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# MARINER 10

# MERCURY ENCOUNTER PRESS KIT

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Mariner 10, the first spacecraft to explore the planet Mercury, will reach the planet on March 29th, passing Mercury on the dark side about 540 miles (860 km) above the surface.

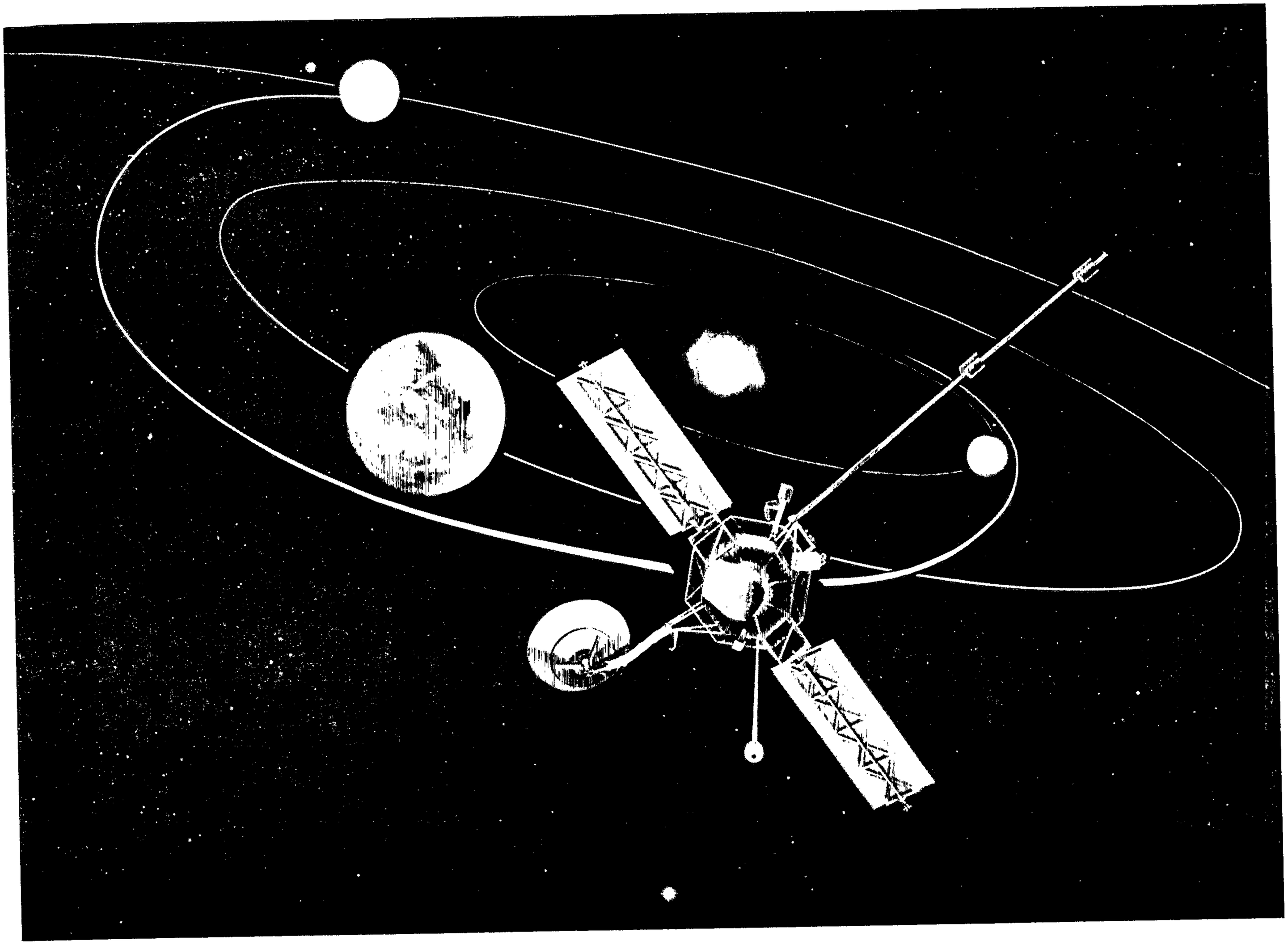
Mariner 10 was launched November 3, 1973 on the first dual-planet mission to Venus and Mercury and the first mission designed to use the gravitational attraction of one planet to reach another. It reached Venus on February 5, returning a full complement of scientific data including several thousand photographs. The gravitational attraction of Venus altered the spacecraft's flight path aiming it towards the orbit of Mercury.

(A trajectory correction was performed in mid-March to refine the flight path from a miss-distance of about 4400 miles (7000 km) on the sunlit side of Mercury to its current trajectory).

Photography of Mercury will begin on Saturday, March 23, at a range of 3.3 million miles (5.28 million km), with transmission of the early calibration photographs to Earth scheduled during the day. A total of about 2000 photographs of Mercury will be transmitted to Earth during the fly-by.

Photography will continue daily as Mariner 10 closes on its target and will continue after the point of closest approach (on March 29th) as the spacecraft pulls away from Mercury.

The incoming photography has been designed for three basic objectives. The first objective is to obtain 90% coverage of the visible, sunlit portion of the disc at an approximate resolution of 1.5 miles (2.5 km). The second photographic series



Mariner 10 Flight to Venus and Mercury

has the objective of attaining high resolution, .8 miles (1.3 km) of 30% of the visible disc. The third series, of prime importance, will seek a resolution of 0.8 km (.5 miles) down to about 900 ft. (300 meters). This latter series of pictures should allow geological interpretation of Mercury.

On March 29, as the spacecraft flies past the dark side of Mercury, its array of scientific experiments will measure the atmosphere, if any, chart temperature ranges on the surface, perform sun and Earth occultations and observe the interaction of the solar wind with the planet. The flight path past the dark side was chosen to allow the occultations, to observe the solar wind interactions and measure temperature changes from the day side into the night side.

