Messenger at Mercury, 2008 January

In the last issue of the *Journal* [(**118**(1), 6–9 (2008)] we reviewed recent BAA observations of Mercury. NASA's *Messenger* spacecraft encountered Mercury on Jan 14, approaching to just 200km at the closest point. As can be seen from Figure 1, it imaged part of the hemisphere that *Mariner 10* did not view during any of its three encounters of 1974–'75.

It is easy to calculate what part of the planet was sunlit. Extrapolation from the BAA *Handbook* shows that Mercury (during its E. elongation) on Jan 14 at 0h UT had a CM longitude of 224° and a phase of 0.82. The phase angle i is given by:

$$\text{phase} = 0.5\ (1 + \cos i)$$

therefore i=50°. This implies that longitudes from 94° to 274° (at the observable terminator) were sunlit and therefore imaged. (*Messenger* arrived later than 0h UT, but the calculation will serve our purposes.)

Messenger returned a number of excellent images, and in this short note we illustrate some examples (Figures 2–4). One of the highlights of the new mission was the imaging of the entire *Caloris* basin, (Figures 2–3) leading to a larger estimate of its diameter from 1300km to close to 1550km. This basin had appeared bisected at the terminator on the *Mariner* images. Under the near-vertical lighting prevailing this time, *Caloris* appears relatively bright and therefore geologically comparatively young, and may be one of the largest and youngest basins in the Solar System. The basin is an area of smooth plains but is also pockmarked by a number of young craters; it also has a large number of radial and tangential lineaments and some unusual dark-rimmed craters (Figure 3A).

The *Messenger* website adds the following: 'Near the centre of the basin, an area unseen by *Mariner 10*, this remarkable feature – nicknamed 'the spider' by the science team – was revealed. A set of troughs radiates outward in a geometry unlike anything seen by *Mariner 10*. The radial troughs are interpreted to be the result of extension (breaking apart) of the floor materials that filled the *Caloris* basin after its formation. Other troughs near the centre form a polygonal pattern. This type of polygonal pattern of troughs is also seen along the interior margin of the *Caloris* basin. An impact crater about 40km (~25 miles) in diameter appears to be centred on 'the spider.' (Figure 3B).'

Elsewhere on the planet, *Messenger* observed further examples of scarps (Figure 4), and therefore provided more evidence of its past crustal shrinkage. It re-observed some features discovered by *Mariner 10*, under different lighting conditions (Figure 5). It also carried out spectroscopic analyses to determine the surface mineralogical composition as well as investigating the planet's sodium 'tail', magnetic field and magnetosphere.

It is important to compare *Messenger*'s new images of the previously unmapped hemisphere with Earth-based images and drawings: see Figures 6–7. In Figure 6 we compare the classic work of G. V. Schiaparelli and E. M. Antoniadi with a blurred and degraded version of Figure 2. Both observers had clearly mapped the *Caloris* basin with its darker surroundings. In Figure 7 we compare more recent CCD work. Again the accord is very good, and the resolution of the ground-based work surprisingly high. Another puzzling feature of the older telescopic work was the fact that Mercury's S. cusp always appeared darker than the N. one. These latest images show that this is simply because the S. polar region is more densely cratered and rougher than the northern.

Messenger will encounter Mercury again in October before it finally enters into orbit around the innermost planet. Watch this space!

