NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. 755-8370
755-8347

FOR RELEASE: UPON RECEIPT

Richard T. Mittauer
(Phone: 202/755-3680)

PROJECT: MARINER 9

PRESS KIT

contents

- more -

October 22, 1971

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MARINER 9 MARS ENCOUNTER -- NOVEMBER 13

Man will have his first opportunity for a lengthy look at another planet, other than earth, with daily and seasonal changes in its atmosphere and on its surface when a United States spacecraft is injected into orbit around Mars on November 13.

After a 400-million kilometer (248-million mile) journey from launch at Cape Kennedy on May 30, Mariner 9 will fire an onboard rocket for about 15 minutes to insert it into orbit around Mars. All previous U.S. planetary spacecraft have attained only brief views of Mars on fly-by missions.

Also aimed at increasing man's knowledge of Mars are two Russian spacecraft, Mars 2 and 3, now nearing the planet to climax journeys that began with their launches on May 19 and May 28. NASA and the Academy of Sciences of the USSR recently agreed to rapid exchange of findings of special interest by the U.S. and Soviet probes.

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October 22, 1971

The National Aeronautics and Space Administration has planned for Mariner a basic 90-day mission of returning scientific data from Martian orbit. Mariner's mission is being managed for NASA by its Jet Propulsion Laboratory, Pasadena, California.

In the 90-day basic mission, two television cameras will take more than 5,000 pictures of the Martian surface -- mapping more than 70 percent of the planet's surface and repeatedly photographing areas of interest.

Three other instruments, measuring invisible radiation from Mars in ultraviolet and infrared, will provide additional information on the planet's surface -- its temperature, composition, and altitude profile -- and on its atmosphere -- its composition, structure, temperature and pressure.

Two other scientific experiments will measure variations in Mariner's radio signal to study the Martian atmosphere and to measure the planet's orbit around the Sun, the orbit of its two moons and its gravitational field.

In orbit around Mars, Mariner also will be able to provide the first pictures showing the surface of Mars' two tiny moons, Deimos and Phobos.

On November 13, Mariner will be aimed for a preliminary orbit around Mars with a period of about 12 and 1/2 hours, a periapsis (low point) of 1,350 kilometers (800 miles) and an apoapsis (high point) of 17,700 kilometers (11,000 miles). The planned refined orbit for the bulk of the 90-day basic mission will be an 11.98-hour orbit with an apoapsis of 16,800 kilometers (10,500 miles) and a periapsis of about 1,200 to 1,280 kilometers (750 to 800 miles).

The orbit will be inclined about 65 degrees to the Martian equator so that more than 80 percent of the planet can be mapped.

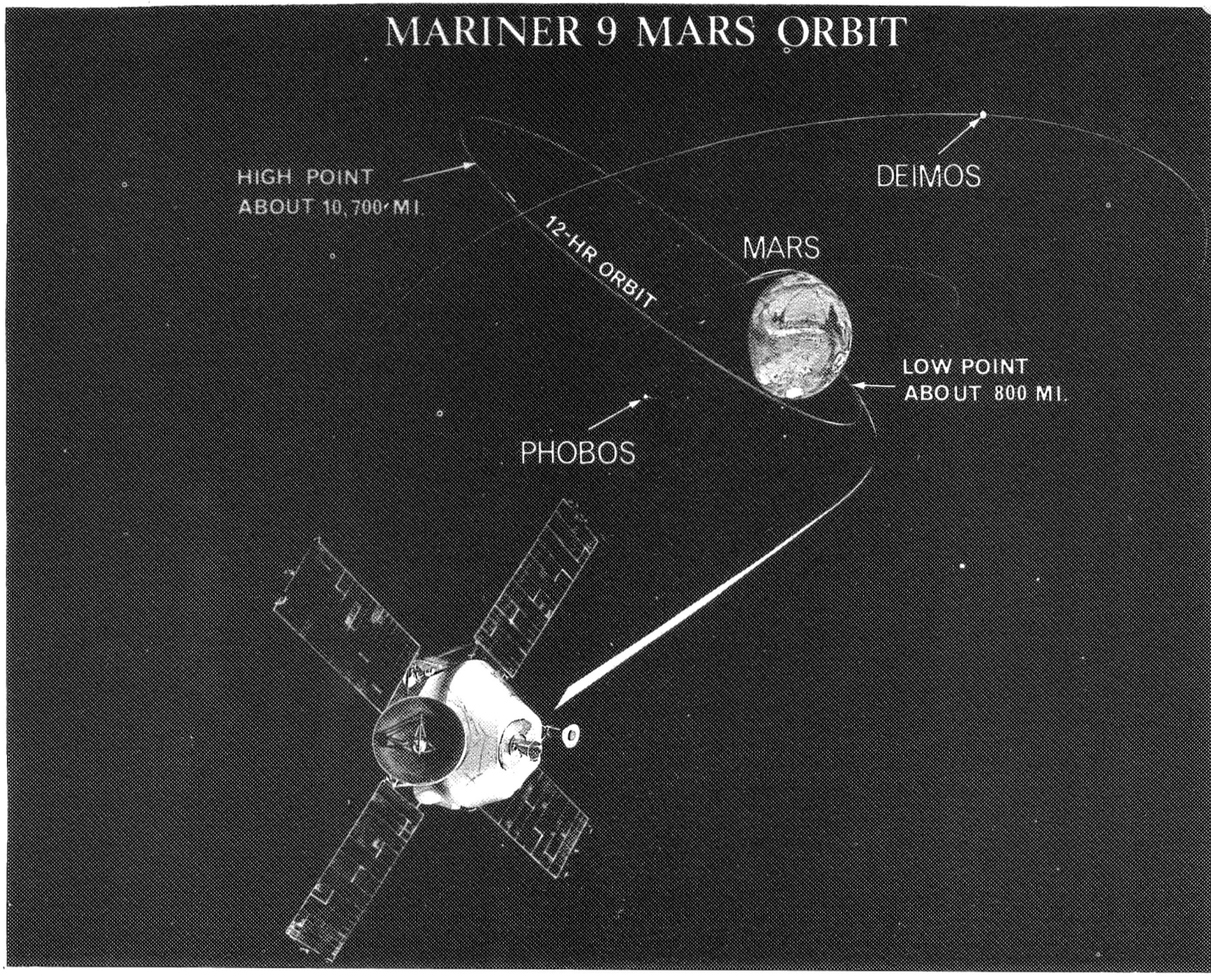
The final orbit will be achieved several days after orbit insertion. It may require up to three orbit trims to establish the desired period and periapsis.

