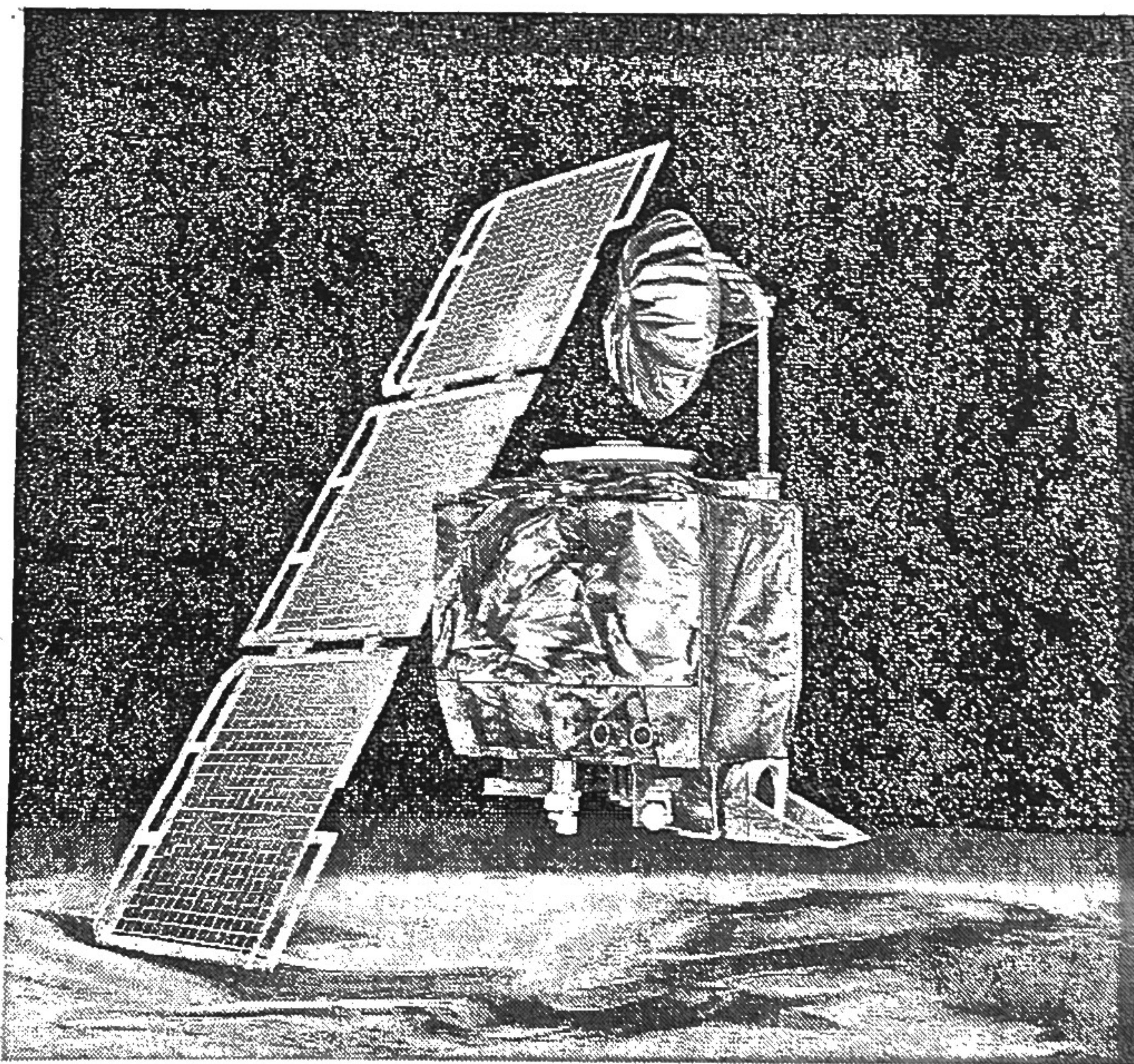


Case Studies: Metric/English Conversion Errors

The Mars Climate Orbiter: A Multimillion Dollar Mistake

Although NASA declared the metric system as its official unit system in the 1980s, conversion factors remain an issue. The Mars Climate Orbiter, meant to help relay information back to Earth, is one notable example of the unit system struggle. The orbiter was part of the Mars Surveyor '98 program, which aimed to better understand the climate of Mars. As the spacecraft journeyed into space on September 1998, it should have entered orbit at an altitude of 140-150 km above Mars, but instead went as close as 57km. This navigation error occurred because the software that controlled the rotation of the craft's thrusters was not calibrated in SI units. The spacecraft expected newtons, while the computer, which was inadequately tested, worked in pound forces; one pound force is equal to about 4.45 newtons. Unfortunately, friction and other atmospheric forces destroyed the Mars Climate Orbiter. The project cost \$327.6 million in total. Tom Gavin, an administrator for NASA's Jet Propulsion Laboratory in Pasadena, stated, "This is an end-to-end process problem. A single error like this should not have caused the loss of Climate Orbiter. Something went wrong in our system processes in checks and balances that we have that should have caught this and fixed it."



The Mars Climate Orbiter, image courtesy NASA/JPL-Caltech

NASA's Constellation Program: A Possible Casualty of Metric/English Conversions

Another NASA related conversion concern involves the Constellation project, which is focused mainly on manned spaceflight. Established in 2005, it includes plans for another moon landing. The Constellation project is partially based upon decades-old projects such as the *Ares* rocket and the *Orion* crew capsule. These figures and plans are entirely in English units; converting this work into metric units would cost approximately \$370 million.