

1964

40)

Ranger 6

Nation: U.S. (17)

Objective(s): lunar impact

Spacecraft: P-53 / Ranger-A

Spacecraft Mass: 364.69 kg

Mission Design and Management: NASA JPL

Launch Vehicle: Atlas-Agena B (no. 8 / Atlas D no. 199 / Agena B no. 6008)

Launch Date and Time: 30 January 1964 / 15:49:09 UT

Launch Site: ETR / launch complex 12

Scientific Instruments:

- 1) imaging system (six TV cameras)

Results: This fourth American attempt at lunar impact was the closest success. The spacecraft, the first Block III type vehicle with a suite of six TV cameras, was sterilized to avoid contaminating the lunar surface. The series would also serve as a test bed for future interplanetary spacecraft by deploying systems (such as solar panels) that could be used for more ambitious missions. The Block III spacecraft carried a 173-kilogram TV unit (replacing the impact capsule carried on the Block II Ranger spacecraft). The six cameras included two full-scan and four partial-scan cameras. Ranger 6 flew to the Moon successfully and impacted precisely on schedule at 09:24:32 UT on 2 February. Unfortunately, the power supply for the TV camera package had short-circuited three days previously during

Atlas booster separation and left the system inoperable. The cameras were to have transmitted high-resolution photos of the lunar approach from 1,448 kilometers to 6.4 kilometers range in support of Project Apollo. Impact coordinates were 9°24' north latitude and 21°30' east longitude.

41)

no name / [Zond]

Nation: USSR (24)

Objective(s): Venus flyby

Spacecraft: 3MV-1A (no. 4A)

Spacecraft Mass: c. 800 kg

Mission Design and Management: OKB-1

Launch Vehicle: 8K78 (no. T15000-19)

Launch Date and Time: 19 February 1964 / 05:47:40 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments:

- 1) radiation detector
- 2) charged-particle detector
- 3) magnetometer
- 4) piezoelectric detector
- 5) atomic hydrogen detector
- 6) radio telescope
- 7) ultraviolet and Roentgen solar radiation experiment
- 8) technology experiment
- 9) plasma engines

Results: This was another Soviet “third-generation” deep space probe that failed to

accomplish its mission of a Venus flyby. This spacecraft failed to reach Earth orbit due to a malfunction in the launch vehicle's third stage. Later investigation indicated that a liquid oxygen leak through an unpressurized valve seal froze propellant in the main pipeline. As a result, the pipeline cracked, leading to an explosion in the third stage.

42)

no name / [Luna]

Nation: USSR (25)

Objective(s): lunar soft-landing

Spacecraft: Ye-6 (no. 6)

Spacecraft Mass: c. 1,420 kg

Mission Design and Management: OKB-1

Launch Vehicle: 8K78M (no. T15000-20)

Launch Date and Time: 21 March 1964 /
08:15:35 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments:

- 1) imaging system
- 2) radiation detector

Results: This fourth Soviet attempt to achieve a soft-landing on the Moon failed to reach an intermediate orbit around Earth. During the boost phase, the launcher's third-stage engine's main liquid oxygen valve failed to open when the valve rod broke off. As a result, the third-stage engine never reached full thrust and eventually cut off prematurely at T+489 seconds. The spacecraft never reached Earth orbit.

43)

Kosmos 27 / [Zond]

Nation: USSR (26)

Objective(s): Venus impact

Spacecraft: 3MV-1 (no. 5)

Spacecraft Mass: 948 kg

Mission Design and Management: OKB-1

Launch Vehicle: 8K78 (no. T15000-22)

Launch Date and Time: 27 March 1964 /
03:24:42 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments:

Bus:

- 1) radiation detector
- 2) charged-particle detector
- 3) magnetometer
- 4) piezoelectric detector
- 5) atomic hydrogen detector

Lander:

- 1) barometer
- 2) thermometer
- 3) radiation detector
- 4) micro-organism detection experiment
- 5) atmospheric composition experiment
- 6) acidity measurement experiment
- 7) electro-conductivity experiment
- 8) luminosity experiment

Results: The probe, designed to accomplish atmospheric entry into Venus, successfully reached Earth orbit but failed to leave for Venus when the Blok L upper stage malfunctioned. The upper stage evidently lost stable attitude due to a failure in the circuit of the power supply for the attitude-control system. The spacecraft burned up in Earth's atmosphere the following day. Had this mission been successful, it would probably have been given a Zond designation.