Both orbit insertion and orbit trim will be performed with the onboard 660 kilogram (300 pound) thrust rocket engine.

Orbit insertion will require approximately a 15-minute engine burn to slow the spacecraft sufficiently to allow the Martian gravitational field to pull the Mariner into orbit. Orbit trims will require only brief engine firings.

The approach velocity will be approximately 18,000 kilometers (11,185 miles per hour), relative to Mars. Burning of the engine will reduce this velocity to about 12,500 kilometers (7,830 miles per hour).

- more -


MARINER 9 MARS ORBIT
HIGH POINT
ABOUT 10,700 MI.
12-HR ORBIT
DEIMOS
MARS
LOW POINT
ABOUT 800 MI.
PHOBOS

PRE-ENCOUNTER PHASE

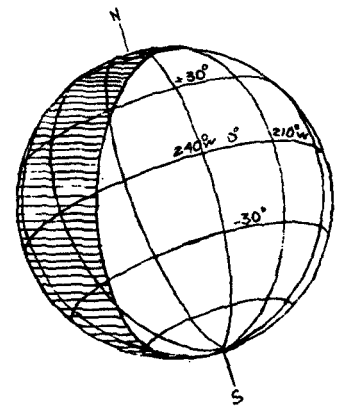
Prior to orbit insertion Mariner will transmit to Earth three sequences of approach pictures of Mars. This photography will begin on November 10 at about 2 p.m., PST, with the first playback, of 31 pictures, occurring about 24 hours later on Thursday, November 11. The range for these pictures will be from 861,000 to 571,000 kilometers (535,000 to 355,000 miles) from Mars. Twenty-five pictures of Mars and six pictures of the Martian moon Deimos will be included.

The second playback will be on November 12, at about 7:15 p.m., PST, range, 523,000 to 257,000 kilometers (325,000 to 160,000 miles). Twenty-four pictures of Mars and seven Deimos pictures. The third playback will begin on November 13, at about 7 p.m., PST, following orbit insertion. Range 210,000 to 113,000 kilometers (130,000 to 70,000 miles). Twenty-three pictures of Mars and two Phobos, six Deimos pictures.

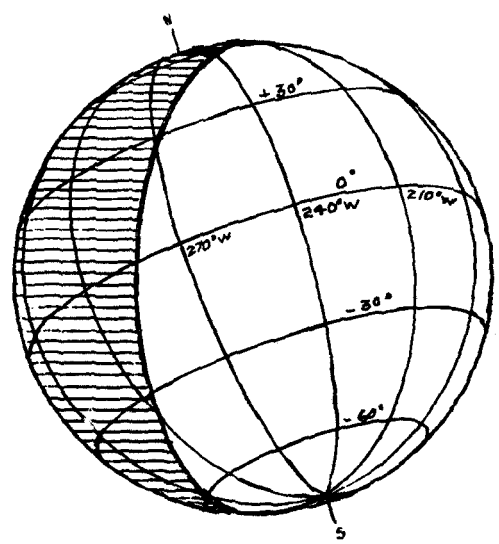
Photography on each of the first two sequences will be timed to provide coverage of a complete revolution of Mars as it revolves in front of the approaching spacecraft. With the exception of a single, low-resolution picture of Phobos taken on the Mariner 6 and 7 missions in 1969, the Martian moons have been seen or photographed, from Earth, only as pinpoints of light.

Approach photography of the moons will provide refinements of the orbital paths and velocity measurements calculated from Earth. This data will be utilized later to accurately aim the TV cameras at the moons for relatively close range photography while in orbit around Mars.

