The telemetry data confirmed the design concepts for a deep space vehicle. Ranger demonstrated that a spacecraft can be accurately controlled in attitude during a long journey through space. The stabilized spacecraft made possible both an efficient power supply from solar cells and efficient communications to earth through a high-gain directional antenna.

Ranger also proved that precision space guidance is possible through the mid-course manoeuvre technique. This requires an excellent radio tracking system on the earth and a large electronic computer to calculate the trajectory and make the necessary correction in a matter of a few hours.

Analysis of Ranger trajectory data has resulted in several major improvements in our knowledge of physical parameters of the earth-moon system. The mass of the moon, or rather the value of G times the lunar mass, was determined as 4902.58 in units of kilometres cubed per second squared. This compares with the old astronomical value of 4900.76. The astronomical value had an estimated standard deviation of ± 5.0, while the Ranger value is ± 0.17. Figure 18: Note in this figure that the lunar mass was also determined from Mariner II data. This calculation rested upon the measurement of the position of the barycentre of the earth-moon system. Thus Ranger data have improved the accuracy of our measure of the lunar mass by a factor of 30. Figure 19: Similarly, the uncertainty in the mass of the earth was reduced to about ⅓ of the previous astronomical value.

Determination of the impact times of Ranger VI and VII have resulted in a new estimate of the lunar radius of 1,735 kilometres, 0.3 kilometres less than the previously accepted value.

Correlation of tracking data from the three ground stations gave a measurement of the relative locations of the stations with respect to the spin axis of the earth. These data have resulted in small changes in the surveyed locations of the stations. The accuracies are better than 30 metres.

The TV pictures taken by Ranger are of excellent quality. This figure (Figure 20) shows the manner in which Ranger approached the moon, and the next Figure (Figure 21), the area actually photographed. Interpretation of these photographs is still under study, but some interesting observations can be readily made from the final pictures. For example, this (Figure 22) is the last photograph taken with the A camera. It covers an area about 1⅔ miles on a side. Superimposed on this photograph is a mosaic of pictures taken with the P cameras and showing increasing detail.

Figure 23: This is an enlargement of this mosaic. The dimensions of the last photograph were about 60 x 150 feet. You will see that the surface of this particular lunar area is relatively smooth. There are no large scattered boulders. All of the surfaces appear round. Scientists believe that this is clear evidence of the extent of erosion on the surface. This erosion is due to bombardment by meteoric dust and by debris from the large meteor impacts.

The violent temperature extremes and the solar radiation, particularly in the X-ray and ultra-violet regions, have also modified the surface.

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