44)

Zond 1

Nation: USSR (27)

Objective(s): Venus impact

Spacecraft: 3MV-1 (no. 4)

Spacecraft Mass: 948 kg

Mission Design and Management: OKB-1

Launch Vehicle: 8K78 (no. T15000-23)

Launch Date and Time: 2 April 1964 /
02:42:40 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments:

Bus:

- 1) radiation detector
- 2) charged-particle detector
- 3) magnetometer
- 4) piezoelectric detector
- 5) atomic hydrogen detector

Lander:

- 1) barometer
- 2) thermometer
- 3) radiation detector
- 4) micro-organism detection experiment
- 5) atmospheric composition experiment
- 6) acidity measurement experiment
- 7) electro-conductivity experiment
- 8) luminosity experiment

Results: Although this Venus impact probe was successfully sent toward Venus, ground controllers discovered a series of major malfunctions in the spacecraft during its coast to the planet. These included depressurization of the

main spacecraft bus when the glass cover of a solar-stellar attitude-control sensor cracked. Additionally, the internal radio transmitters of the spacecraft were automatically switched on at the wrong time—during depressurization, when the gas discharge created high-voltage currents that shorted out the system. Contact was maintained with the still-pressurized 290-kilogram lander module until 25 May 1964, by which time controllers had managed to conduct two major course corrections (at 560,000 kilometers and 13 to 14 million kilometers from Earth, respectively), the first time such actions had been performed on a Soviet interplanetary spacecraft. The inert spacecraft eventually flew by Venus on 19 July 1964 at a range of 110,000 kilometers. The Soviets later published some data on cosmic-ray flux measured by Zond 1.

45)

no name / [Luna]

Nation: USSR (28)

Objective(s): lunar soft-landing

Spacecraft: Ye-6 (no. 5)

Spacecraft Mass: c. 1,420 kg

Mission Design and Management: OKB-1

Launch Vehicle: 8K78M (no. T15000-21)

Launch Date and Time: 20 April 1964 /
08:08:28 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments:

- 1) imaging system
- 2) radiation detector

Results: This was the fifth Soviet attempt at a lunar soft-landing. The mission was aborted early when during the ascent to Earth orbit, the launch vehicle's third-stage engine prematurely shut down. A subsequent investigation indicated that the engine cut off due to loss of power when a circuit between a battery in the fourth stage (which powered the third-stage engine) and the I-100 guidance unit was broken.

46)

Ranger 7

Nation: U.S. (18)

Objective(s): lunar impact

Spacecraft: P-54 / Ranger-B

Spacecraft Mass: 365.6 kg

Mission Design and Management: NASA JPL

Launch Vehicle: Atlas-Agena B (no. 9 / Atlas D no. 250 / Agena B no. 6009)

Launch Date and Time: 28 July 1964 /
16:50:07 UT

Launch Site: ETR / launch complex 12

Scientific Instruments:

- 1) imaging system (six TV cameras)

Results: Ranger 7, the second of the Block III Ranger series, was the first unequivocal success in U.S. efforts to explore the Moon—after thirteen consecutive failures. In some ways, it marked a major milestone in American deep space exploration because the ratio in favor of successes increased dramatically after this point. After a nominal midcourse correction on 29 July, Ranger 7 approached the Moon precisely on target two days later. Just 15 minutes prior to impact, the suite of TV cameras began sending back spectacular photos of the approaching surface to JPL's Goldstone dish in California. The last of 4,316 images was transmitted only 2.3 seconds prior to impact at 13:25:49 UT on 31 July 1964. The impact point was at 10°38' south latitude and 20°36' west longitude on the northern rim of the Sea of Clouds. Scientists on the ground were more than satisfied with Results; image resolution was, in many cases, one thousand times better than photos taken from Earth. Scientists concluded that an Apollo crewed landing would be possible in the mare regions of the lunar surface, given their relative smoothness.

47)

Mariner 3

Nation: U.S. (19)

Objective(s): Mars flyby

Spacecraft: Mariner-64C / Mariner-C

Spacecraft Mass: 260.8 kg

Mission Design and Management: NASA JPL

Launch Vehicle: Atlas-Agena D (no. 11 / Atlas D no. 289 / Agena D no. AD68/6931)

Launch Date and Time: 5 November 1964 /
19:22:05 UT

Launch Site: ETR / launch complex 13

Scientific Instruments:

- 1) imaging system
- 2) cosmic dust detector
- 3) cosmic-ray telescope
- 4) ionization chamber
- 5) magnetometer
- 6) trapped radiation detector
- 7) solar plasma probe
- 8) occultation experiment

Results: NASA approved two probes for the Mariner-Mars 1964 project in November 1962. The primary goal of the two spacecraft was to photograph the Martian surface using a single TV camera fixed on a scan platform that could return up to twenty-one pictures after an eight-month journey. During the launch of Mariner 3, the first of the two probes, the booster payload shroud failed to separate from the payload. Additionally, battery power mysteriously dropped to zero (at T+8 hours 43 minutes), and the spacecraft's solar panels apparently never unfurled to replenish the power supply. As a result, ground control lost contact with the spacecraft, which eventually entered heliocentric orbit. A later investigation indicated that the shroud's inner fiberglass layer had separated from the shroud's outer skin, thus preventing jettisoning.