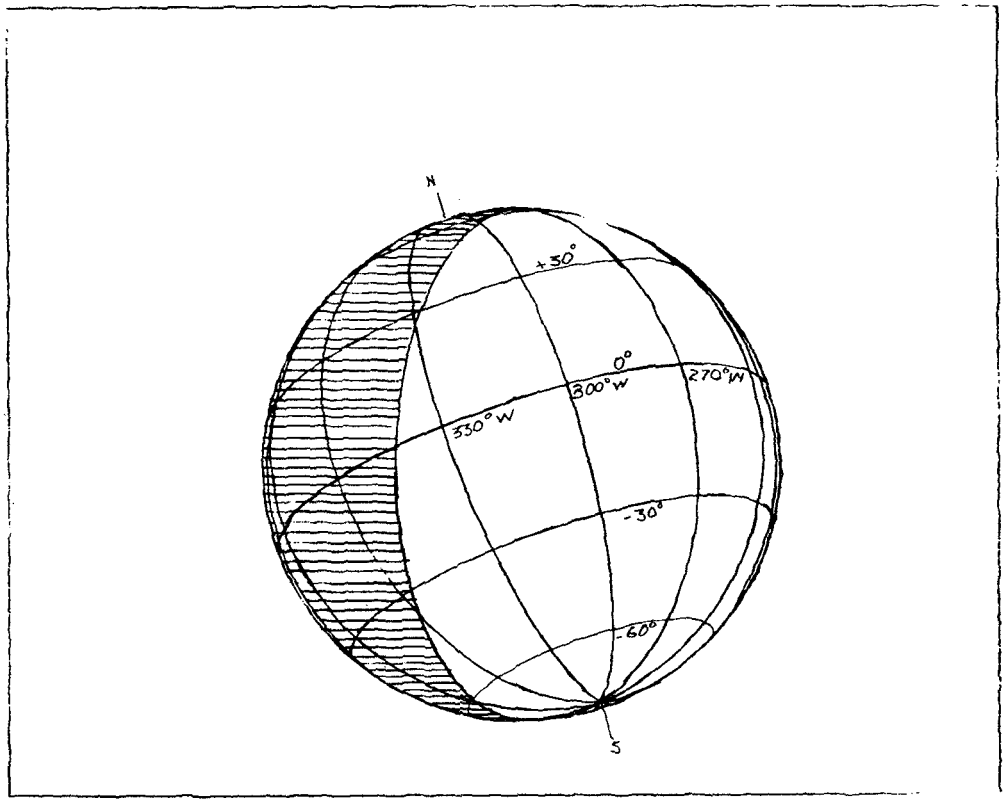
- more -



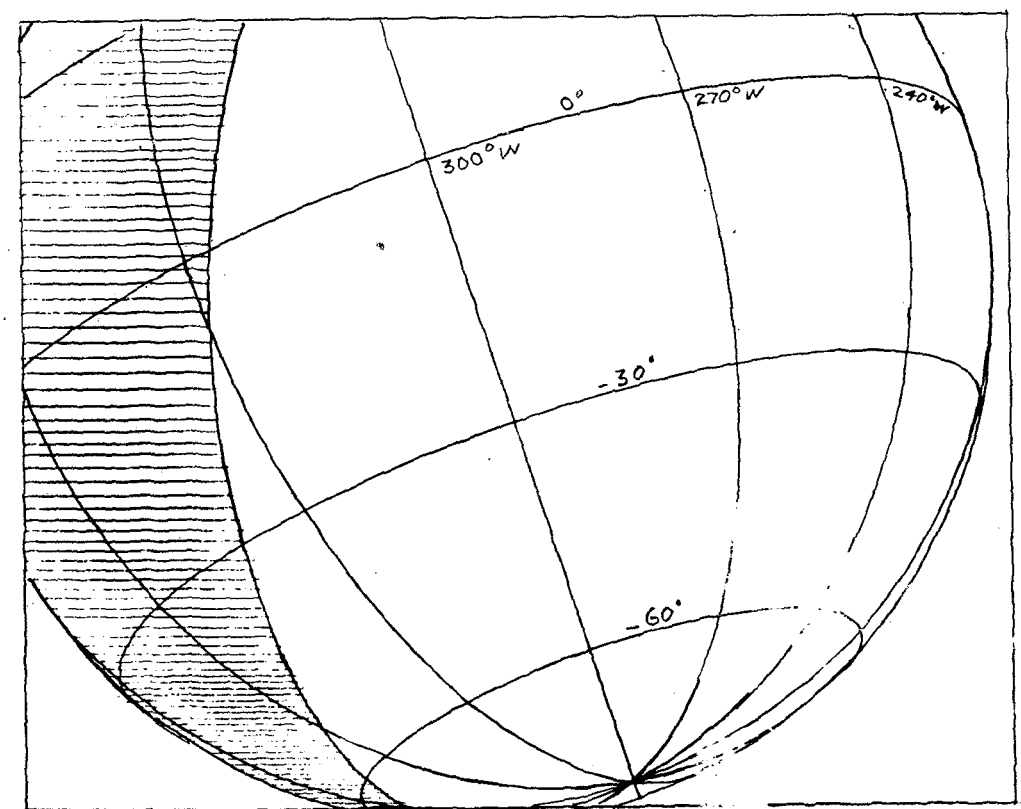
PRE-ORBIT SEQ. 1, FRAME 1
APPROX. RANGE: 525,000 MI.



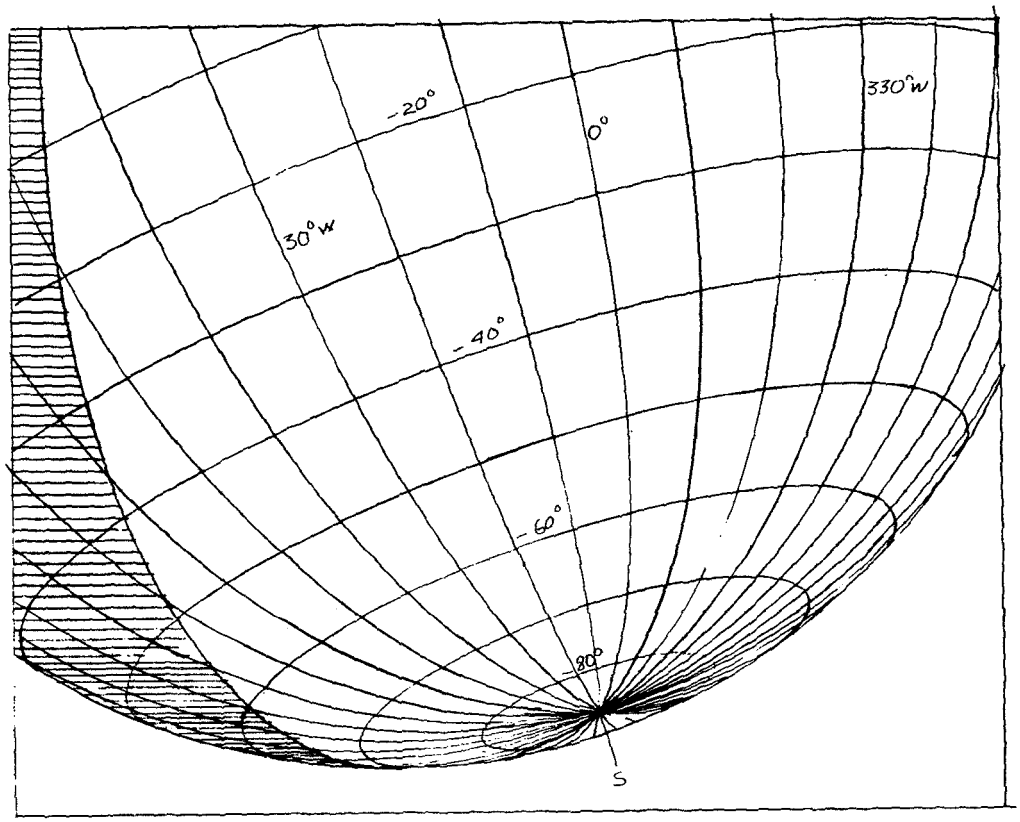
PRE-ORBIT SEQ. 1, FRAME 31
APPROX. RANGE: 355,000 MI.