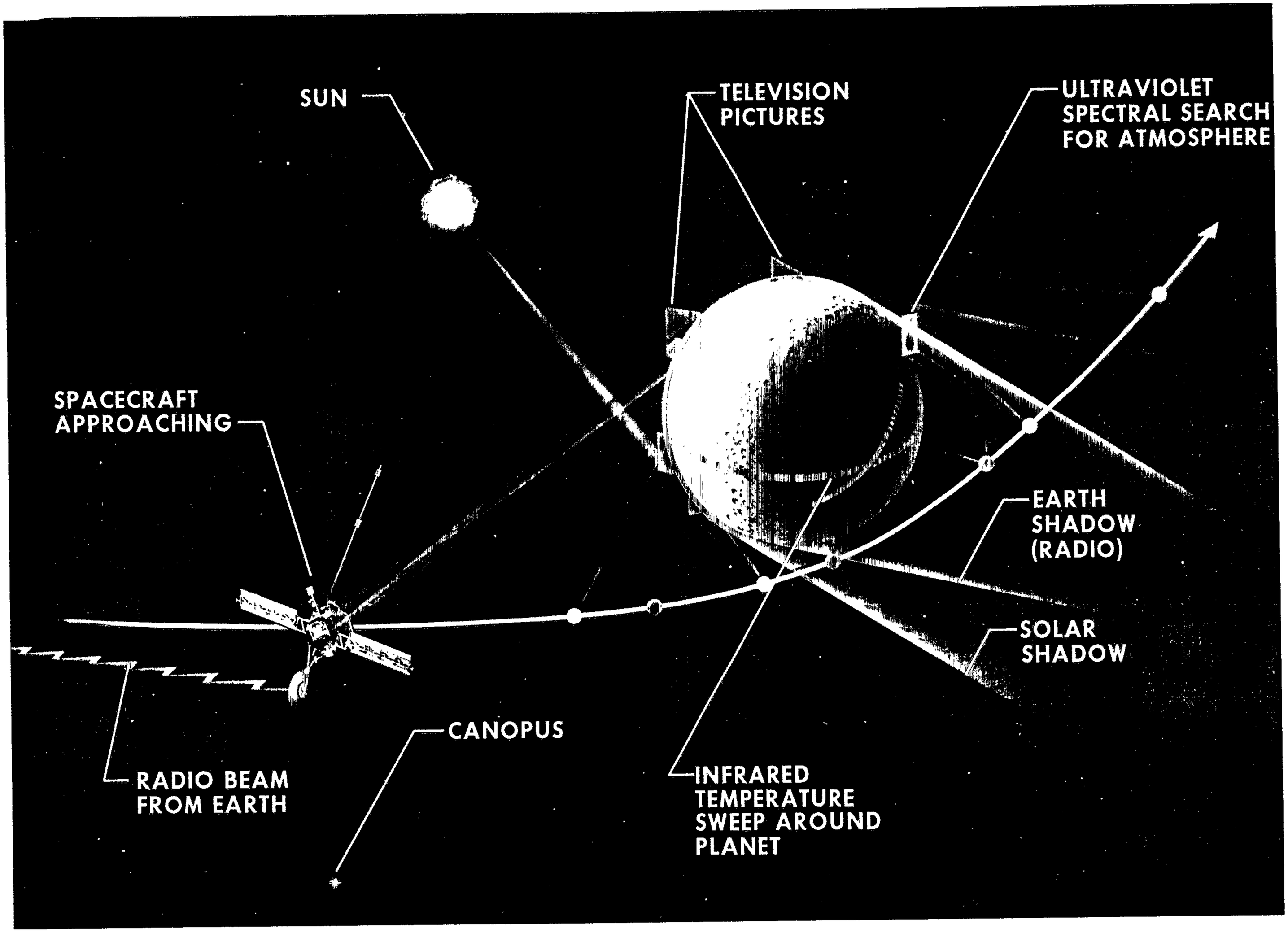
Scientific data will be transmitted from the spacecraft at a rate of 22050 bits per second to receiving stations equipped with 210-ft. (64-meter) antennas at Goldstone, California's Mojave Desert; Canberra, Australia, and near Madrid, Spain. Encounter at Mercury, on March 29, will occur over the Goldstone station.

During the encounter period, the television experiment is divided into five parts. Encounter (E) is defined as point of closest approach.

Incoming Far Encounter Sequence

The first sequence covers a period of E minus 6.5 days to E-17 hours.

In this period, 6 full tapes (36 frames each) will be recorded aboard the spacecraft and played back to the Goldstone




Fly-By of Mercury by Mariner 10

station. (A specific sequence of filters will be used throughout the encounter sequences).

A Mercury diameter experiment will be performed by the television experiment during the period to refine this figure. The shape of Mercury (departures from a spherical shape) can also be determined in this experiment.

In addition to the taped photographs in this period, there will be additional frames transmitted in real-time without being recorded. (The photographs taped aboard the spacecraft are also transmitted to Earth in real-time).

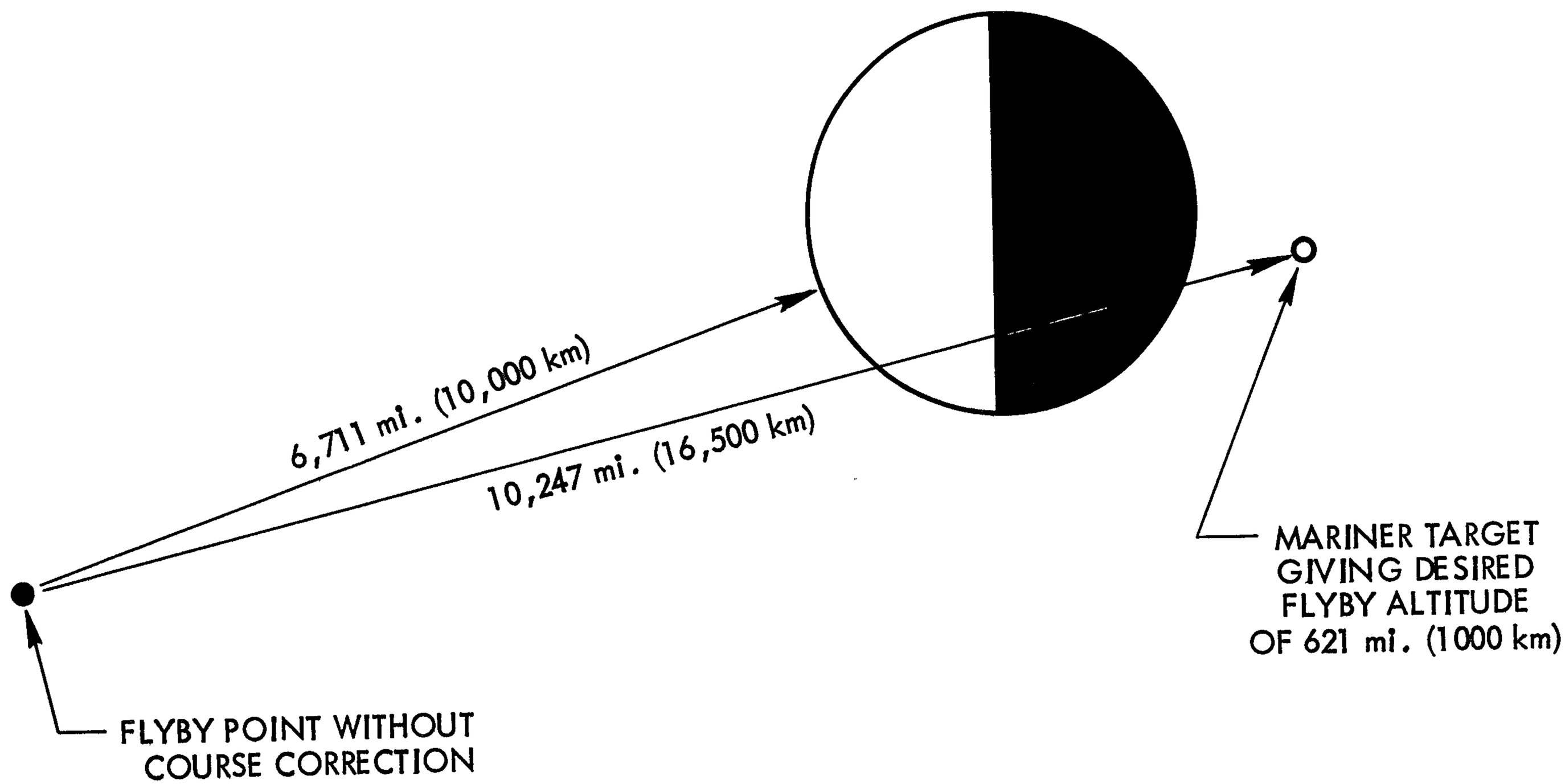
Real-time photographs transmitted to Earth will be in a reduced resolution format, leaving out some picture elements.

