



ASTRONAUTS LOVELL, ANDERS & BORMAN
Farther from home than any men before.

SPACE

Christmas at the Moon

The U.S. has sent 17 manned missions into space, but none has been as ambitious or adventurous as the next one on NASA's schedule. If all goes well, on the morning of Dec. 21 a 3,100-ton Saturn 5 will rise slowly from its pad at Cape Kennedy. Three days later, Astronauts Frank Borman, James A. Lovell Jr. and William A. Anders will be spending Christmas Eve in the spaceship Apollo 8, farther from home than any men have ever been: they will be circling the moon.

Shortly after lift-off, Apollo 8 will go into a "parking" orbit 115 miles above the earth. If mission controllers are satisfied that all the ship's systems are working properly, the final stage of the Saturn booster will be reignited during the second or third orbit. The resulting thrust will increase Apollo's speed to 24,000 m.p.h.—enough to free it from the earth's environment and send it on a curving trajectory toward the moon.

By the time Apollo approaches within 30,000 miles of its lunar target, its speed will have tapered off to 2,100 m.p.h. Then, as the moon's gravity begins to exert a stronger and stronger tug, Apollo will accelerate once more. To slow the spaceship down and place it in lunar orbit, Apollo's big engine will fire a strong braking blast. Following two circuits of the moon, the engine will be used again to move Apollo's orbit to 70 miles above the cratered lunar landscape, which the astronauts will survey and photograph. Eight revolutions later, the engine will be called on for a third—and crucial—firing. That jolt will enable the Apollo

to escape the moon's gravitational pull and start the three astronauts speeding back to earth. Just 7½ days after take-off, Apollo 8 should parachute into the Pacific. Total distance traveled (exclusive of the ten rides around the moon): nearly half a million miles.

Long Shot. For all the meticulous planning, NASA acknowledges that Apollo 8 involves greater risks than any of the previous manned space flights. Not only will the spacecraft be as many as three days away from a safe landing (v. no more than three hours in earth-orbiting missions), but it will be entirely dependent on its own propulsion system to break out of lunar orbit. If that lone engine should falter, the astronauts would be stranded, circling the moon with absolutely no hope of rescue.

That danger is a long shot indeed. Apollo's engine has been checked countless times in flight and on the ground. At the slightest hint of trouble, the mission could be safely aborted at any of a dozen points along the way. Even as Apollo nears the moon, the astronauts will still be able to make a "no-go" decision. Should the spacecraft fail to be slowed down as planned, it can simply make a high-speed loop of the moon and head back toward earth.

If NASA officials are jittery at all, it is because of heightened Soviet space activity. As NASA was announcing the Apollo flight plan, Russia's unmanned Zond 6 was heading toward its own rendezvous with the moon. The Soviets also disclosed last week that in October, Zond 5 had carried the first creatures around the moon—two turtles, some wine flies and meal worms. But the Russians were notably taciturn on details of these missions.

Some U.S. scientists speculated that with their second lunar shot in two months, the Russians might be making

last-minute preparations for sending their own cosmonauts around the moon ahead of Apollo 8. Landing on the moon is something else again. The Russians have yet to make a soft landing on an airless surface. By contrast, the unmanned U.S. Surveyor has touched down gently on the moon, and much the same system will be used in the lunar module (landing craft) that will finally take a man to the moon's crust.

After the flawless flight of Apollo 7 last month, NASA leaders are so confident of Apollo 8's success that some of them are talking about a lunar landing after only one more Apollo mission, instead of the two originally planned. After being shoved into an earth orbit early next year, Apollo 9 will practice docking with a lunar module. Soon after, Apollo 10, whose three-man crew was picked last week, will travel to the moon. Once in lunar orbit, two Apollo astronauts will descend in a lunar module to within 10 miles of the moon's surface, then return to the command ship whirling overhead. That expedition, some NASA officials in Houston suggested, may yet be changed to an actual touchdown. If so, it could place Americans on the moon as early as next spring. More likely, the lunar landfall will be made at least two months later, during the flight of Apollo 11.

TECHNOLOGY

On a Cushion of Air

Graceful as they are in the air, today's jetliners have become increasingly awkward on the ground. Taxiing under their own power, they use inordinate amounts of fuel; maneuvering them in maintenance areas and hangars is tough and time-consuming. And such troubles will only grow worse with the introduction of the 490-passenger Boeing

ROBERT W. KELLEY



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