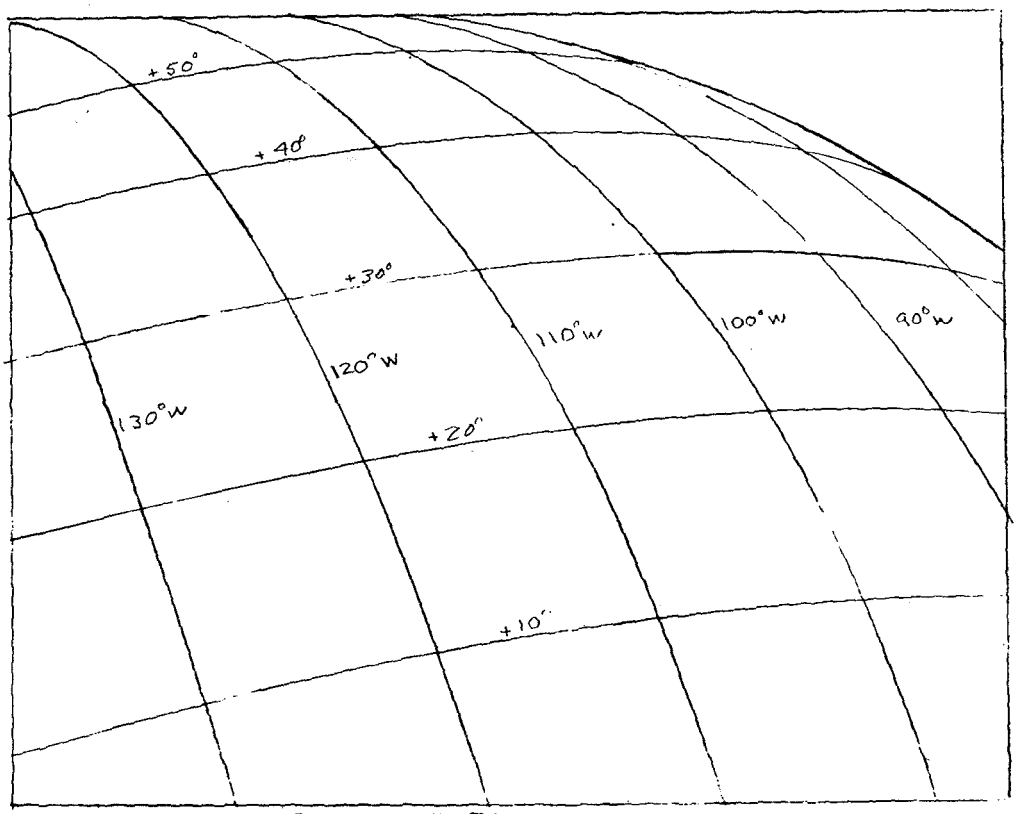
PRE-ORBIT SEQ. 2, FRAME 1
APPROX. RANGE: 325,000 MI.



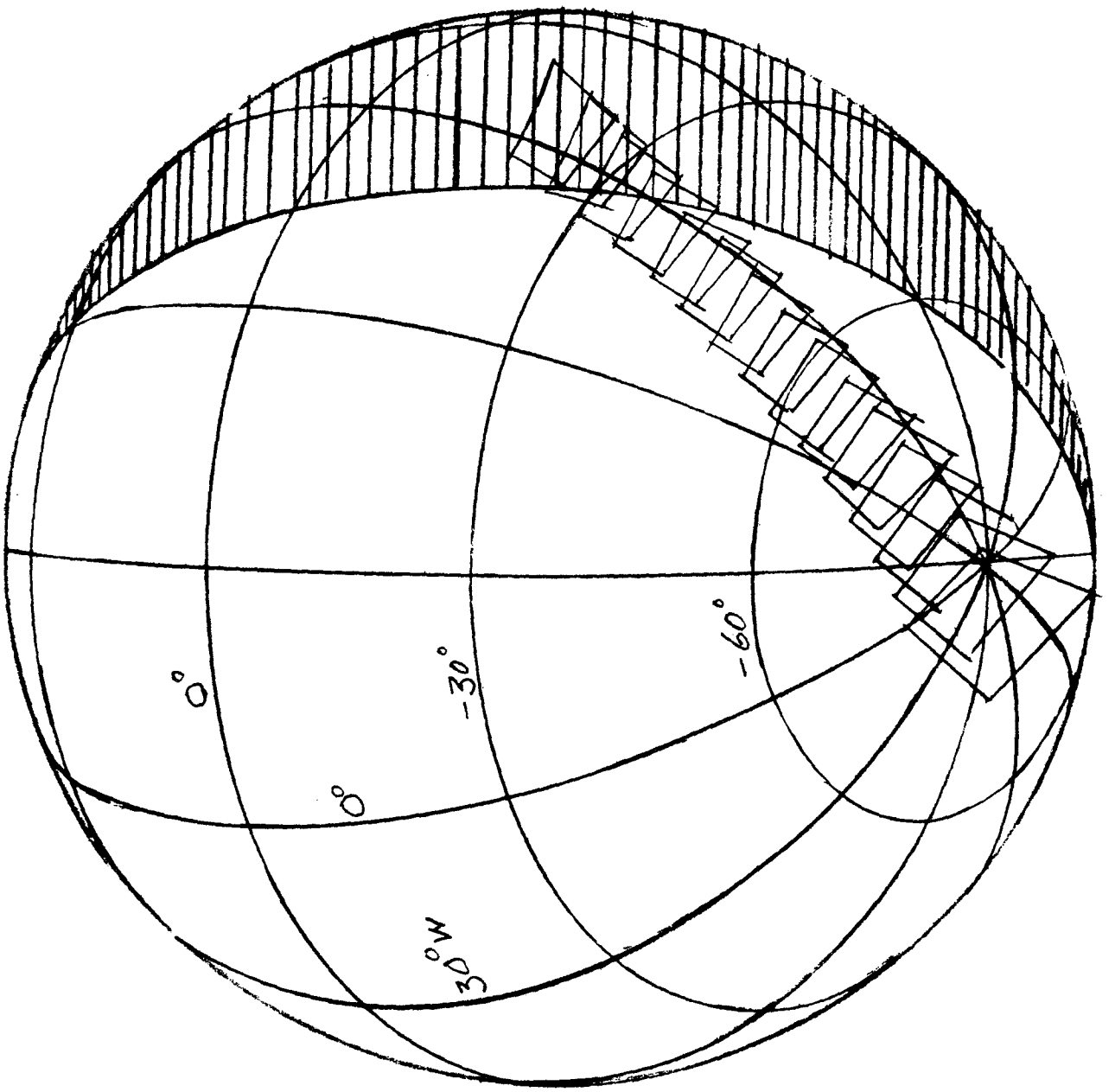
PRE-ORBIT SEQ. 2, FRAME 30
APROX. RANGE: 160,000 MI.