Taped photographs will be transmitted at full resolution.

The limitation in transmitting only reduced resolution photographs in real-time is a 22050 bit-per-second transmission rate versus a camera capability of taking a photograph, containing more than 5 million bits, every 42 seconds. The interval between photographs is not sufficient time to transmit an entire picture. When transmitting a taped picture, however, the entire full resolution frame can be sent.

The real-time transmissions in this period will be used for the Preliminary Albedo and Phase Function Experiment to analyze the relective properties of Mercury at different lighting angles.

# MARINER 10 MERCURY FLYBY TARGET



The full resolution frames will be used to construct photographic mosaics of the Mercury surface. The cameras will view about one-half of the sunlit face of Mercury (one-fourth of the entire planetary surface) during approach to the planet and another half in the outgoing sequence.

Incoming Near-Encounter Sequence

The second sequence begins at E-17 hours to E-3 1/2 hours. Eight half-tape loads (18 frames) will be recorded and transmitted in this sequence. An ultraviolet airglow spectrometer experiment will be done at the end of each half tape consisting of eight $10^{\circ}$ slews back and forth across the planet.

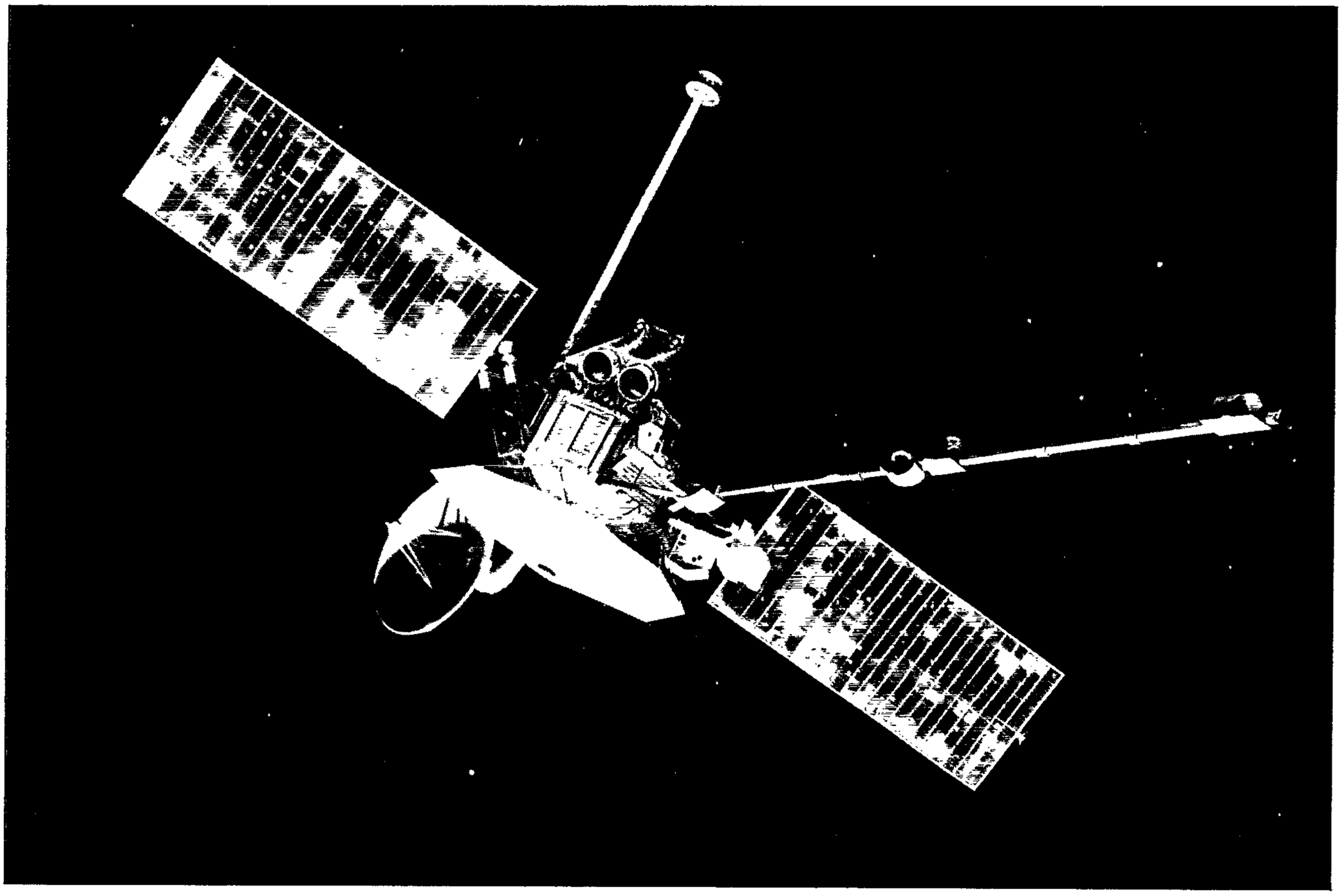
A mosaic is programmed for E-13.3 hours and another at E-4.9 hours. The latter will be important as a basis for locating later pictures covering smaller areas at a higher resolution. The resolution of this mosaic will be about 2.5 miles (4 km).