48)

Mariner 4

Nation: U.S. (20)

Objective(s): Mars flyby

Spacecraft: Mariner-64D / Mariner-D

Spacecraft Mass: 260.8 kg

Mission Design and Management: NASA JPL

Launch Vehicle: Atlas-Agena D (no. 12 / Atlas D no. 288 / Agena D no. AD69 / 6932)

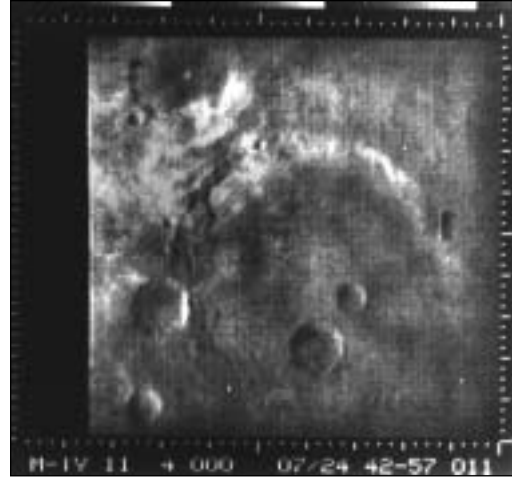
Launch Date and Time: 28 November 1964 / 14:22:01 UT

Launch Site: ETR / launch complex 12

Scientific Instruments:

- 1) imaging system
- 2) cosmic dust detector
- 3) cosmic-ray telescope
- 4) ionization chamber
- 5) magnetometer
- 6) trapped radiation detector
- 7) solar plasma probe
- 8) occultation experiment

Results: The Mariner 4 mission, the second of two Mars flyby attempts in 1964 by NASA, was one of the great early successes of the Agency, returning the very first photos of another planet from deep space. Using a new all-metal shroud, the spacecraft lifted off without any problems and was successfully boosted toward Mars by the Agena D upper stage. A single mid-course correction on 5 December ensured that the spacecraft would fly between 8,000 and 9,660 kilometers from the Martian surface. Approximately 40 minutes prior to closest



Eleventh picture of Mars from Mariner 4 (in "raw" state) taken through the green filter from 12,500 kilometers away, showing a crater 121 kilometers in diameter in the Atlantis region. Mariner 4 was the first spacecraft to get a close look at Mars. Flying as close as 9,846 kilometers, Mariner 4 revealed Mars to have a cratered, rust-colored surface, with signs on some parts of the planet that liquid water had once etched its way into the soil. Mariner 4 was launched on 28 November 1964 and arrived at Mars on 14 July 1965.

approach (which was at 01:00:57 UT on 15 July 1965 at a range of 9,846 kilometers), the TV camera began taking the first of twenty-one images (plus twenty-two lines of a twenty-second) through red and green filters. About 1.25 hours after the encounter, Mariner 4 dipped behind the right-hand side of Mars (as viewed from Earth) in order to refract its radio signals through the Martian atmosphere. Data indicated that surface pressure was quite low—future Mars landers would have to be equipped with retro-rocket engines in addition to parachutes. The probe detected daytime surface temperatures of about -100°C . A very weak radiation belt, about 0.1 percent of that of Earth's, was also detected. The day after the closest encounter, Mariner 4 began transmitting its photos back to Earth. The images clearly showed Mars to be an ancient Moon-like body with widespread cratering. Given the thin atmosphere, scientists believed it unlikely that Mars harbored any life. NASA maintained contact with the spacecraft until 1 October 1965, when the probe was 309 million kilometers from Earth. Two years later, in October 1967, the spacecraft was reactivated for attitude con-

trol tests in support of the Mariner 5 mission to Venus, which used a similar spacecraft bus. Final contact was lost on 21 December 1967.

49)

Zond 2

Nation: USSR (29)

Objective(s): Mars flyby

Spacecraft: 3MV-4 (no. 2)

Spacecraft Mass: 996 kg

Mission Design and Management: OKB-1

Launch Vehicle: 8K78

Launch Date and Time: 30 November 1964 / 13:12 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments:

- 1) radiation detector
- 2) charged-particle detector
- 3) magnetometer
- 4) piezoelectric detector
- 5) radio telescope
- 6) nuclear component of cosmic-ray experiment
- 7) ultraviolet and Roentgen solar radiation experiment
- 8) imaging system

Results: Zond 2 was the Soviet Union's first third-generation ("3MV") spacecraft sent toward Mars. This particular model, the 3MV-4, was designed to fly by the planet and take photographs. After the spacecraft successfully entered a trans-Mars trajectory, ground controllers discovered that the probe's solar panels had not completely unfurled, which deprived the vehicle of full power. Later investigation indicated that a tug cord, designed to pull the panels free at the moment of separation from the Blok L upper stage, had broken off. Controllers were able to fully open the panel only on 15 December 1964, but by then the time for the first midcourse correction to fly by Mars had already passed. Additionally, between communications sessions, there had been a failure in the onboard programmed timer immediately after transinterplanetary injection that led to inappropriate thermal conditions for the spacecraft. On 18 December, before loss of contact, Zond 2 successfully fired six plasma electric rocket engines (twice) as a technology demonstrator for future deep space missions. The spacecraft was to have flown by Mars on 6 August 1965. It eventually entered heliocentric orbit.