PRE-ORBIT SEQ. 3, FRAME 4
APPROX. RANGE: 87,000 MI.



PRE-ORBIT SEQ, 3, FRAME 31
APPROX. RANGE: LESS THAN 75,000 MI.



ORBIT I

ORBITAL OPERATIONS

The Mars orbit for Mariner 9 was selected to place periapsis in the middle of the view period (after orbit trim) of the 64-meter-diameter (210-foot) antenna of the Deep Space network at Goldstone in the California Mojave Desert, about 240 kilometers (150 miles) northeast of JPL. Only the 64-meter antennas of the DSN can receive at 16,200 bits per second.

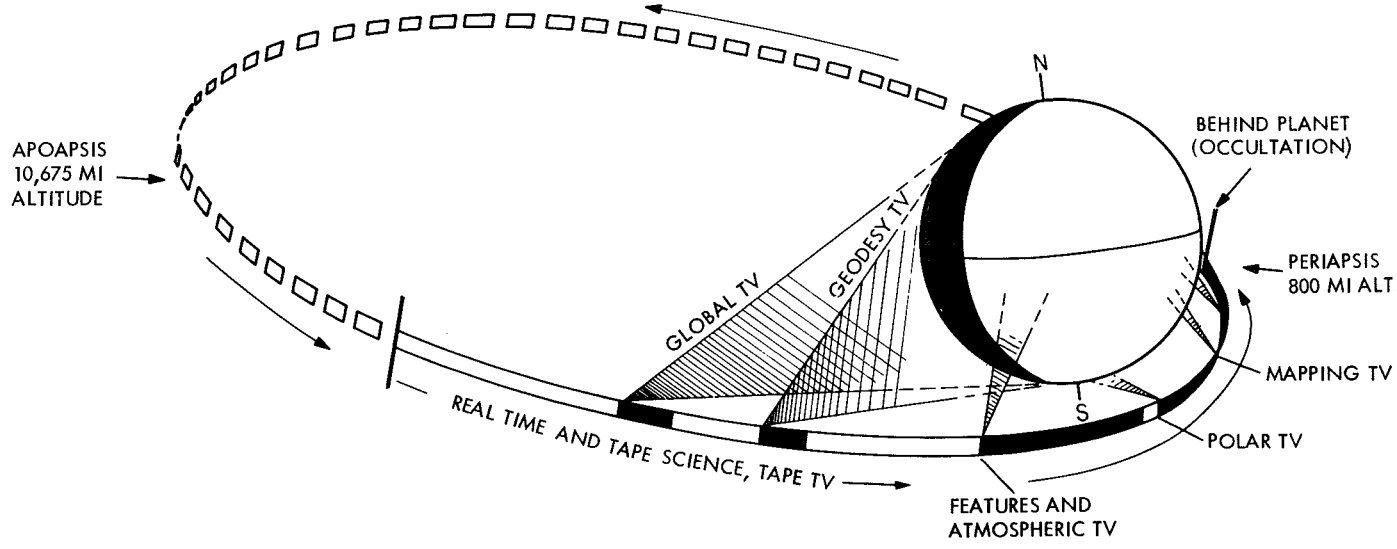
Goldstone will view Mars each day from about 1 p.m. to 11 p.m., PST, during one of the two daily spacecraft orbits of Mars. During that time, Mariner 9 will transmit two tape-loads of TV and other science data. The first tape-load will have been taken and stored on the tape recorder on the previous orbit when Mars was not in view of Goldstone. The second tape-load will be taken and transmitted during the Goldstone view period.

Each tape-load, requiring three hours to transmit, will have about 30 TV pictures and data from:

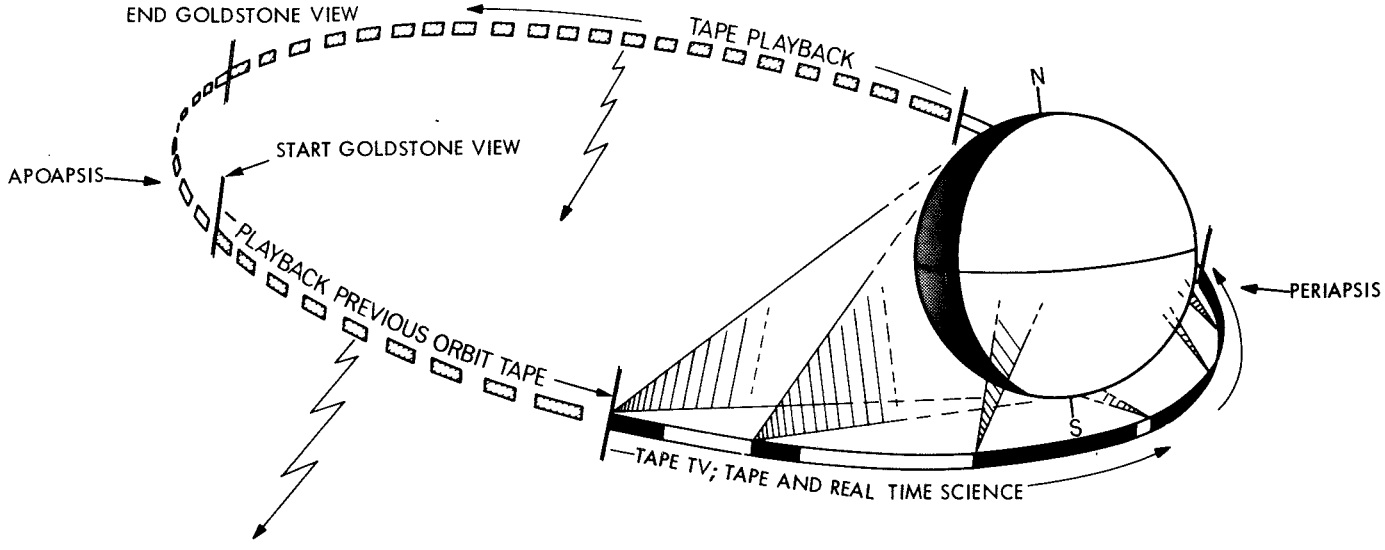
the Infrared Interferometer Spectrometer; study of the planet's surface and composition, atmospheric composition, temperature, pressure and water content, Infrared Radiometer; surface temperature measurements, and Ultraviolet Spectrometer; atmospheric composition, structure and pressures.