Richard McKim, *Director*

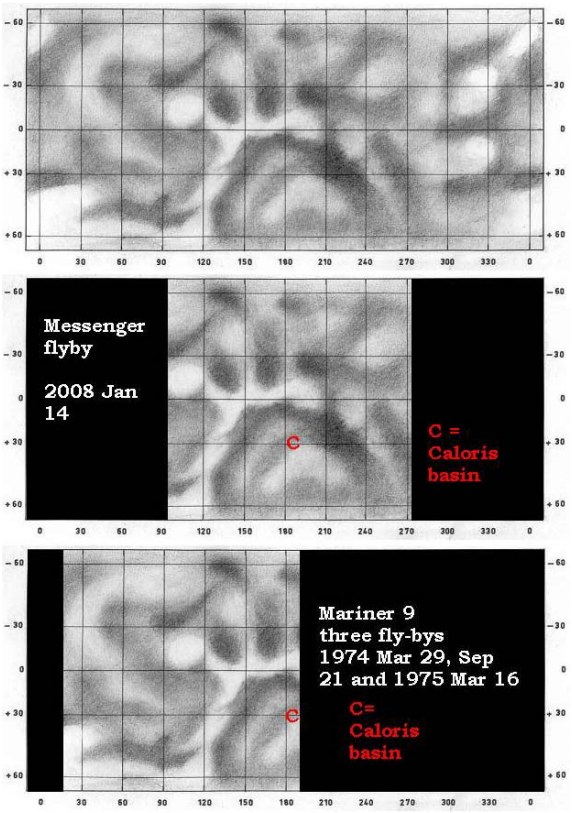

Figure 1. The standard albedo map of Mercury, compiled from ground-based photographs and drawings, after Camichel and Dollfus, 1968, upon which are superimposed the longitudes imaged by *Mariner 10* and *Messenger*. South is uppermost.

Figure 2. A view of the gibbous Mercury captured by *Messenger* on 2008 Jan 14 at a distance of 27,000km, 80 minutes after closest approach. A false-colour image with enhanced colour contrast made by combining images through red, infrared and ultraviolet filters. The bluest features are the youngest. The *Caloris* basin can be recognised in the lower left quadrant. South is uppermost. This and all other *Messenger* images are provided by NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington. See the website at **http://messenger.jhuapl.edu/index.php**

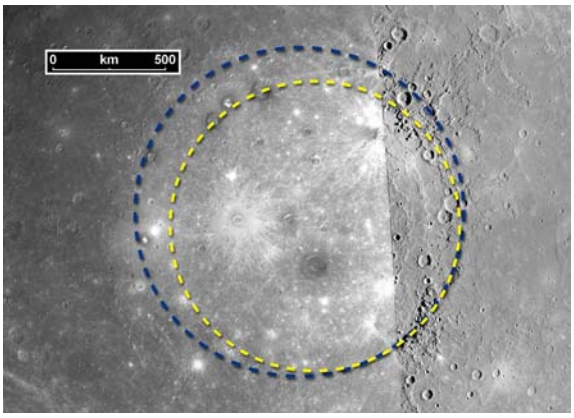

Figure 3A. A close-up view of *Caloris*. On the left, *Messenger*'s view; stitched onto the right is a collage from *Mariner 10*, under more oblique lighting. Note how the modern estimate of the basin diameter (in blue) has been revised upwards from that of the 1970s (in yellow). North is uppermost.

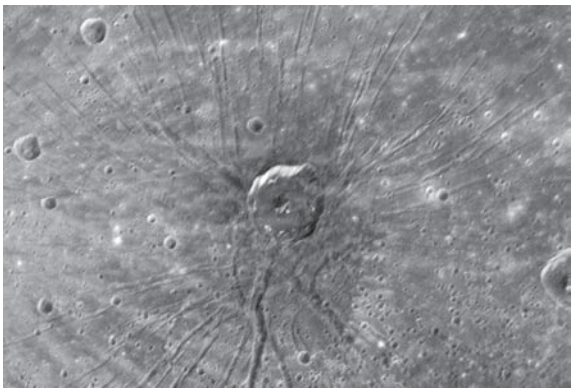

Figure 3B. The striking pattern of fractures in the centre of *Caloris* basin, centred upon a 40km wide impact crater. North is uppermost.

