, Mars Global Surveyor in 1998 and 2003, Mars Express in 2004, and from the surface of Mars with the Spirit rover in 2005. Highlights from some of these missions will be described. For many years the moons of Mars have provided some of the best scientific data on the evolution of small bodies in the solar system. Many scientific puzzles remain, including the origin of the moons.

In addition to increased scientific study, the Martian moons have occasionally been the subject of popular culture. In 1912 Edgar Rice Burroughs published a story entitled "Under the Moons of Mars," in which he referred to the "hurtling moons of Barsoom," the name by which the fictional Martians knew their planet. The story was printed in book form in 1917 as *A Princess of Mars*, part of the famous John Carter on Mars series. In 1955 science fiction writer Donald Wollheim published his bracing adventure story *The Secret of the Martian Moons*, and in 2000 Thomas Mallon published his more sedate novel *Two Moons*, set in Washington, D.C. at the time of the discovery. With missions to Mars in the 21<sup>st</sup> century, perhaps even with crews, the moons of Mars are likely to receive increased attention both from science and the general public.

### References:

[1] Steven J. Dick, *Sky and Ocean Joined: The U. S. Naval Observatory, 1830-2000* (Cambridge: Cambridge University Press, 2003), pp. 206-237.

[2] Jürgen Blunck, *Mars and its Satellites: A Detailed Commentary on the Nomenclature* (Smithtown, N.Y.: Exposition Press, 1977 and 1982).

<sup>1</sup> NASA HQ, 300 E. Street, SW, Washington, D. C. 20546, steven.j.dick@nasa.gov