

# SURVEYING THE LUNAR SURFACE

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Man has finally put his feet squarely upon the moon's surface through an incredible mastery of space travel.

Today the moon, tomorrow . . . where in the uncharted vastness of space?

There is special interest to the surveyor in man's landing on the moon. He now has another planet to chart, and perhaps, even carry out land boundary surveys as he has done on earth.

## HOW WIDE THE MOON? WHO NEEDS TO KNOW?

The first question will be answered when the answer to the second question is established. The "need to know" question goes beyond the excitement of discovery. Unless there are strong economic and political reasons for dividing the moon's land into parcels there will be little need for "boundaries" to be established.

If investigation into the geology of the moon's rock does not disclose high valuable mineral content it is not likely that highly detailed accurate ground survey will be required. As evidence of this let us look to our own Antarctic where climate conditions are severe (down to  $-77^{\circ}\text{F}$ ) but not anywhere near as severe as those on the moon. As recently as 1964, there were discoveries of whole mountain ranges by the U.S. Navy. There are therefore greater tracts of unknown areas in the Antarctic than exist on the moon where we now have mapping covering 99.6% of its surface.

Actually most of the moon has already been surveyed photographically by five lunar orbiters which circled round and round the moon in 1966 and 1967. These orbiters took pictures from nearly 4,000 miles above the moon's surface to less than 30 miles, and then sent them back to earth by radio. Are there not greater possibilities in economic discovery in the Antarctic than on the moon?

This is not the question however. We are talking about the moon. It is quite conceivable that more detailed and accurate mapping of the moon will be required, and in order to accomplish this, ground control of high accuracy will be necessary.

Is this control within the realm of possibility? Certainly. Proper control should be able to tell us more about the movement of the moon's crust and the moon's motion. It is already known that the moon is gradually moving away from us and it is known that at one time (less than 2 billion years ago) the moon must have been only 11,000 miles away from earth. The tides, if there were any, would have been catastrophic based on today's standards being 1,000 times greater than they are now.

Since, in my view, boundaries are not likely to be needed in the foreseeable future, it seems ridiculous to contemplate on how or when they would be laid down. However, since control survey might be needed, let us dwell on how and when this survey work might be established.

It is quite possible that "monuments" may be planted on the moon's surface but these would be of the nature of "control monuments" so that mapping of higher accuracy could be undertaken.

One of these monuments is quite possibly in existence right now — the reflector used for laser measurement and set by the crew of Apollo 11. It is possible to measure from earth to that station with an accuracy of plus or minus 2' (accuracy of plus or minus 6" was hoped for).

All that is required now is to relate this monument to the latitude and longitude of the moon. The lines of latitude can be established since the poles are known. The prime meridian of longitude has been set midway between the visible edges, thereby running through the closest portion of the moon to us.

Other such monuments could be estab-

lished possibly without the necessity of human assistance and along with the reflectors it might be possible to set up cameras at these stations such as those outlined in an article in "Surveying and Mapping", September, 1969, entitled "Regional Application of Satellite Geodesy Methods" by Kurt Lambeck of the Smithsonian Astrophysical Observatory.

This procedure outlines the possibility of taking simultaneous photographs at a single target and relating the single target's true position in relation to the background of stars. The multiplicity of observations increased the accuracy obtained as shown here.

Accuracies of 15 centimetres in 100 kilometres could be obtained from this procedure. Perhaps a reflector and flare target could be sent from earth that the various cameras would photograph at identical times with the information being radioed back to earth for calculation.

It might even be possible with increased technology to determine the target position from earth as well giving added redundancy to the configuration. Perhaps even laser measurements might be able to be obtained at the main stations. Who knows what procedures might be possible in a few years. I merely point out that there are possibilities already.

How wide the moon? We already know a considerable amount of the moon's physical features. A great wealth of information has already been obtained by Surveyors 1 to 7 and the Apollo missions and this information has been gained in far shorter time than has been feasible here on earth.