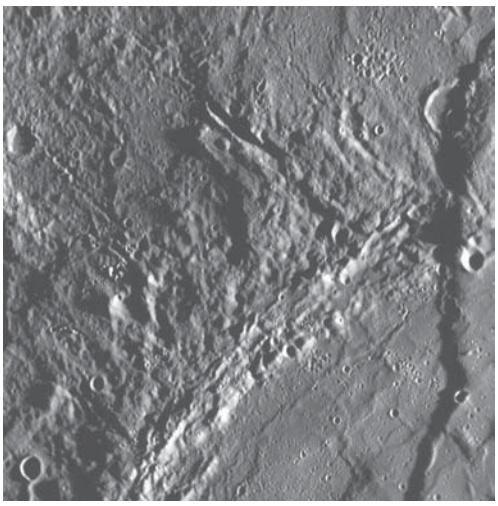

Figure 4. Mercurian cliffs: a new long scarp on the previously unknown hemisphere. This *Messenger* image is 200km wide. North is uppermost.

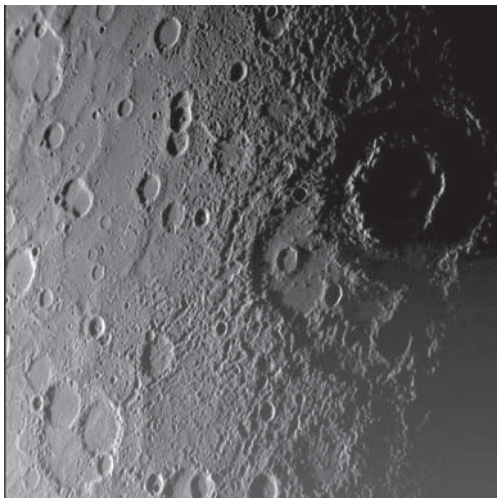

Figure 5. *Vivaldi*, a double-ringed crater whose outer diameter is about 200km. Craterlets down to 1km diameter can be resolved. This crater had previously been imaged by *Mariner 10* at lower resolution and under different illumination. North is uppermost.

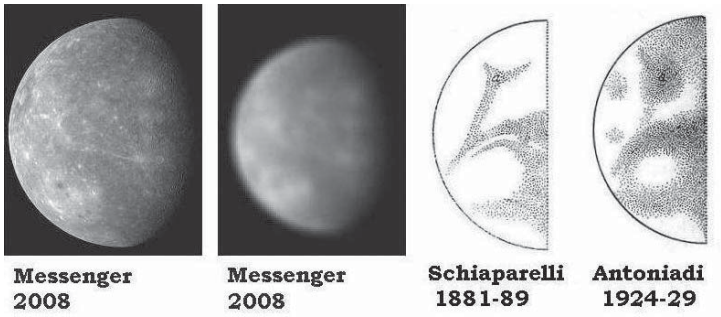

Figure 6. Reduced and blurred copies of Figure 2 compared with the classic work of Schiaparelli and Antoniadi. South is uppermost. All illustrations show *Caloris* as a light oval with dusky borders.

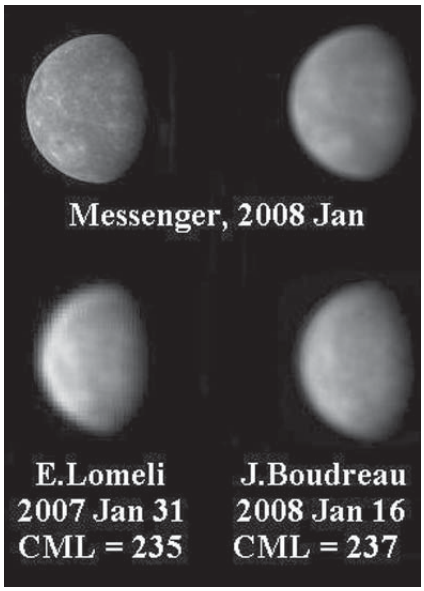

Figure 7. Recent CCD images by Ed Lomeli (Sacramento, CA, USA, 235mm SCT) and John Boudreau (Saugus, MA, USA, 279mm SCT) compare very well with *Messenger's* image of the *Caloris* hemisphere. (Boudreau's image kindly supplied by Frank Melillo.)