FUTURE EXPLORATION OF MERCURY; F. Vilas, NASA Johnson Space Center/SN3, Houston, TX 77058.

Historically, scientists interested in the study of the planet Mercury always declare that this is a difficult planet to study due to its close proximity to the Sun. They're right. This same proximity has led scientists to assume that Mercury, being created in its present location, represented an extreme endmember planet in the Solar System. As a result of recent ground-based observations and theoretical models, they may be wrong: Mercury may have formed at a different location, been subjected to a bombardment that stripped the planet of its exterior, and moved to its present location. (And Jupiter thought it had problems...) The Mercury we know today is a planet where the atmospheric constituents, surface mineralogy, solar wind, and magnetic field all interact and affect one another. Thus, experiments that shed light on the attributes of one of these things stand an excellent chance of enlightening Hermeophiles about the properties or dynamics of another. For example, measuring the abundance and distribution of K, Na, and Ca and folding these data into sputtering and volatilization models may constrain the composition and petrologic type of possible feldspar units (1).

So... what to do. Creative ground-based exploration of the planet is now underway (e.g., radar imaging, mid-IR spectroscopy) fueled by the improvements in detector technology across the entire spectrum used to probe the planets, and the creativity and desperation of true Hermeophiles. But major advances in exploration of the planet require observations from above the Earth's atmosphere. Simply moving the study of Mercury to Earth orbit eliminates the requirement of observing optically through either the thick Earth atmosphere or during broad daylight, both conditions that can affect data quality. The surface resolution of telescopic observations improves significantly (e.g., the modest 60-cm diameter telescopes proposed for the Discovery project as part of the Planetary Research Telescope (2) decrease the spatial element size on Mercury's surface to 220 km, a factor of ~30 over what can be wrested from ground-based observations). These sort of observations require either a Telescope Allocation Committee with the courage to turn one of the existing Earth-orbiting telescopes as close to Mercury as would be possible before insolation damages the equipment (or maybe just run it on a suicide mission following the planet ever closer to the Sun), or a new satellite equipped to mitigate the potential of damage with a small angular separation.

Better yet, let's go back to Mercury and expand the work begun by Mariner 10. By calculating a suite of Venus and Earth gravity-assisted trajectories, Yen demonstrated that much less energy is required to send a probe to Mercury (3) than previously assumed. Creative ways to handle the increased thermal load on spacecraft must be developed. The proximity of the spacecraft to the planet's surface allows geochemical composition experiments to determine the relative abundances of many elements in the surface material and altimetry experiments to delineate the surface topography. Two spacecraft missions were funded for study by the Discovery program. The Mercury Polar Fly-by mission proposes to investigate the recently-discovered polar caps and complete the mapping of Mercury begun by Mariner 10 (4). The long fly-by trajectory allows the spacecraft to have its perihelion near Mercury's aphelion, thus minimizing thermal effects. The Hermes mission proposes to put a spacecraft in polar orbit around Mercury that will address the questions of surface composition and morphology of Mercury's surface including the poles, the characteristics or Mercury's atmosphere, and magentic and gravitational fields (5). A European consortium has also proposed the Mercury Orbiter spacecraft which would study the surface topography and magnetic field properties (6).

Mercurian landers lie outside the budgetary/technological envelope associated with current mission planning.

Future Exploration of Mercury: Vilas

References: (1)Sprague,A.L. per. comm. (2)Broadfoot, A.L.(1994)Planetary Research Telescope proposal;(3)Yen,C.-W.(1985)AIAA 85-346;(4)Spudis, P.D. et al.(1994) LPSC XXV,1323;(5)Nelson,R.M. et al.(1994)LPSC XXV,985;(6)Grard, R. et al. (1994) ESA Journal *18*, 197.