MARINER 9 MARS ORBIT

(12 HR PERIOD)



ORBITAL EVENTS OVER FOREIGN STATIONS



ORBITAL EVENTS OVER GOLDSTONE, CAL

All the instruments are bore-sighted with the TV cameras to allow close correlation of data.

Two additional experiments do not require instruments -- occultation and celestial mechanics. Occultation data including atmospheric pressure is derived from atmospheric effects on the radio signal as the spacecraft passes behind Mars and the signal passes through the Martian atmosphere. The celestial mechanics experiment will include measurements of the orbit of the two moons, the Martian gravitational field and the ephemeris of Mars (its position at a given time in solar orbit). The measurements are derived from tracking data.

The first playback of data taken from orbit will begin at 6:57 a.m., PST, Sunday, November 14. The first ten pictures will be relayed to JPL by cable from the Robledo tracking station near Madrid at 2,025 bits per second. The playback will require six hours, 34 minutes to complete.

The remainder of the first orbit tape will be received at the Goldstone station at 16,200 bits per second. These first orbital pictures will be a mapping sequence. The transmission sequence will begin at 2:37 p.m., PST, and conclude at 4:55 p.m.

The second orbit pictures, also to be played back Sunday, November 14, from 6:40 p.m. to 9:55 p.m., PST, will most likely include more mapping frames as will all sequences prior to orbit trim. Following orbit trim, full science will be conducted.

Orbit 3 transmission time is 2:22 p.m., PST, Monday, November 15, to 5:37 p.m., PST.

Orbit 4 pictures will be transmitted between 7:39 p.m. and 10:54 p.m., PST, Monday, November 15.

Orbit 5 playback will occur, after the scheduled orbit trim, on Tuesday, November 16 between 8:32 p.m. and 11:47 p.m., PST.

There will be no photography on Orbit 6 due to the orbit trim, now planned for 7:00 p.m., November 16.

Orbit 7 pictures, to be transmitted to Earth from 1:46 p.m. to 4:56 p.m., PST, November 17, will be a repeat of the first orbit photography -- a swath of mapping pictures north from the South Pole. The first "full science" sequence will be conducted on the eighth orbit, also on November 17. This sequence includes global, geodesy, polar edge atmospheric and mapping pictures.

Although each day's orbital operations have been planned in advance, a daily science team meeting will be held, prior to the Goldstone view period, to capitalize on the flexibility of an orbital flight mission.

Analysis of photography from the previous orbits and computer-generated correlation with the other science instruments will allow scientists to react to an opportunity to study unusual or unexpected surface or atmospheric phenomena.

A typical orbit provides photographic options for global, geodesy, polar, variable surface features, mapping, and atmospheric pictures, use of various filters, photography of the two moons, real-time transmission of spectral data from the spectrometers and radiometer, occultation measurements of the Martian atmosphere, ultraviolet spectrometer recording of Lyman alpha emissions, night side recording of data by the spectral instruments, and Doppler and ranging data for the celestial mechanics experiments.

The exact mix of data to be taken on each orbit, although pre-scheduled, is optional. The attached chart gives the scheduling for the first portion of the mission. Note that "full science" sequences begin after orbit trim, tentatively scheduled for Tuesday, November 16.

The basic 90-day mission will yield a map of 70 percent of Mars with wide angle camera at a resolution of one kilometer (3,000 feet). Narrow angle pictures, at a resolution of 100 meters (300 feet), will nest inside the wide angle pictures.

The Martian North Pole will not be visible to the spacecraft in the 90-day period of the basic mission. It will be soon after, however, and coverage of the Pole would be included in any plans for an extended mission.

Phobos and Deimos will be photographed and data taken by the spectral instruments from orbit at ranges from 5,000 kilometers to 8,000 kilometers (3,000 to 5,000 miles). Any surface markings should be visible.

The ultraviolet spectrometer will provide a pressure map and thus an altitude map of the surface which can be correlated with the photographs. The resolution of this instrument will permit pressure mapping and analysis of atmospheric constituents inside larger craters.

Photography of the South pole will stress studies of a number of features including ridge-like structures seen in the Mariner '69 pictures termed "circumpolar quasi-lineal features." Much of the polar snow (carbon dioxide with possibly a trace of water ice) seen in the 1969 Mariner pictures will have disappeared to reveal the underlying features.

MARS SCIENCE

Mars is a constantly changing world with seasonal and daily variations that have been observed with difficulty from Earth and only briefly by three previous fly-by spacecraft.

In this orbiting mission a battery of instruments will probe the planet on a daily basis for three months and possibly longer.

The surface will be examined by photography and in the infrared wavelengths. The atmosphere will be examined in the ultraviolet and infrared and by the occultation experiment.

From the top of the thin Martian gas envelope down to the surface and the interior of craters, the atmospheric instruments will record data to identify gases, plot the mixture of constituents and variations relative to time and area.