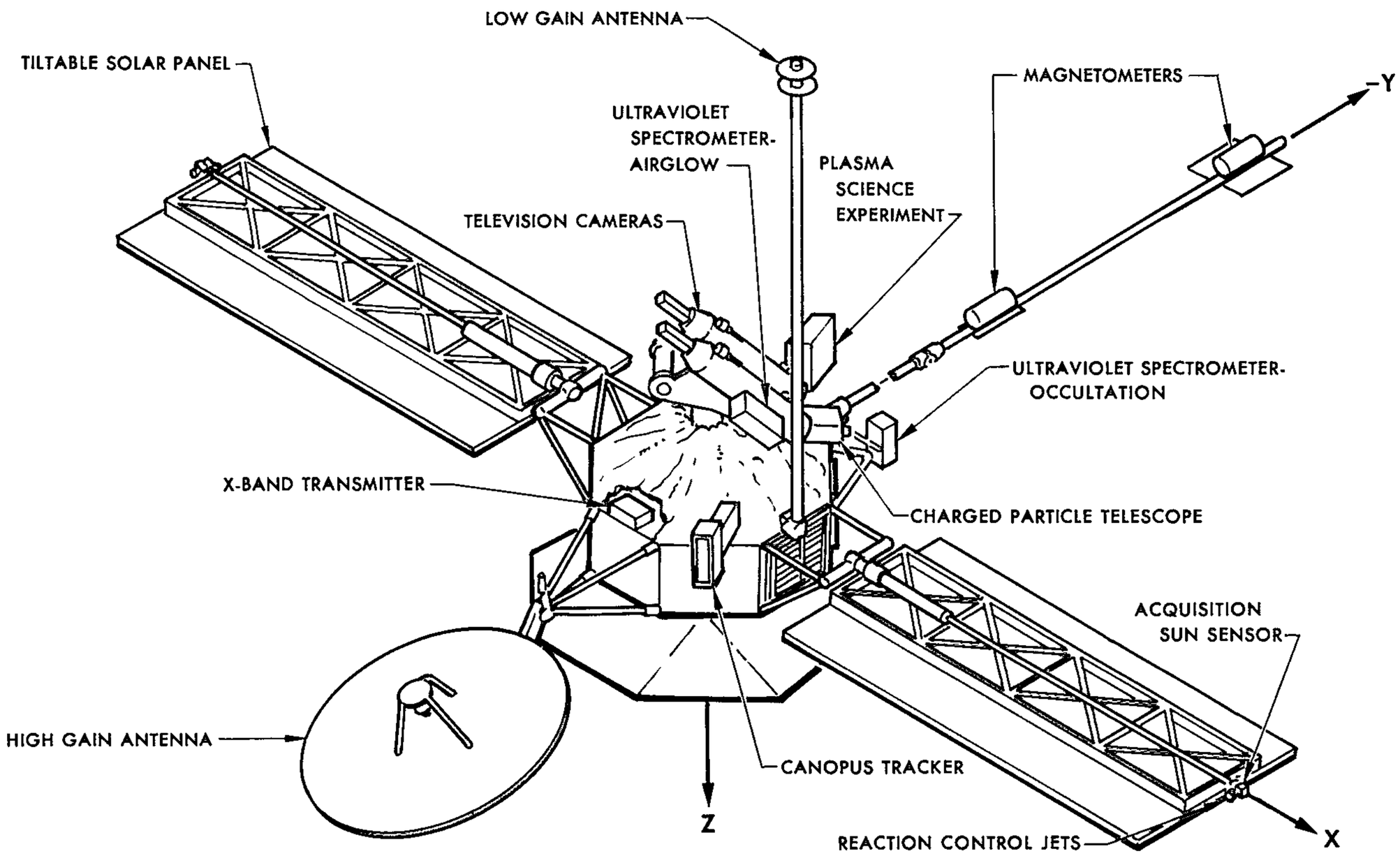
Mercury Encounter Sequence

The next sequence is from E-3.5 hours to E+4.45 hours. During that time, 612 full resolution partial frames will be transmitted in real-time and 35 full frames will be taped (18 incoming and 17 outgoing) to be transmitted later.

During this period, the Ultraviolet Airglow Experiment will perform three experiments; at E-2, a helium search; at E-1 hour, oxygen search, and at E, an argon search.

This is also the period in which Earth and Sun occultations occur and the Radio Science Experiment and the Ultraviolet Occultation Spectrometer will make atmospheric measurements, if






Mariner 10 Spacecraft

an atmosphere exists at Mercury. The Plasma Science Magnetometer, and Charged-Particle Telescope experiments will observe the interaction of Mercury with the solar wind which emanates continuously from the sun.

Outgoing Near-Encounter Sequence

This sequence is nearly the reverse of the Incoming Sequence. There will be 144 taped full frames and 144 real-time quarter frames. The Ultraviolet Experiment will repeat the searches for oxygen and helium. Photography will again provide mosaics, of the visible, sunlit disc.

Outgoing Far-Encounter Sequence

This sequence will continue until E+13 days. The UVS will scan Mercury daily until E+7 days when the instrument will be turned off. Photography in this sequence will total more than 500 taped and real-time frames and will include a second satellite search and a second Mercury diameter experiment.

# THE PLANET MERCURY

Mercury is a small, dense, gray planet close to the Sun, with essentially no atmosphere and surface temperature varying from extremely hot to very cold. It has an eccentric orbit, and a very slow rate of rotation.

This innermost planet is very difficult to observe from Earth because of its orbital position, its small size and its relatively low reflectivity. As a consequence, pending the flyby mission of Mariner 10, remarkably little is known about Mercury, although recent improvements in Mercury knowledge, based partly on new techniques, have been striking. The general expectation of many observers is that this planet tends to resemble the Moon more than any other known body. However, Mercury is not the Moon, and the lack of knowledge about it has permitted many speculations.

