ASTRONOMY

Putting the Moon to Work

Moon helps in calculating more accurately great distances here on earth. Shows speed at which earth turns. Aids in exploring outer layers of the sun.

By MARTHA G. MORROW

➤ EVEN IF man never gets to the moon, the moon is much more useful than just to furnish light for lovers and create the tides of the sea.

Man is just beginning to discover its value in:

Calculating more accurately the size of the earth, and great distances across oceans and deserts.

Determining more exactly the passage of time, and studying the speed at which the earth is turning.

The moon by itself is of little use in telling us about the universe beyond. But when it comes between the earth and the sun or a distant star, it can reveal much. The moon helps us explore the outer layers of the sun during a total solar eclipse and has shown much about its composition. Within recent years astronomers and other scientists have used the moon to estimate the size of certain stars, and to discover stars that are really not just one but two quite close together.

The moon, by way of a solar eclipse, helped prove that light from the more distant stars can be bent by gravity, thus putting on a firmer basis Einstein's theory of relativity. It has also shown itself useful in getting radio messages through during a blackout. Even when hidden by clouds, the moon can be depended upon to bounce shortwave radio signals back to receivers here on earth located hundreds of miles from the sending station.

Use Moon as Telescope

Man may never succeed in actually placing a telescope on the moon, far above the earth's interfering atmosphere, but the moon itself can be employed as a telescope. The moon's edge, serving much the same purpose as a simple pinhole camera, for certain investigations really furnishes us an 800-inch telescope with a focal length of 200,000 miles. Astronomers are just beginning to learn how to put it into service.

Watched by man for thousands of years, the moon is still an object of detailed study. Its movement around the earth, for instance, is quite irregular. If it is to help us in surveying great distances here on earth over sea or desert, and in clocking the earth's rotation, its inconstant motion must be predicted more accurately.

The outline of the moon, which on clear nights you often see against a background of dark blue sky and pinpoint stars, is constantly changing. Thus the different areas of the moon seen in profile must be mapped in greater detail.

The moon takes as long to travel around the earth, on the average, as it does to turn around its own axis. Thus the same side of the moon always faces the earth. But the moon's distance in its eccentric orbit varies whereas its axial rotation does not, so that sometimes we can peek a bit farther around one edge, sometimes we see a little more around the other.

At one time or another observers here on earth have seen nearly 60% of the moon's total surface. It is this marginal zone of the moon, seen one time or another at its edge and comprising approximately one fifth of its visible portion, that is being studied by C. B. Watts of the U. S. Naval Observatory, Washington.

Large scale profiles of the moon are being constructed from photographs taken at the U. S. Naval Observatory, the Yale University Southern Station at Johannesburg, South Africa, and at the Lowell Observatory, Flagstaff, Ariz. Measurements of the side best seen in outline are made by automatic apparatus utilizing a microscope equipped with light-sensitive cells.

Maps showing these variations in the moon's edge, which now are being plotted more carefully than has previously been thought necessary, are expected to be ready for publication in 1956. As soon as available, they will probably be used in surveying large areas here on earth. They are also expected to prove of great value in helping to improve our time determinations by detecting slight changes in the earth's rotation.

Photograph Moon With Stars

Soon it will be possible to photograph the exact position of the moon at any instant against a background of stars. A new type of camera, which was developed by Dr. William Markowitz of the U. S. Naval Observatory, will enable astronomers to photograph, without blurring, the moon as it races across the sky along with the fainter, more stationary stars.

The new device guides on both the moon and the background stars during the 15

MAPPING MOON—Through use of special moon photographs and machines, the mountains and the valleys of the moon are transferred to strips of paper as a wavy line. Here astronomer Alvah D. Allen and mathematician Becky Lichtenstein of the U. S. Naval Observatory examine some of the results of the work done on the six miles of paper strips so far completed.

seconds or so needed for the faint stars to show up on the photographic plate. The key to its success is a dense, tilting filter.

This dark filter cuts out most of the moon's bright light so only 1/1000 of the light gets through to the plate. Thus the stars surrounding the moon show up clearly. It is the regular speed at which the motor-driven filter is turned that makes the moon apparently "stand still" long enough to show up in detail on the time exposure.

An electronic "brain" with its great ability for handling involved calculations now is fast at work on an astronomical timetable for the moon, plotting its erratic motions.

Thanks to this electronic calculating machine, future positions of the moon among the stars are being figured with greater accuracy than has ever before been possible. The work is being done under the supervision of Dr. W. J. Eckert of the Watson Scientific Computing Laboratory of the International Business Machines Corp., and G. M. Clemence, director of the U. S. Nautical Almanac Office of the U. S. Naval Observatory. Showing the positions of the moon at half-day intervals from 1952 to 1971, this lunar ephemeris will probably be ready during 1953.

Electronic "Brains" Used

Several decades ago such highly accurate positions for the moon were not considered essential, but today the exact position of the moon is needed more and more in astronomy and surveying. Working from the original formulas, the electronic "brain" is producing highly reliable figures which will enable time experts to use the moon as well as the sun and stars in estimating the passage of time.

Not just the moon, but also the earth rotates at a slightly irregular speed. This shows up in the apparent position of the moon as seen from the earth. When more accurate tables for the moon's position are available, it will be possible to use the moon as a clock to show up irregularities in the speed at which the earth spins.

Surveyors have found the moon helpful in estimating great distances here on earth. They have found it of value during a total or partial eclipse for accurate measures of small angles; now they are discovering how to utilize it on those more frequent occasions when the moon comes between the earth and a distant star, temporarily cutting off the star's light.

Promising Survey Method

The shadow of the moon cast by a star cannot be seen, but the instant it passes overhead can be recorded with a photoelectric device. This cutting-off of the star's light occurs suddenly, thus its appearance can be timed most accurately.

When two observers at different positions on the earth time the instant the shadow of a particular feature on the moon's edge passes over their telescope, the length of the path followed by the shadow of this feature of the moon is readily calculated. Thus report J. A. O'Keefe, Miss Pamelia Anderson, Donald D. Mears and others of the Army Map Service of the Corps of Engineers.

Within the past few years, teams of photoelectric observers and surveyors of the Army Map Service have timed the passage of the moon's shadow from one location to another. On each occasion the shadow cast by the same star was clocked on the same night by at least two observers. This work indicates the moon's shadow is a promising means of surveying great earth distances.

As man studies the moon and learns more about its eccentricities, he will find that it can reveal much about the sun and stars beyond, as well as the earth.

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