The instruments will view an early winter atmosphere and surface in the North and early summer in the South.

The information gathered should provide a broad picture of the factors that shape physical processes at work on Mars. The questions to be answered range from daily Martian weather patterns to the history of the formation of the planet and how its evaluation compares with that of Earth.

The cutting edge of this mission is not only the opportunity to examine Mars in detail on a daily basis but is also the carefully planned correlation of data from the instruments to yield more than the sum total of the parts.

For example, the ultraviolet experiment and the two infrared experiments are bore-sighted with the two TV cameras. The ultraviolet and infrared spectrometers in probing the atmosphere, provide an elevation profile of the surface under the scan path. This in turn, can be correlated with other data as was the case in the 1969 Mariner flight.

A photograph can be correlated with temperatures on the surface and the pressure and constituents of the atmosphere above the area photographed. A physical feature on the surface can thus be related to other data obtained.

Past observations have established the presence of clouds, hazes, bright spots and flares of light on the surface. Yellow clouds, thought to be dust, can grow large enough to obscure a large portion of the face of Mars and last a month or two. White clouds range from a haze, lasting a few hours, to huge dense clouds persisting for days or weeks. Dark grey clouds have been reported and thought to possibly be volcanic in origin. Four were reported in 1950 and 1952. Flares seen on the surface have also been attributed to possible volcanic activity.

Study of these phenomenona by the combined instrument package is an objective of the mission.

Another specific scientific objective is a study of the "wave of darkening." Observations from Earth have established that there is an apparent seasonal darkening of features on Mars but if it progresses at a regular rate in a waveform is, today, open to question.

The spacecraft will arrive at Mars at the peak of the darkening period in the Southern hemisphere. It will be observed at its maximum intensity and can be compared with observations in the Northern hemisphere and with Earth-based telescope observation.

The water content of the Martian atmosphere is known to be extremely low, similar to the dry Antarctic. But it is possible that free water was frozen in the past and remains under the surface like perma-frost. Heat escaping from the interior of Mars could melt the ice and provide a water source. If so, such an area would be a prime target for the Viking Lander that will seek evidence of life on Mars in 1976.

In the low pressure of the Martian atmosphere, however, water can only exist in a frozen or vaporous state with perhaps a short lived intermediate state that could moisten the soil. In the event of underground ice melting there is, then a possibility of a cloud forming over the area. Photography of such a cloud correlated with water vapor and temperature measurements could indicate an area suitable for life forms.

The mapping of Mars in this mission is a basic objective. It is essential in the study of a planet to establish a three dimensional shape of the planet, the figure. A persistent discrepancy exists between optical observations from Earth and data derived from the orbits of the two moons of Mars and spacecraft fly-by trajectories.

Studies of the Mariner 9 data may resolve that question and will establish the Martian geoid, a standard spherical reference surface for mapping. On Earth, the geoid coincides with mean sea level in the oceans.

Discrepancies of five to 10 degrees in latitude and longitude, 290 to 610 kilometers (180 to 380 miles) at the surface, are not uncommon between various published maps of Mars. A recently completed 10-year Mars Map Project, using all Earth-based visual and photographic data from 1877 to 1958 may have reduced errors to about one degree, or 50 kilometers (31 miles), in regions where well defined surface markings (i.e., albedo variations) are available. One of the major mapping applications of the wide-angle camera photography will be to precisely locate surface markings to an accuracy of approximately 1.6 kilometers (one mile).

Data from Mariners 6 and 7 have been used to establish a central grid with uncertainties in the order of 10 kilometers (6 miles).

MARS FACT SHEET

Diameter	6,742 kilometers (4,190 miles)
Inclination	24.9 degrees
Rotational Speed	0.26 kilometers per sec. (0.16 miles per sec.)
Mean Distance from Sun	228,000,000 kilometers (141,500,000 miles)
Distance from Earth	
maximum	398,887,000 kilometers (247,900,000 miles)
minimum	55,784,000 kilometers (34,670,000 miles)
Orbital Speed (average)	77,000 kilometers per hour (48,000 miles per hour)
Martian Year	687 days, 23 hours

Moons (discovered 1877)	Phobos	Deimos
Est. Diameter	19 kilometers (12 miles)	10 kilometers (6 miles)
Distance from Mars	6,100 kilometers (3,750 miles)	19,000 kilometers (12,000 miles)
Period	7 hr. 39 min.	1 day, 6 hr., 17 min.
Orbit Inclination	0.57'	1^{o} 18'

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MARINER 9 SCHEDULE MARS NOVEMBER, 1971