Mercury's diameter is half again as large as the Moon's. Its mass, however, is about five times as great, so that its density is 5.5 times that of water, about equal to Earth's, and far greater than the Moon's 3.34. Densities from about 4 to 6 have been asserted in recent decades, attesting to the difficulty of obtaining precise data from Earth-based observations. Mercury's surface, like the Moon's, has a low visual albedo. Radar reflectivity, microwave, infrared and photometric characteristics are approximately those of the Moon's.

Various observers have mapped the surface of Mercury, including Giovanni Schiaparelli in the Nineteenth Century, E. M. Antoniadi in the early Twentieth Century, and Audoin Dollfus in the 1950's. Although names have been informally assigned to some light and dark features, the maps are not entirely consistent with one another. Recently, radar astronomers have observed the planet, measuring the period of rotation (Dyce and Pettengill in 1965) and identifying and tracking features (Goldstein in 1971).

Earth-Mercury-Moon Size Comparison

(Dr. Richard Goldstein of the Jet Propulsion Laboratory produced altitude profiles and small-area maps of radar features from experiments conducted in 1972 and 1973.)

MOTION, ROTATION AND THEIR CONSEQUENCES

Mercury's orbit is rather eccentric, with the solar distance varying from about 29 million to over 43 million miles. As a consequence, the amount of sunlight and heat falling on the planet varies by more than a factor of two.

The planet's rotation period is locked to its orbital period in a ratio of 2:3. Until 1965, it was believed that this ratio was 1:1, that Mercury always turned the same face to the Sun, as the Moon does to Earth. Radar measurements at that time and since, confirmed by theoretical studies and historical review of visual observations, defined the 2:3 relationship. This ratio produces a solar day for Mercury which is 176 Earth days, or two Mercury years, long.

However, the motion of the Sun in the Mercury sky is not perfectly smooth or regular, because of the eccentricity of the planet's orbit. (The same phenomenon of interaction between orbital motion and rotation causes lunar libration.) In the case of Mercury, the Sun seems to stand still in the sky, then go backwards briefly before continuing forward once each orbital period or twice each "day". This occurrs when Mercury and the Sun are closest togeter and occurrs directly over two specific areas on opposite sides of the globe. Here, the Sun stays within a few degrees of the zenith for three weeks at a time, appearing twice as big and hot as elsewhere. The surface temperature at such points is estimated to vary from a high value of about (940°F) to a nightime low of (-350°F). At other locations on the equator, the high temperature may not exceed about 500°F.

Mariner's Experimenters expect to improve and confirm previous knowledge of the planet's dimensions, motion and rotation, and to obtain accurate and extensive temperature surveys.

ATMOSPHERE

One reason temperatures are believed to be so extreme on Mercury is that it does not appear to have any significant amount of atmosphere. Early visual observations of possible clouds, and later optical instrument readings of polarization and spectral bands associated with $CO_2$ had suggested a Mercurian atmosphere about as dense as that of Mars. Nikolai Kozyrev in 1963, and again in 1974, claimed the detection of hydrogen in Mercury's atmosphere, but all Earth-based observations are subject to great difficulty and uncertainty because of our atmosphere, and observations of Mercury are more so because of additional solar effects.

Negative results in most attempts to repeat and extend these observations, alternative explanations for observed effects, and other factors lead many planetary scientists to conclude that Mercury's atmosphere, if any, is extremely tenuous. Many planetologists believe that the atmosphere can be no more than a few millionths as dense as ours. The high temperature on and around Mercury would tend to cause any atmosphere to escape, even though the surface gravity is slightly more than that of Mars, and more than twice the Moon's.

Inert gases, such as neon, argon, krypton, etc., may be present in a Mercury atmosphere, but are not easily detectable by Earth-based methods. Mariner 10's two, highly sensitive ultraviolet spectrometers are designed to search for these and other gases at very low abundances. In addition, the occultation experiments performed when the spacecraft goes out of sight from Earth will probe for evidence of an ionosphere and atmosphere on Mercury.

SURFACE CHARACTERISTICS AND FEATURES

Under the difficult observing conditions from Earth, Mercury seems to be a smaller, darker less distinct version of Mars, yellowish instead of reddish. At best, Mercury in the telescope presents almost as good an image as the Moon offers to the naked eye.

Recent radar investigations of part of Mercury's surface reveal altitude differences as great as 1 to 1 1/2 miles (1 1/2 to 2 km), over distances of 100 to 200 miles (200 to 300 km). They also show many detectable surface features--some possibly circular like the lunar craters. Many planetologists expect to find craters on Mercury.

Photometric and infrared measurements also suggest the surface texture of Mercury resembles the Moon: a mixture of divided material of various particle sizes and relatively high porosity, called a regolith. The light and dark areas may correspond rather simply to geological features, as do the lunar highlands and maria, or they may not, as appears to be the case with Mars.

Since so very little is known about the surface of Mercury, it is obvious that TV pictures and other Mariner 10 scientific activities will produce a very large improvement in this area of knowledge. Experimenters hope to obtain many surveys of surface features, especially those near the terminators, in the long-shadowed zones on each side of the planet, at resolutions approaching 100 meters (330 ft.)

MERCURY'S INTERIOR AND MAGNETISM

Mercury is dense enough to have iron as an important chemical constituent. If it were fully differentiated, the iron core would extend roughly two-thirds of the way up from the center, with sillicate rock on top; however, the planet is so small that the interior is unlikely to be hot

enough for its materials to settle out and separate to a great extent. In this respect, too, it may resemble the Moon.

Little is known for certain about the conditions which prevail in the planets' interior . The Earth, which is relatively dense, massive and rapidly rotating, has a history of tectonic activity, including vulcanism and crustal plate motion, and a magnetic field. The outer planets which appear to rotate rapidly have very low densities. Nothing is known about the activities of their surfaces if they have them, but Jupiter, at least, has a powerful magnetic field.

The Moon exhibits neither tectonic activity nor magnetism to any noticeable degree, though it has old volcanoes. Mars has no detectable magnetism, but shows many complex fault zones, a gigantic rift valley, and massive old volcanoes. The Moon is a small body of moderate density; Mars somewhat larger and denser. The Moon rotates slowly; Mars, almost as rapidly as the Earth. Venus almost Earthlike in size and density, but rotating very slowly, displays no magnetic field, and its surface is essentially hidden from geologists.

The planet Mercury, by comparison, stands between the Moon and Mars in size, next to Earth's in density, between the Moon and Venus in rotation rate. Most investigators do not expect Mercury to show either a magnetic field or tectonic activity; however, few expected to see the evidences of activity which Mariner 9 found on Mars.

