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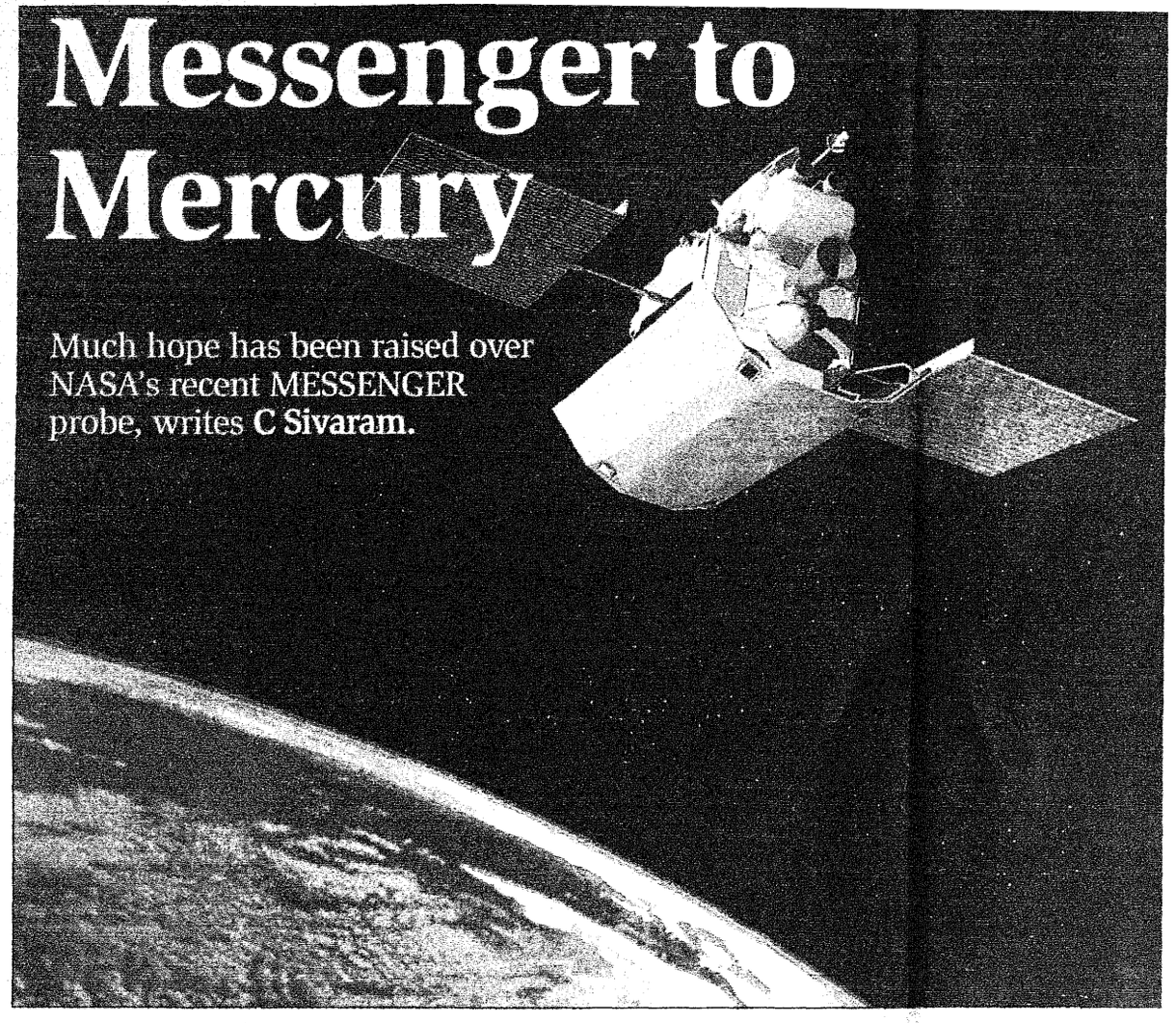
Messenger to Mercury