DAY	DATE	TIME (PST)	EVENT	TAKE TV PICTURES (hr:min)	PLAYBACK & DISPLAY TV (hr:min)	REMARKS
M	11/8	8:00 AM	OPEN PRESS ROOM AT JPL			
M	11/8	3:16 PM** 5:48 PM**	START MARS TV CALIBRATION SEQUENCE #1 END MARS TV CALIBRATION SEQUENCE #1	27 pics 2:32		5 "A" Camera pictures (wide-angle); 22 "B" Camera (narrow angle). All pics played back to Goldstone @ 16,200 bps.
M	11/8	6:36 PM 9:17 PM	START PLAYBACK TV CAL. SEQ. #1 END PLAYBACK TV CAL. SEQ. #1		27 pics 2:41	
Tu	11/9	2:56 PM** 6:10 PM**	TAKE MARS TV CAL. SEQ. #2 END MARS TV CAL. SEQ. #2	28 pics 4:14		2nd series calibration pics; 28 "A" frames. Receive one picture each 5 min., 42 sec.
Tu	11/9	7:06 PM 10:03 PM	START PLAYBACK MARS TV CAL. SEQ. #2 END PLAYBACK MARS TV CAL. SEQ. #2		28 pics 2:57	
W Th	11/10 11/11	2:17 PM** 2:56 PM**	TAKE FAR ENCOUNTER TV -- POS-1 END POS-1 (PRE-ORBIT SCIENCE-1)	31 pics 24:39		25 Mars pics thru one Martian day. 6 pics of Deimos. Range 535,000 to 355,000 miles.
Th	11/11	3:16 PM 6:23 PM	START PLAYBACK POS-1 END PLAYBACK POS-1		31 pics 3:07	
Th F	11/11 11/12	7:02 PM** 6:54 PM**	TAKE POS-2 END POS-2	31 pics 23:52		One Mars pic each hour for 24 hours. 7 pics of Deimos. Range 325,000 to 160,000 miles.
F	11/12	7:16 PM 10:23 PM	START PLAYBACK POS-2 END PLAYBACK POS-2		31 pics 3:07	
F Sa	11/12 11/13	10:30 PM** 8:07 AM**	TAKE POS-3 END POS-3	31 pics 9:37		Range 130,000 to 70,000 miles. Two Phobos; 6 Deimos.
Sa	11/13	4:17 PM** 4:24 PM 4:32 PM** 4:39 PM	ENGINE START -- ORBIT INSERTION BURN ENGINE START -- GROUND RECEIVE SIGNAL ENGINE CUTOFF -- MARINER 9 in ORBIT ENGINE CUTOFF -- GROUND RECEIVE SIGNAL			Rocket engine fires for 15 1/2 minutes at 300-pounds thrust. Slows s/c by 3600 mph. One-way light time is 6m., 43s.
Sa	11/13	4:42 PM**	1ST PERIAPSIS -- ORBIT #0			Altitude 750 to 800 miles.
Sa	11/13	4:46 PM 5:22 PM	ENTER OCCULTATION -- LOSE SIGNAL at EARTH EXIT OCCULTATION -- REACQUIRE SIGNAL			Mars between s/c and Earth. Occurs each orbit till 12/22.
Sa	11/13	7:37 PM 11:02 PM	START PLAYBACK POS-3 END PLAYBACK POS-3		31 pics 3:25	Final far-encounter pics for Mars mosaics; 8 moon pics.
Su	11/14	4:41 AM** 5:05 AM**	START 1st ORBIT TV END 1st ORBIT TV	33 pics 0:24		One pic each 42 seconds. Mapping pass from South Pole.
Su	11/14	5:08 AM**	PERIAPSIS -- ORBIT #1			Achieve 12.5-hr. Mars orbit.
Su	11/14	6:57 AM 1:37 PM	START PLAYBACK ORBIT #1 TV (10 PICS) END PLAYBACK ORBIT #1 TV		10 pics 6:34	Playback first 10 pics to Spain @ 2025 bps. 45 min. per pic.
Su	11/14	2:37 PM 4:55 PM	RESUME PLAYBACK ORBIT #1 TV END PLAYBACK ORBIT #1 TV		23 pics 2:18	Resume 16,200 bps rate to Goldstone. One each 5 m., 42s.
Su	11/14	5:00 PM** 5:34 PM** 5:37 PM**	START 2nd ORBIT TV PERIAPSIS -- ORBIT #2 END 2nd ORBIT TV	33 pics 0:37		First 16 pics "phase function" experiment with A & B cameras. 17-picture A & B mapping pass.
Su	11/14	6:40 PM 9:55 PM	START PLAYBACK ORBIT #2 TV END PLAYBACK ORBIT #2 TV		33 pics 3:15	
M	11/15	3:45 AM** 6:00 AM** 6:08 AM**	START 3rd ORBIT TV PERIAPSIS -- ORBIT #3 END 3rd ORBIT TV	32 pics 2:23		Ten wide-angle (A) frames for calibration; six wide-angle pics of South Pole; 16 wide-angle pics on night side.
M	11/15	2:22 PM 5:37 PM	START PLAYBACK ORBIT #3 TV END PLAYBACK ORBIT #3 TV		32 pics 3:15	
M	11/15	5:51 PM** 6:25 PM** 6:28 PM**	START 4th ORBIT TV PERIAPSIS -- ORBIT #4 END 4th ORBIT TV	33 pics 0:37		First 16 pics "phase function" experiment with A & B cameras. 17-picture A & B mapping pass.
M	11/15	7:39 PM 10:54 PM	START PLAYBACK ORBIT #4 TV END PLAYBACK ORBIT #4 TV		33 pics 3:15	
Tu	11/16	4:36 AM** 6:51 AM** 7:00 AM**	START 5th ORBIT TV PERIAPSIS -- ORBIT #5 END 5th ORBIT TV	32 pics 2:24		10 A frames for calibration; 6 A pics of South Pole; 16 pics on night side.
Tu	11/16	6:46 - 7:16 PM**	ENGINE BURN -- ORBIT TRIM MANEUVER			New orbit period: 11.98 hrs.
Tu	11/16	7:16 PM**	PERIAPSIS -- ORBIT #6			
Tu	11/16	8:32 PM 11:47 PM	START PLAYBACK ORBIT #5 TV END PLAYBACK ORBIT #5 TV		32 pics 3:15	Playback calibration, South Pole, night side.
W	11/17	6:46 AM** 7:10 AM** 7:13 AM**	START 7th ORBIT TV END 7th ORBIT TV PERIAPSIS -- ORBIT #7	31 pics 0:24		Mapping sequence from South Pole (similar to Orbit #1).
W	11/17	1:48 PM 4:56 PM	START PLAYBACK ORBIT #7 TV END PLAYBACK ORBIT #7 TV		31 pics 3:08	
W	11/17	5:05 PM** 7:12 PM** 7:12 PM**	START 8th ORBIT TV PERIAPSIS -- ORBIT #8 END 8th ORBIT TV	33 pics 2:07		First post-trim "full science" sequence: global, geodesy, polar edge atmospheric. UVS limb and mapping pics.
W	11/17	8:12 PM 11:20 PM	START PLAYBACK ORBIT #8 TV END PLAYBACK ORBIT #8 TV		33 pics 3:08	

**Spacecraft event times. All others are "Earth Receive" times. (e.g. One-way light time at 3 p.m. Nov. 8 is 6 min., 20 sec.; At time of orbit insertion on Nov. 14, 6 min., 43 sec.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JET PROPULSION LABORATORY
10/27/71