PLASMA INTERACTION

The inner planets face and interact with the solar plasma--the supersonic flux of charged particles streaming out of the Sun in different ways. The magnetic field of the Earth interacts with the plasma flow at a distance of several planetary radii above the surface, creating a very complex shock structure. The ionosphere of Venus provides a weaker, and more compact

interaction, although the shock wave is detectable far downstream in the direction, away from the Sun. The Moon, with neither magnetosphere nor atmosphere, meets the plasma flow essentially with its solid surface.

Mercury's form of interaction could, in principle, resemble any of these models, or none. It is most likely to resemble the Moon in this respect, too, and some scientists have suggest that the dark quality of Mercury's surface might have been caused by the plasma. Mariner's experiments are designed to detect and measure any of a moderately wide range of possibilities in this area, as in others.

NOTE: The following sequence will be further detailed and refined following the final trajectory correction maneuver. All times are stated in Pacific Daylight Time. TV transmission times are stated in Earth-receive time (spacecraft time plus 8-minutes light time). The sequence is carried through encounter plus one day.

SEQUENCE OF EVENTS--MERCURY

| | | |
|---|---|---|
| Sat., March 16 | | Final trajectory correction maneuver. |
| Sun., March 17 | 10:00 a.m. | Turn on all science. |
| | | Load s/c computer with encounter sequence. |
| Fr., March 22 | 1:46 p.m. | Encounter minus 7 days. Range to Mercury: 3,832,000 miles. |
| | | Turn on TV cameras. |
| Sat., March 23 | 4:08-6:38 a.m. | Start Mercury television. Take 216 frames, real-time low resolution; (one every 42 seconds). Preliminary albedo and phase function experiment. |
| | 6:38-7:23 a.m. | Record 36 TV pictures of the equatorial vicinity of Mercury in search of possible moons. No real-time sample. |
| | 7:23-11:48 a.m. | Play back 36 moon search pictures (one every 3 minutes, 44 seconds). |
| | 12:18-12:45 p.m. | Take 36 TV pictures; record on tape recorder while transmitting low-resolution of each in real-time (one every 42 seconds). Resolution of taped frames: 120 kilometers. |
| | 12:45-3:08 p.m. | Play back taped frames (one every 3 min., 44 seconds) full resolution, full frames. (Ultra-violet Spectrometer planetary calibration sequence for 10 minutes during playback.) |
| | 1:46 p.m. | Encounter minus 6 days.<br>Range to Earth: Approx. 82 million miles.<br>Range to Mercury: 3,282,000 miles. |

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| Sun., March 24 | 12:18-12:45 p.m. | Record 36 TV pictures and transmit low-resolution of each in real time (one every 42 seconds). Resolution: 100 kilometers. |
| | 12:45-3:08 p.m. | Play back 36 frames (one every 3 min., 44 sec). UVS calibration, 10 minutes. |
| | 1:46 p.m. | Encounter minus 5 days. Range to Mercury: 2,738,000 miles. |
| Mon., March 25 | 12:18-12:45 p.m. | Record 36 TV pictures and transmit low-resolution of each in real time (one every 42 sec). Resolution: 80 kilometers. |
| | 12:45-3:08 p.m. | Play back 36 frames (one every 3 min, 44 sec). UVS calibration, 10 minutes. |
| | 1:46 p.m. | Encounter minus 4 days. Range to Mercury: 2,184,000 miles. |
| Tue., March 26 | 12:18-12:45 p.m. | Record 36 TV pictures and transmit low-resolution of each in real time (one every 42 sec). Resolution: 60 kilometers. |
| | 12:45-3:08 p.m. | Play back 36 frames (one every 3 min, 44 sec). UVS calibration, 10 minutes. |
| | 1:46 p.m. | Encounter minus 3 days. Range to Mercury: 1,624,000 miles. |
| | 3:53-4:36 p.m. | Record 36 TV pictures--moon search. No real-time sample. |
| | 4:36-6:58 p.m. | Play back 36 moon search pictures (one every 3 min, 44 sec). |
| Wed., March 27 | 12:18-12:45 p.m. | Record 36 TV pictures and transmit low-resolution of each in real time (one every 42 sec). Resolution: 40 kilometers. |
| | 12:45-3:08 p.m. | Play back 36 frames (one every 3 min, 44 sec). UVS calibration, 10 minutes. |
| | 1:46 p.m. | Encounter minus 2 days. Range to Mercury: 1,016,000 miles. |
| Thu., March 28 | 12:18-12:45 p.m. | Record 36 TV frames and transmit low-resolution of each in real time (one every 42 sec). Resolution: 20 kilometers. |
| | 12:45-3:08 p.m. | Play back 36 frames (one every 3 min, 44 sec). UVS calibration, 10 minutes. |

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| | 1:46 p.m. | Encounter minus one day. Range to Mercury: 463,000 miles. |
| | 4:13-5:08 p.m. | Record 36 TV frames--dark current buildup for Mercury diameter experiment. |
| | 5:08-7:28 p.m. | Play back 36 Mercury diameter experiment frames. Canberra station tracking. |
| | 9:43-9:57 p.m. | Begin near encounter sequence. Record half-tape--18 TV pictures--and transmit low-resolution of each in real time (one every 42 sec). Resolution: 12 kilometers. |
| | 9:49 p.m. | UVS scan of Mercury for hydrogen and helium (eight 10° slews). UVS scans at end of each recording session until 9:12 a.m. 3/29. |
| | 9:57-11:08 p.m. | Play back first near-encounter half tape----18 TV frames (one every 3 min, 44 sec). |
| | 11:00 p.m. | Transfer tracking Canberra to Madrid. |
| | 11:08-11:21 p.m. | Record 18 frames. Resolution: 11 kilometers. |
| | 11:21pm-12:31 a.m. | Play back 18 TV frames. |
| Fri., March 29 | 12:31-12:44 a.m. | Record 18 frames. Resolution: 9.9 kilometers |
| | 12:44-1:55 a.m. | Play back 18 TV frames. |
| | 1:46 a.m. | Enc. minus 12 hrs. Range to Mercury: 281,100 miles. |
| | 1:55-2:08 a.m. | Record 18 frames. Resolution: 8.8 kilometers. |
| | 2:08-3:19 a.m. | Play back 18 TV frames. |
| | 3:19-3:32 a.m. | Record 18 frames. Resolution: 7.8 kilometers. |
| | 3:32-4:43 a.m. | Play back 18 TV frames. |
| | 4:43-4:56 a.m. | Record 18 frames. Resolution: 6.7 kilometers. |
| | 4:56-6:07 a.m. | Play back 18 TV frames. |
| | 6:07-6:20 a.m. | Record 18 frames. Resolution: 5.7 kilometers. |
| | 6:20-7:31 a.m. | Play back 18 TV frames. |
| | 7:31-7:44 a.m. | Record 18 frames. Resolution: 4.7 kilometers. |
| | 7:44-8:55 a.m. | Play back 18 TV frames. |
| | 7:00 a.m. | Transfer tracking Madrid to Goldstone. |
| | 7:46 a.m. | Enc. minus 6 hrs. Range to Mercury: 140,500 miles. |

