SPACE

Earth to Mars in 229 Days

Mariner 4 will have traveled more than 325 million miles when it reaches Mars on July 14, takes television pictures, and then passes beyond the planet—By Jonathan Eberhart

See Front Cover

➤ THE LONGEST recorded journey in the history of man will reach its goal on Wednesday, July 14—and keep on going.

The Mariner 4 spacecraft, launched Nov. 28, 1964, will have covered more than 325 million miles in order to take a few television pictures and transmit some experimental radio signals. Together, these two activities should add a great deal to man's sketchy knowledge of the planet Mars.

A little after dinnertime, at 8:00 p.m. (EDT), Mariner's camera, which will have been automatically aimed many hours before, will take its first picture. Diagram of the picture-taking sequence is shown on this week's front cover.

As many as 21 pictures will be taken and stored on magnetic tape before they are played back to receivers on earth. This is necessary because the recording is many times faster than the playback rate.

Mariner has had an interesting flight, during which it has faced many hazards and set many records.

Here is a brief history:

In less than three and a half weeks of flight. Mariner 4 had already passed through two streams of meteoroids.

In exactly one month after launch, the spacecraft had passed the 50-million-mile mark, and made nearly 10 million separate data measurements of the space around it.

data measurements of the space around it. On the first Sunday of 1965 (Jan. 3), at one minute before noon (EST), the data transmissin rate from the spacecraft was reduced by 75%, from 33-1/3 bits per second to 8-1/3 bits per second. This was necesary in order to keeps the transmissions coming clearly as Mariner traveled further and further into space.

During the tenth week of the flight, earth "moved ahead" of Mariner; that is, it moved ahead in its orbit of a line between Mars and the sun. Earth would stay ahead of the spacecraft throughout the rest of the flight.

on Feb. 27, Mariner passed the 150 million mile mark.

A tragedy: just as scientists announced that they had figured out how to use data from the solar plasma probe, which had developed a malfunction during the first week of flight, another experiment—the ion chamber—went awry. The Geiger-Mueller tube in the ion chamber "went delirious," perhaps as a result of an "overdose" of electrons from a recent large solar flare.

Two days later, on March 5, Mariner switched its transmissions to a narrow-beam

antenna, called "high gain" because it compresses the signal into a smaller path, boosting the signal strength. This was Mariner's last ace-in-the-hole for improving long-distance reception.

By March 11, Mariner 4 had covered half the length of its flight.

A week later, the ailing ion chamber stopped providing data altogether.

The halfway mark for time of flight was reached on Monday, March 22.

On Tuesday, April 6, Mariner set a record for continuous operation of an American deep-space probe—130 days—breaking the record of its predecessor, the Mariner II Venus probe in 1963.

On April 29, another record was set, this time a world record for long-distance communication. Mariner's new mark, 66 million miles (although its record is now almost five times that) eclipsed that of the 1963 Soviet vehicle called Mars I.

One quarter of a billion miles of flight—that unbelievable point was reached on May 12.

Two weeks and a day later, Mariner reached a distance from earth of one astronomical unit from earth, equal to the mean distance of the earth from the sun, or about 93 million miles (though it had actually traveled much farther).

Now...the moment approaches. On the Big Day (July 14) Mariner's sensors will start searching the sky for Mars at 11:41 a.m. (EDT). Commands will flash back and forth between earth and the spacecraft checking and rechecking the TV camera's orientation. This is a problem because at this great distance every command from earth, and every reply from Mariner, takes more than 11 minutes to reach its destination—even at the speed of light!

The actual picture-taking will take only 25 minutes, but the playback will require 10 days.

One hour and 27 minutes after the last picture is made, Mariner will pass "behind" Mars on the side away from earth, and data transmission will stop. About 53 minutes after that, the spacecraft will reappear and the radio signal will resume.

By measuring the exact time of the signal lapse, as well as the signal strength just before and just after Mars blocks the path, scientists hope to learn something about the density of the Martian atmosphere. Such information is vitally important in planning any sort of Mars landing mission. (Should a landing vehicle be a rocket? Should it have wings? How much heat will be caused by friction?)

Only three tracking stations, with three on standby in case of emergency, are monitoring Mariner's flight. By the time the vehicle approaches Mars, no closer than about 5,600 miles, the signal strength will be down to .00000000000000000000000 watt. Despite equipment failures, meteor showers, solar flares, and perhaps even "little green men," Mariner seems to be doing just fine.

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A MARINER'S-EYE VIEW—On July 14, three NASA tracking stations spaced around the globe will use huge parabolic antennas like the one above (right) to receive television images of Mars like the ones above (left), sent from millions of miles away by the Mariner IV spacecraft.