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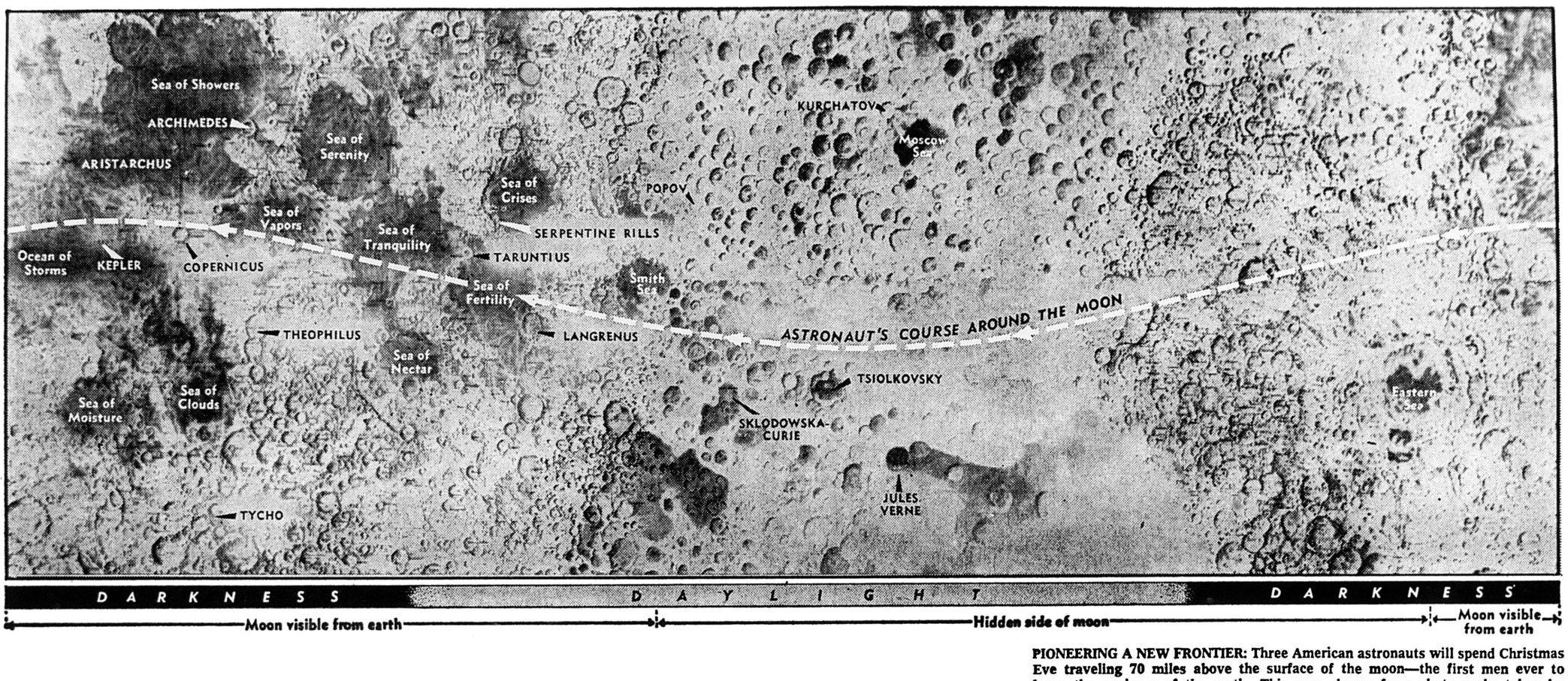

PIONEERING A NEW FRONTIER: Three American astronauts will spend Christmas Eve traveling 70 miles above the surface of the moon—the first men ever to leave the environs of the earth. This map, drawn from photographs taken by Soviet spacecraft, shows the orbital course of Apollo 8 and some important lunar features. The astronauts will see only those on the side of the moon that will be in sunlight during their flight.

To the Moon

Man Breaks His Ties to the Planet Earth

Throughout man's slow evolution to his present level of technology he has been chained to his home planet. First he ventured onto the sea, hugging the coast in the beginning but finally navigating the vast oceans.

In time, he was able to build craft that could fly in the ocean of air overhead — balloons and finally aircraft. In these he crossed the trackless polar regions and other wastes. Within the last decade he has built spacecraft that carried him into orbit around the earth. But he remained tied to this planet, skirting the upper wisps of its atmosphere and protected by its enclosing magnetic field from much of the harsh radiation of space.

Yesterday he cast loose his tie to the earth and set forth on the first voyage across the ocean of space to our nearest celestial neighbor, the moon. Aboard the Apollo 8 spacecraft, launched from Cape Kennedy in the morning, were three brave men: Col. Frank Borman of the Air Force, in command, Capt. James A. Lovell Jr. of the Navy and Maj. William A. Anders of the Air Force.

They were lifted through the atmosphere by the thundering thrust of a giant Saturn 5 launch vehicle. After almost two full orbits of the earth, the third and uppermost stage of the launch assembly gave the spacecraft its push toward the moon. Early Tuesday morning the spacecraft should pass in front of the moon, as the latter sails its slow orbit of the earth.