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| 8:55-9:08 a.m. | Record final near encounter half tape. 18 TV frames. Resolution: 3.7 kilometers. |
| 9:08-10:20 a.m. | Play back final near encounter half tape--18 frames. |
| 10:20 a.m. | Start encounter sequence. Charged particle telescope, magnetometer and plasma science instrument all operating as in interplanetary space. |
| 10:20-1:37 p.m. | Real time TV. 282 partial frame pictures, high resolution. One picture every 42 seconds. Resolution at start of sequence: 2.3 kilometers. |
| 10:46 a.m. | Encounter minus 3 hours. Range to Mercury: 70,200 miles. UVS helium scan. |
| 11:46 a.m. | Enc. minus 2 hrs. Range to Mercury: 46,800 miles. TV resolution: 1.2 kilometers. UVS Carbon/ Oxygen scan. |
| 12:15-12:53 p.m. | Temperature scans of planet by infrared radiometer. |
| 12:46 p.m. | Enc. minus 1 hr. Range to Mercury: 23,200 miles. UVS argon scan. TV resolution: 700 meters. |
| 1:18-1:31 p.m. | Record final 18 frames (on second half of tape) of close encounter incoming disc. Resolution: 400 meters. |
| 1:42 p.m. | Enter solar occultation. Spacecraft in sun's shadow. |
| 1:43 p.m. | UVS Carbon/Oxygen scan. |
| 1:46 p.m. | ENCOUNTER<br>Range to Mercury: Less than 600 miles.<br>Range to Earth: About 93 million miles. |
| 1:49 p.m. | Exit solar occultation. Spacecraft again in sunlight. |
| 1:50 p.m. | Enter Earth occultation. Goldstone tracking station loses radio signal from Mariner for about 12 minutes. Radio science S/X-band experiment. |
| 2:05 p.m. | Start outgoing encounter TV. Record 17 frames on 1st half of s/c tape. Real-time partial frame pictures after exit Earth occultation. Resolution: 200 meters. |
| 2:02 p.m. | Exit Earth occultation. Reacquire s/c radio signal. |

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| | 2:18 p.m. | Complete Encounter TV tape. |
| | 2:18-6:09 p.m. | Real time TV. Outgoing disc in 351 partial frames. |
| | 2:46 p.m. | Enc. plus 1 hr. Range to Mercury: 21,300 miles. UVS helium scan. TV resolution: 1.5 kilometers. |
| | 3:46 p.m. | Enc. plus 2 hrs. Range to Mercury: 44,800 miles. |
| | 3:00 p.m. | Transfer tracking, Goldstone to Canberra. |
| | 6:09 p.m. | End real time encounter TV. |
| | 6:09-7:19 p.m. | Play back 2nd half of encounter tape (one every 3 min, 44 sec). 18-frame half tape was recorded between 1:18 and 1:31 p.m. |
| | 7:19-7:33 p.m. | Start outgoing near-encounter TV. Record 18 pictures on 2nd half of tape and transmit low-resolution frames in real time (one every 42 sec). Resolution: 4.5 km. |
| | 7:33-8:44 p.m. | Play back 18 frames (one every 3 min, 44 sec). |
| | 8:44-8:57 p.m. | Record 18 frames. Resolution 5.2 kilometers. |
| | 8:57-10:07 p.m. | Play back 18 frames. |
| | 10:07-10:21 p.m. | Record 18 pics. Resolution: 6.2 kilometers. |
| | 10:21-11:31 p.m. | Play back 18 frames. |
| | 11:00 p.m. | Transfer tracking, Canberra to Madrid. |
| | 11:31-11:45 p.m. | Record 18 pics. Resolution: 7.3 kilometers. |
| | 11:45-12:55 a.m. | Play back 18 frames. |
| Sat., March 30 | 12:55-1:09 a.m. | Record 18 pics. Resolution: 8.3 kilometers. |
| | 1:09-2:19 a.m. | Play back 18 frames. |
| | 2:19-2:33 a.m. | Record 18 pics. Resolution: 9.4 kilometers. |
| | 2:33-3:43 a.m. | Play back 18 frames. |
| | 3:43-3:57 a.m. | Record 18 pics. Resolution: 10.4 kilometers. |
| | 3:57-5:07 a.m. | Play back 18 frames. |
| | 5:07-5:21 a.m. | Record final 1/2 tape (18 pics) of outgoing near encounter TV. Resolution: 11.5 kilometers. |

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| 5:21-7:39 a.m. | Play back entire tape at 22 kbps. One picture every 3 minutes, 44 seconds. Includes 1st half of tape -- Encounter TV -- recorded at 2:05 p.m. Friday. |
| 7:39-11:09 a.m. | Play back 1st half of tape at slow readout rate (one picture every 11 minutes, 12 seconds). Slow rate benefits return of non-imaging science recorded with TV during encounter. |
| 11:09-12:19 p.m. | Play back 1st half of tape a third time at regular readout rate (one picture every 3 minutes, 44 seconds). |
| 1:32-2:26 p.m. | Record 36 frames-Mercury diameter measurement. |
| 2:26-4:44 p.m. | Play back 36 Mercury diameter measurement frames. |
| 7:12 p.m. | Begin outgoing far encounter TV sequence. |

Outgoing far encounter TV consists of 15 full tape loads of pictures (36 frames each). Low resolution frames of each picture will be transmitted during each record session. Sessions continue through April 11 and include four tape loads of satellite search mosaics on March 31 and April 2. Resolution decreases from 21 kilometers on March 30 to 234 kilometers on April 11. All playbacks at the rate of one picture every 11 minutes, 22 seconds.

# EXTREME ULTRAVIOLET

This experiment consists of two independent instruments, a fixed-pointing occultation spectrometer, mounted on the spacecraft body, and an airglow instrument, mounted on a scan platform. The experiment will perform analysis of planetary atmospheres.