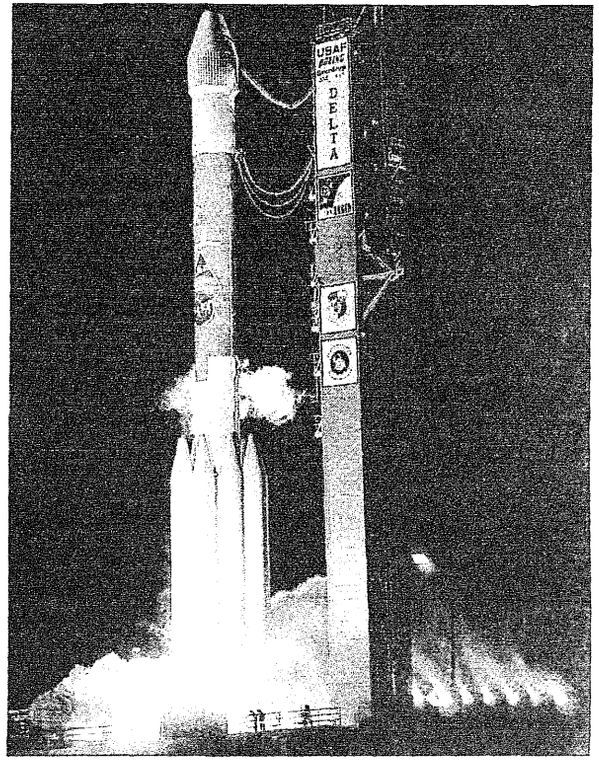
Much hope has been raised over NASA's recent MESSENGER probe, writes **C Sivaram.**

On January 15, 2008, the messenger spacecraft made its first flyby past planet Mercury. Mercury is the planet closest to the Sun, taking a mere 88 days to complete one orbit. Consequently, its surface is heated to torrid temperatures of several hundred degrees. It is the smallest of the major planets (and densest!) with a diameter hardly 40 percent of the earth and one twentieth the earth mass. The proximity to the Sun has also resulted in its taking nearly 60 days to rotate on its axis. It is the least studied of the inner planets. Although Venus and Mars have been visited by innumerable spacecrafts, the only craft to rendezvous with Mercury was Mariner 10, in 1974! During its three flybys of the planet, Mariner 10 imaged about half of Mercury's surface at an average resolution of about a kilometre. It discovered the planet's internal magnetic field (a very weak field, nevertheless indicating pressure of an iron core). It also measured ultraviolet signatures of hydrogen, helium and oxygen in the rarefied atmosphere apart from determining some of the physical properties of the surface materials. For instance, Mercury has a ratio of metal to silicates higher than any other planet.

MESSENGER stands for Mercury Surface Space Environment, Geochemistry and Ranging mission. The spacecraft was launched on August 3, 2004 and will orbit Mercury for one earth year after completing three flybys of the planet. The first flyby was on Jan 15, 2008. The cruise phase of the mission is more than six years and includes one Earth flyby (which occurred on August 2, 2005 with a closest approach distance of 2,350 km over Mongolia) the event providing important calibration for the instruments.

The first of the two Venus flybys occurred on Oct 4, 2006 with a closest approach of 3,000 km. The second Venus flyby on June 5, 2007, sufficiently lowered the spacecraft perihelion distance to allow the subsequent three flybys of Mercury. The second and third Mercury flybys are expected to occur on Oct 6, 2008 and Sept 29, 2009 respectively.

The spacecraft is expected to go into orbit around Mercury around mid March 2011. The orbital phase is one year long, near polar orbital observational endeavour covering global imaging, detailed surface composition and topographic data, geometry of internal magnetic field and magnetosphere, radius of Mercury core, etc.



An artist's impression of MESSENGER, as it leaves Earth (left); The launch of MESSENGER spaceprobe to planet Mercury (above).

The flyby today will image the hemisphere of the planet not seen by Mariner 10 apart from getting high resolution spectral observations to map mineralogy of surface (and polar deposits) while conducting energetic particle distribution analysis and exospheric survey.

Among the several puzzles regarding the innermost planet, answers to following problems may be settled: (a) Planetary formation processes giving high metal to silicate ratio (b) geological history (c) Origin and nature of the magnetic field (d) structure and size of the core (e) important volatile materials and nature of radar reflective substances known to exist at the poles.

This may shed light on other questions concerning the planet's high density, volcanic history, polar deposits, high metal content, peculiar magnetosphere, etc. An optimised set of seven miniaturised scientific instruments would provide answers to these and other key questions which are critical to our future understanding of how the terrestrial planets formed and evolved. Determining whether Mercury's outer core is liquid (like that of the Earth) or solid involves measurement of its obliquity which requires repeated altimetry measurements and details of its global gravitational field from range-rate measurements from the orbiting spacecraft.

Gamma ray and neutron spectrometry could detect an enhancement of near hydrogen in polar crater floors while visible and ultraviolet spectrometry would reveal the exosphere species.

Planetary scientists are keenly awaiting the results of all these studies. The detailed messages from the MESSENGER are expected to much improve our understanding of the planetary formation in general and the origin and formation of terrestrial planets in particular.