The astronauts are then to fire a propulsion rocket to inject their spacecraft into orbit around the moon. If the engine fails, they should have a "free ride" around the moon and back to earth, flying too fast for capture, by lunar gravity, into an orbit of the moon.

Key Test

If they do achieve such an orbit with this engine, their lives will depend on successfully restarting it after they have completed 10 circuits of the moon, about midnight Tuesday. Should the engine fail, they would be trapped indefinitely in lunar orbit with food and oxygen for only a matter of days.

The performance of this engine on the first manned Apollo flight, a 10-day mission in October, was so good that leaders of the project consider a failure highly unlikely, assuming that the engine has worked well during the first part of the flight.

Another hazard that had to be taken into account in planning this flight was that of collision with the booster that injected the manned spacecraft on its trajectory to the moon. In doing so, the booster pushed itself into the same flight path.

The astronauts cast their craft loose from the booster 20 minutes after the firing and maneuvered to a safe distance away. The booster then began to eject its remaining liquid oxygen through its rocket nozzle in such a manner as to slow its flight.

This presumably has removed any danger of collision during the maneuvers near the moon.

Another hazardous point will be the return into the earth's atmosphere at slightly more than 24,000 miles an hour—far faster than any manned re-entry to date. However, an earlier unmanned Apollo flight was driven back into the atmosphere, by rocket power, at greater speed and its blunt heat shield provided the necessary protection.

The critical element of reentry, so far as safety is concerned, is penetrating the atmosphere at the proper angle. Too steep an entry would slow the vehicle too fast, overheating and possibly disintegrating the space craft. If the angle is too shallow, the spacecraft might skip out of the atmosphere like a flat stone on water and be thrown from the vicinity of the earth.

What justification is there for the risks being taken by the men now en route to the vicinity of the moon? There have been rumbles of criticism — the flight was premature; its timing was unfortunate (the launch time, controlled to some extent by the geographic positioning of Cape Kennedy relative to the moon, was such that the attempt to escape from lunar orbit will take place on Christmas Day); the mission could have been accomplished just as well without astronauts aboard.

The flight has been justified in terms of official goals as necessary for operational reasons. They include the first attempt at deep space navigation and the proving out of the Apollo communications and tracking systems that will be critical when an attempt is made to land on the moon, some time next year.

Likewise it will be possible, for the first time, to assess whether or not the spacecraft can be kept at room temperature during three days of continuous exposure to searing sunlight. In all previous manned flights the vehicle has spent part of each 90-minute orbit in the frigid shadow of the earth. To avoid overheating of one side the vehicle is being kept in a slow roll.

Scientific Tasks

While the operational tasks of the astronauts are those most clearly related to the final goal of a landing, far more important from a scientific point of view are the observations that, it is hoped, they can make between those prime tasks. In this respect they may demonstrate the advantages of having men aboard exploratory spacecraft, rather than scanning devices.

Thus the astronauts will try to look for clues to such hotly disputed questions as whether or not the sinuous rills on the moon were formed, long ago, by flowing water. They will peer down at the sharp peaks rising from the centers of some craters in search of vent holes. If they find them, that will greatly encourage those who believe the craters are volcanic cones rather than rebound features produced when large objects impacted on the moon, producing the craters in the first place.

While observations that can be made on the night side of the moon will be limited, the astronauts are expected to gaze northward toward the crater Aristarchus, where observers on earth have repeatedly reported red glows, hinting at possible volcanic activity.

There are, of course, other reasons for going to the moon not spelled out in the official announcements. The goal, set by President Kennedy, of landing men before the end of this decade was clearly in response to Soviet feats in space. Had there been no Soviet competition, the attempt to send men to the moon might not have taken place until well into the 1970's.

Early this month the Russian launch sites were properly positioned relative to the moon for a lunar mission but none materialized. Indeed, despite many hints and unauthoritative statements, the Russians have never made it clear whether or not they plan a lunar landing attempt in the near future.

But the motivation to reach the moon was that drive for exploration, that love of adventure—personal or vicarious—that down through the ages has sent men to every corner of the earth, often at great risk.

Man's drive to surmount the ridge and see the next valley, to learn what lies beyond the sea, has been a key element in his conquest of the earth. His entry upon voyages across the seas of space marks the start of a new era in human history, one that is almost certain to carry him beyond the moon to other bodies of the solar system.

This could lead to the manned exploration of Mars and, perhaps, of the cooler realms of the Venus atmosphere.

It is typical of our times that much of the world will be able to share in these experiences. The Apollo 8 spacecraft carries not only a variety of cameras, but a television system through which those on earth will, so to speak, sit beside the astronauts and gaze down at the fast-moving lunar landscape as they orbit.

For a few brief periods on Christmas Eve — if all goes well —the world, so to speak, will be in orbit around the moon instead of the other way around.

—WALTER SULLIVAN