At Mercury, the occultation spectrometer will search for an atmosphere above the edge (limb), of the planet's disc:

The airglow instrument will scan the entire disc to detect radiation from and measure altitude distribution of Hydrogen, Helium, Argon, Oxygen, Neon and Carbon components, if these gases are present.

During cruise the two instruments will measure distribution of Hydrogen Lyman-alpha emanating from the galactic and Magellanic cloud sources.

Close to Earth, the airglow instrument will observe the Hydrogen Corona of Earth, search for helium and measure the reflective properties of the moon at extreme ultraviolet wavelength.

At Venus the instruments will measure distribution of Carbon, Oxygen and Hydrogen Lyman-alpha and will search for Helium, Neon and Argon.

INFRARED RADIOMETER

This experiment will measure temperatures on the surface of Mercury and Venus by sampling thermal or infrared radiation.

The trajectory of the spacecraft past Mercury will provide measurements from late afternoon through the night side and into the early morning hours.

It is expected that temperature variations will be large. A thin or non-existent atmosphere will allow intensive heating of the day side. The slow 58.6 day rotation, without a heavy atmosphere to retain heat, will allow the night side to quickly radiate heat from the surface.

Absorption and loss rates can provide indirect evidence in the material of the surface, i.e. sand, gravel, rock. etc.

Unexpected variations, cooler or warmer, may be correlated with photographs of the area or measurements by other instruments. For example, mountains or valleys could give a temperature variation and might be visible in photographs or be reflected in atmospheric pressure measurements. Hot spots could also be correlated with volcanoes or a difference in surface materials.

At Venus, measurements of cloud top temperatures and at the edge of the planets disc will be made at higher resolution than by prior spacecraft.

RADIO SCIENCE

This experiment will provide data for celestial mechanics and occultation measurements from radio tracking of the spacecraft and analysis of planetary atmospheric effects on the radio signal.

The celestial mechanics experiment will determine the mass and gravitational characteristics of both Mercury and Venus from the effect of the planets on spacecraft trajectory and refine our knowledge of the orbits of the planets. The data will also yield estimates of the planets' internal composition and density.

In the occultation experiment radio waves from the spacecraft's transmitter will pass through the atmosphere of Venus or Mercury, enroute to Earth receivers, as Mariner passes behind the planets as seen from Earth.

Trajectories to both planets will provide Earth occultation.

Gases in an atmosphere diffract and diffuse the signal and analysis of the received signal yields pressure and temperature measurements from the top of the atmosphere down to the surface. These measurements can be fitted to a model of the gases present in the atmosphere. Analysis will also reveal if the planet has an ionosphere similar to Earth.

The cut-off of the signal as it grazes the surface provides a measurement of the radius of the planet.

As the thick atmosphere of Venus can bend the signal and trap it in a path around the planet, the antenna can be steered to offset the bending allowing deeper pentration of the atmosphere.

Data will be provided by the spacecraft's standard S-band transmitter and an experimental X-band system.

# PLASMA SCIENCE

The Plasma Science Experiment will provide the first observations of the Solar Wind, a stream of energetic particles emanating from the sun, inside the orbit of Venus.

The experiment will be activated shortly after launch and will provide continuous measurements from the orbit of Earth to the orbit of Mercury, from 1 to 0.4 Astronaumical Units.

Objectives of the experiments are: To determine the mode of interaction between the planet Mercury and the solar wind, and to make a comprehensive study of the plasma regime at Mercury; to verify and extend previous observations of the solar wind interaction with Venus and to clarify the role of the electrons in the interactions; and to investigate the characteristics of the solar plasma between 1 and 0.4 AU.

# TELEVISION EXPERIMENT

Two vidicon cameras equipped with eight filters each and capable of taking both narrow and wide angle phtographs are expected to return 8000 photographs that will include the Earth, Earth and Moon, Venus and Mercury.

They are mounted on a scan platform allowing movement in vertical and horizontal directions for precise targeting.

Catadioptric Cassegrain telescopes are attached to the vidicon cameras for narrow angle photography. An auxiliary optical system mounted on each camera provides wide angle photography. Changing to wide angle photography is permitted by moving a mirror on a filter wheel to a position in the optical path of the auxiliary system.

Exposure times range from 3 millisecons to 12 seconds. Each camera will take a picture every 42 seconds. Each television picture consists of 700 scan lines. There are 832 picture elements per line. Picture elements are digitally coded into 8 bit words for transmission.

The narrow angle system has a focal length of 1500 mm, and 1/2° field of view; the wide angle, 62 mm, 11X14° field of view.

There are seven filter positions. In order, they are: wide angle image relay mirror, blue band pass, ultraviolet polarizing, minus ultraviolet high pass, clear, ultraviolet band pass, defocussing lens (for calibration), and yellow band pass.

## CHARGED PARTICLE EXPERIMENT

The instrument for this experiment has two parts, the Main Telescope and the Low Energy Telescope, mounted on the body of the spacecraft.

The experiment will measure charged particles near Mercury originating on the sun and in interplanetary space. Solar flares will be studied and correlated with measurements from Pioneers 9 and 10.

During cruise portions of the mission the experiment will measure solar and galactic cosmic rays. The separation of solar and galactic rays the effect of the sun on galactic rays is an important objective.

At Mercury, the possible existence of a magnetail and bow shock will be sought.

The instrument can be commanded from Earth for calibration, disabling of failed detectors or to measure only certain high priority particles. The counting capability ranges from 0.01 to 100,000 particles per second.

## MAGNETOMETER

This experiment will detect interactions of the solar wind with Venus and Mercury to yield a picture of the magnetic environment at each planet.

At Venus, evidence of a trailing magnetic field and a planetary field will be sought. Based on prior measurements, any planetary field will be weak.

As both Mercury and Venus rotate slowly, it is not expected that a iron core, if present, could create a dynamo effect as concluded for our own planet.

During the cruise portion of the mission, the experiment will measure interplanetary fields. Measurements between the orbits of Venus and Mercury will be conducted for the first time.

The experiment employs two fluxgate magnetometer sensors both mounted on a six-foot boom. One is mounted close to the spacecraft to measure magnetic disturbance from the spacecraft. This data will be used to interpret measurements by the other sensor which is located outboard on the boom to minimize magnetic effects of the spacecraft.

# MARINER VENUS/MERCURY 1973 SCIENCE INVESTIGATORS

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