GEOPHYSICS

Plan Reflector on Moon

A light-reflecting cube that would bounce a laser beam back to earth from the moon could aid many studies of both lunar and earth constants.

➤ LANDING A light-reflecting cube on the moon's surface is being planned by both the United States and the USSR in their space race.

The device, called a corner reflector, consists of half a cube, a small floor and two "walls" made of mirrors precisely aligned. The cube shape causes the light to be reflected in exactly the same direction in which it entered.

The reflector would bounce back to earth an intense beam of laser light from the moon in the same way that radar waves are reflected from much closer objects as ships, airplanes and satellites. Since laser light is thousands of times more concentrated than the white light of a searchlight, the return from a corner reflector on the moon could easily be detected on earth. A corner reflector weighing only five pounds could do the job but one of 10 pounds would be more efficient.

Drs. R. H. Dicke and D. T. Wilkinson of Princeton University, Princeton, N.J.; P. A. Franken, University of Michigan, Ann Arbor; J. E. Faller and P. L. Bender, Joint Institute for Laboratory Astrophysics, Boulder, Colo.; C. O. Alley, University of Maryland, College Park, and H. H. Plotkin, National Aeronautics and Space Administration's Goddard Space Flight Center, Greenbelt, Md., cooperated in a report on the use of a laser reflector on the moon.

The laser system, or optical radar, would have many advantages over radio waves sent out by a microwave transmitter on the moon.

They suggest at least six experiments that could be made by placing a corner reflector on the moon with one or more of the soft-landing vehicles being planned.

For best results, they agree, the reflector should be landed near the center of the moon. However, even if the reflector were landed quite far from the lunar center, it could be used to obtain "important information in several fields of study."

The experiments, reported in the Journal of Geophysical Research, 70:2267, 1965, include: 1. The size of the moon and its orbit. 2. The size and shape of the earth. 3. Librations of the moon. 4. Determination of the world's standard of time, known as ephemeris time. 5. Improvement of landing site location. 6. Possible detection of gravitational waves.

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SPACE

Pilot Rocket Control Seen

➤ THE FIRST TWO STAGES of the Saturn V rocket that will carry three Apollo astronauts to the moon are so huge, and put so much strain on their passengers, that they have been designed to be controlled remotely from the ground. Now, however, scientists are beginning to think that the mission would be safer with a better chance of success if the astronauts could fly their rocket all the way from the ground up.

The National Aeronautics and Space Administration recently completed a study in which it credited pilot control with possibly making the difference between completion of the flight and failure. The use of a live pilot, said the report, "provides a high degree of flexibility and may contribute to the successful completion of the control tasks during the first stage of flight."

The problems facing an on-board pilot have little to do with the difficulty of the flight plan, since the first stage flight will be rather straightforward, or straight up. The difficulties concern such things as wind, fuel sloshing, which affects the center of gravity, and the flexing of the rocket.

To measure the effects of these conditions on actual human pilots, three NASA scientists at Ames Research Center in California equipped a chair at the end of a centrifuge arm with a control handle that pilots could use to counteract different kinds of motion and vibration. Four Ames research pilots rode the device, along with a few from the Manned Spacecraft Center in Houston and even some visiting pilots from Edwards Air Force Base.

In addition to the sloshing, flexing and wind-blowing, the tests simulated the loss of one or two engines, a crookedly firing engine due to the failure of a hydraulic aiming device, the loss of the "power steering" device, and instrument failure.

Despite all these obstacles, the pilots were almost able to "fly" the mission. In high winds, however, a rate augmentation system was necessary to smooth out jerky motions of both the rocket and the pilot.

Current plans call for the flight to be controlled automatically until after the first and second stages have been jettisoned, the astronauts taking over when the time comes to inject Apollo onto its moon-bound trajectory.

NASA scientists at Ames are now looking into the possibility of manual control for the whole flight, stages one, two and three.

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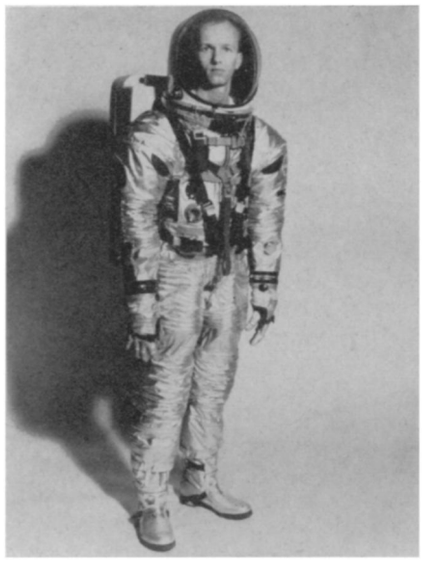

Manned Spacecraft Center

APOLLO SUIT—A pressure suit will protect astronauts on the moon from the dangers of complete vacuum, bombardment from micrometeorites and extreme temperature conditions.

SPACE

Protective Spacesuit Developed for Apollo

➤ A SUIT to keep the wearer cool at 250 degrees Fahrenheit and warm at minus 250 degrees is being designed for the Apollo moon expedition. It will also protect him from bombardment from micrometeorites and from the danger of a complete vacuum.

Called the "Extravehicular Mobility Unit," the suit consists of a number of layers. The one nearest the skin is a liquid-cooled undergarment to counteract the heat generated by the astronaut working on the lunar surface.

The second layer is the pressure garment for protection against vacuum. The soft pressure garment tends to take a spherical shape when pressurized, so joints are built in to provide maneuverability.

Covering the pressure suit is a micrometeorite protection garment, which will provide about as much resistance as a thin sheet of aluminum.

The outer layer is a thermal overgarment composed of many thin layers of superinsulation covered by a white synthetic fabric.

Protection for the astronauts' eyes is provided by an adjustable visor that can reflect 80% to 90% of visible light, 60% to 80% of infrared rays, and nearly all of the ultraviolet rays, necessary in an environment where there is no atmosphere to scatter these potentially harmful rays.

About $12 million has already been invested to develop pressure suits for Gemini and Apollo. The Apollo suit is being developed by crew systems division of the Manned Spacecraft Center, Houston, Texas.

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