ASTRONOMY

Dark Side of Moon Cold

➤ THE DARK SIDE of the moon is less than 270 degrees Fahrenheit below zero, which is at least 30 degrees colder than hitherto supposed during the lunar night.

Studies with a new telescope operated by the California Institute of Technology on California's White Mountain 13,000-foot peak showed that five nights after lunar sunset the temperature was lower than could be recorded by the infrared telescope, which is good to minus 280 degrees. The lunar night lasts 30 times longer than night on earth.

The dust layer on the moon's surface may be quite thin. This reinforcement of the thin dust layer theory of moon composition is supported by discovery of "hot spots" that do not cool as rapidly as the rest of the surface. This suggests that there may be some rocky prominences showing through the dust layer. The other theory is that the moon is covered by a thick layer of dust as the result of bombardment by meteorites for millions of years.

The new telescope has gold-plated mirrors. It is 20 to 50 times more sensitive than any previous system for measuring the temperatures of comparatively "cold" celestial objects. It sees heat waves through a window in the atmosphere that lets in infrared radiation of about a hundred-thousandth of a meter in length, 20 times longer than the wavelengths of visible light. The gold-surfacing of the mirrors reflects the infrared heat waves most effectively, and focuses them on a special kind of germanium crystal. Filters exclude all but the desired infrared waves.

Scattered through this germanium crystal are mercury atoms, which, when struck by heat radiation, give up electrons. The varying number of electrons causes a slight voltage fluctuation in the crystal. These variations, which are later calibrated to indicate temperatures, are amplified about one million times and recorded.

To make the crystal detector as sensitive as possible, it is maintained in a container cooled with liquid hydrogen, reducing its temperature to about 423 degrees below zero. This permits the background noise from "hot" surroundings on earth to be reduced by use of very cold radiation shields.

The observing is done with a double beam system that looks at the spot whose temperature is to be taken and at the same time compares its radiation with that emanating from a nearby spot in the sky. Only the difference in radiation between the two beams is amplified. Thus very small amounts of lunar radiation can be measured despite strong emission from the earth's atmosphere and the surroundings.

The telescope scans across the moon from bright to dark and back again in a period of five minutes. The electronic signal, which is proportional to the amount of radiation being observed, is recorded by a pen on a strip of paper. Photographs of the moon are taken at the same time through a small finder telescope to help locate the points being observed.

The observations were made by Dr. Bruce Murray and Dr. Robert L. Wildey, research fellows in space science.

The new telescope also was used to measure the temperatures of the planets Jupiter and Saturn. The mean temperature for 12 different nights on Jupiter was minus 229 degrees Fahrenheit. Heat radiation from Saturn could not be detected, which means its temperature is below minus 270 degrees.

The giant star Betelguese also had its temperature taken by the new telescope. This is the first report of the measurement of very faint heat radiation coming from beyond the solar system.

The measurement obtained for Betelguese is compatible with previous measurements of visible radiation from the star.

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VIRON

SATELLITE TEST MODEL—The test sphere, 12½ feet in diameter, is inflated before evaluation by the National Aeronautics and Space Administration. One of a series built by the Geophysics Corporation of America's VIRON Division, it is constructed with rigidized expanded aluminum wire mesh laminated between two sheets of polypropylene.

SPACE

Flashing Light Satellite

See Front Cover

➤ THE UNITED STATES launched the "winking star" satellite, Anna, into orbit Oct. 31 to help measure the size and shape of the earth more accurately.

The flashing light satellite weighs 355 pounds and is 36 inches in diameter. Its orbit is about 700 miles above the earth's surface.

Anna is an acronym for Army, Navy, National Aeronautics and Space Administration and Air Force, the main agencies participating in research with the geodetic satellite, which contains optical, radio ranging and radio doppler instruments. Clear signals are being received from the payload.

The "winking star" nickname results from the flashing of four high-density xenon gas lights on the satellite. The lights are photographed against a background of stars as they flash on and off at designated times. The flashes are not visible with the naked eye but can be seen with binoculars if an observer knows when and where to look.

The light beacons, located in pairs on the north and south poles of the spherical satellite, are activated by a code beamed intermittently from the ground. Many nations, including Russia, are participating in the international experiment.

Each time the lights are activated, they flash five times at intervals of 5.6 seconds. Each light has the power of more than one million watts.

By photographing this firefly effect with known stars in the background from differing angles, scientists are able to plot distances between ground stations that took photographs at the same time.

This will help missilemen and mapmakers pinpoint more accurately than now possible any spot on earth. It will also yield increased knowledge of the earth's shape and size, and improved determination of the earth's gravity field.

Anna is powered with a band of solar cells around the equator, as shown in the artist's conception on this week's front cover.

The radio ranging system uses the transmission of a signal with a precisely known wavelength to a satellite-borne transponder that returns this signal to a ground-based radio receiver located with the transmitter. By comparing the relative phase between transmitted and received signals on the ground, it is possible to measure the distance between ground station and satellite.

Simultaneous interrogation of the satellite from a number of ground locations will permit calculation of inter-station distances by triangulation.

The radio Doppler instrumentation of the Anna satellite is an adaptation of the equipment already in use in the Navy Transit satellite navigation system. The geodetic results expected from Anna, however, will be an extension and refinement of the geodetic research of Transit.

The Doppler method employs precise measurements of the Doppler frequency shift of stable radio transmissions from the satellite as observed in ground-based receivers. The frequencies of the satellite transmitters are controlled by ultrastable oscillators.

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