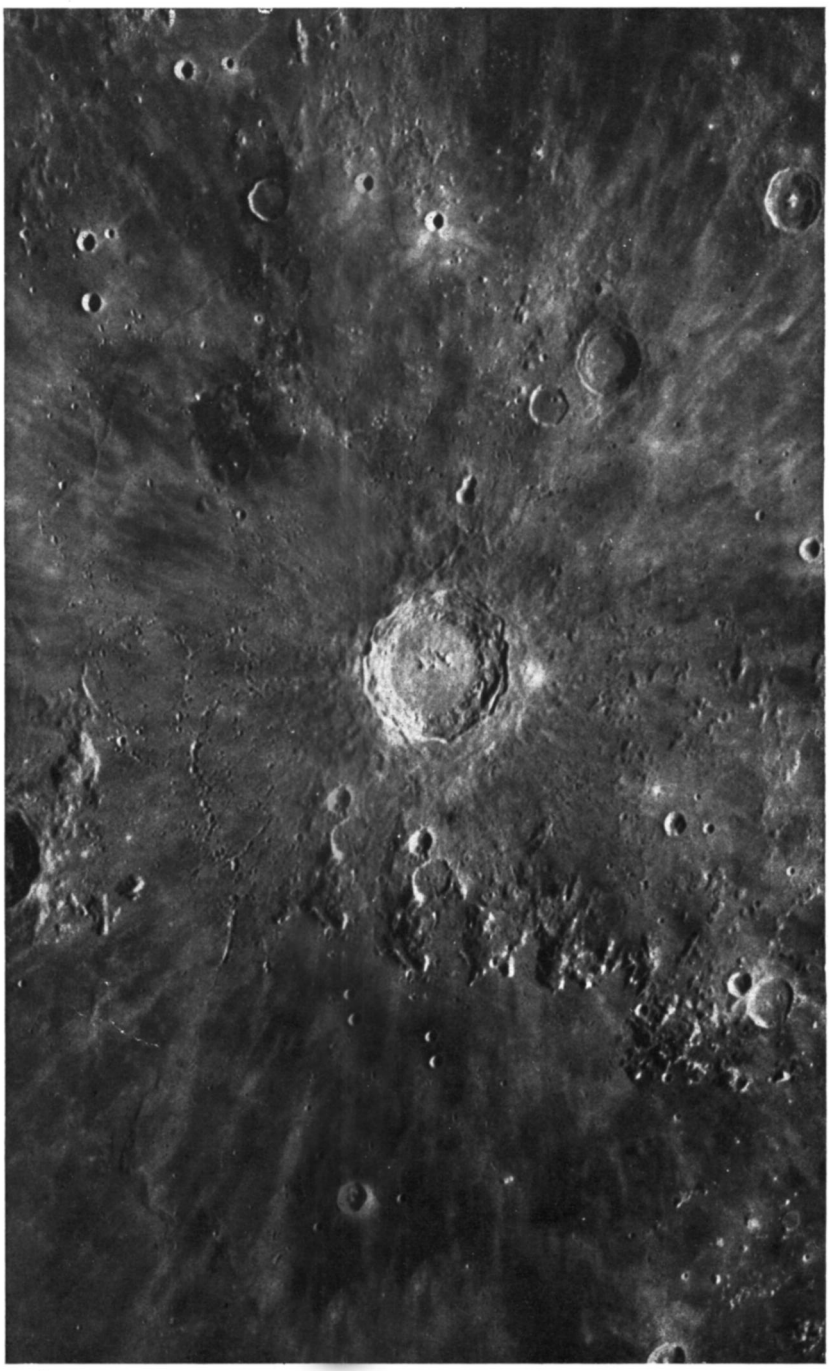
LUNAR PHOTOGRAPHY WITH THE HOOKER TELESCOPE

SOUTH



WEST EAST

NORTH

PLATE IV. Region of Copernicus.

Photograph taken at the 134-foot focus of the 100-inch telescope on Mount Wilson on September 15, 1919, by F. G. Pease.
Scale of print, 75 miles to the inch.

LUNAR PHOTOGRAPHY WITH THE HOOKER TELESCOPE.

By George E. Hale.

My justification for contributing to this symposium is certainly not that of special knowledge. I cannot pretend to have made any serious study of the Moon, and therefore my comments on lunar research are entitled to but little weight. But I could not forego the privilege of joining in this tribute of admiration and respect for the work of my friend Professor Brown, whose fundamental investigations on the motion of the Moon have so richly deserved the award of the Bruce Medal.

The photographs of the Moon reproduced in Plates IV and V have been obtained in the course of a wide variety of tests to which the 100-inch Hooker telescope is being subjected. They are enlarged from negatives made by Mr. Francis G. Pease at the Cassegrain focus of the telescope, where the equivalent focal length is 134 feet, corresponding to a diameter of 15.13 inches of the lunar image (September 15, 1919). Seed 23 plates were used, and the exposures were about one-half second at the terminator, reduced to a smaller fraction toward the much brighter limb by the exposing shutter moved before the plate. The seeing on the night of September 15, 1919, when the photographs here reproduced were made, was hardly better than 3 on a scale of 10. The negatives are sharp, but still sharper ones could undoubtedly be obtained under more favorable conditions. The heavy demands of our regular program of research, however, will leave few opportunities for lunar photography, and these may not often fall on nights combining favorable phase and position of the Moon with the excellent seeing required. Thus it is unlikely that our small collection of good lunar negatives will be rapidly increased.

Our policy will depend, however, upon the possibilities of progress which such photographs may indicate to qualified judges. Few astronomers can claim to possess that intimate acquaintance with the structure and origin of the Earth's face needed in the interpretation of lunar formations At the suggestion of Dr. John C. Merriam a National Research Council committee of geologists, combining the extensive knowledge of topography, volcanology, and other aspects of the science bearing upon this question, will

be invited to examine these and other lunar photographs, and to co-operate with the Mount Wilson Observatory in a study of the Moon if this should appear sufficiently promising.

It is clear that no such study should be based upon photographs alone, as these do not reveal the smallest details visible at the telescope. I have examined the Moon with refractors and reflectors ranging in aperture from 3 to 100 inches, and have been greatly impressed by the exquisite structure, of the most minute pattern, seen with large instruments under the finest conditions. One of the most striking features of this structure results from the presence of innumerable small holes or "craters," similar to those shown in the photographs, but much smaller in diameter. These minute objects, resembling the smallest needle pricks, are particularly numerous on the outer slopes of the walls of Copernicus, where they present a remarkable spectacle. In 1894, when I spent a week with the late Professor Riccó at the summit of Mount Etna, I was struck with the appearance of the many small craters, some still smoking, others dating from prehistoric times, that dotted the slopes of the volcano. Whether these have more than a superficial resemblance to the minute holes seen on the walls of Copernicus and elsewhere on the Moon is an interesting question.

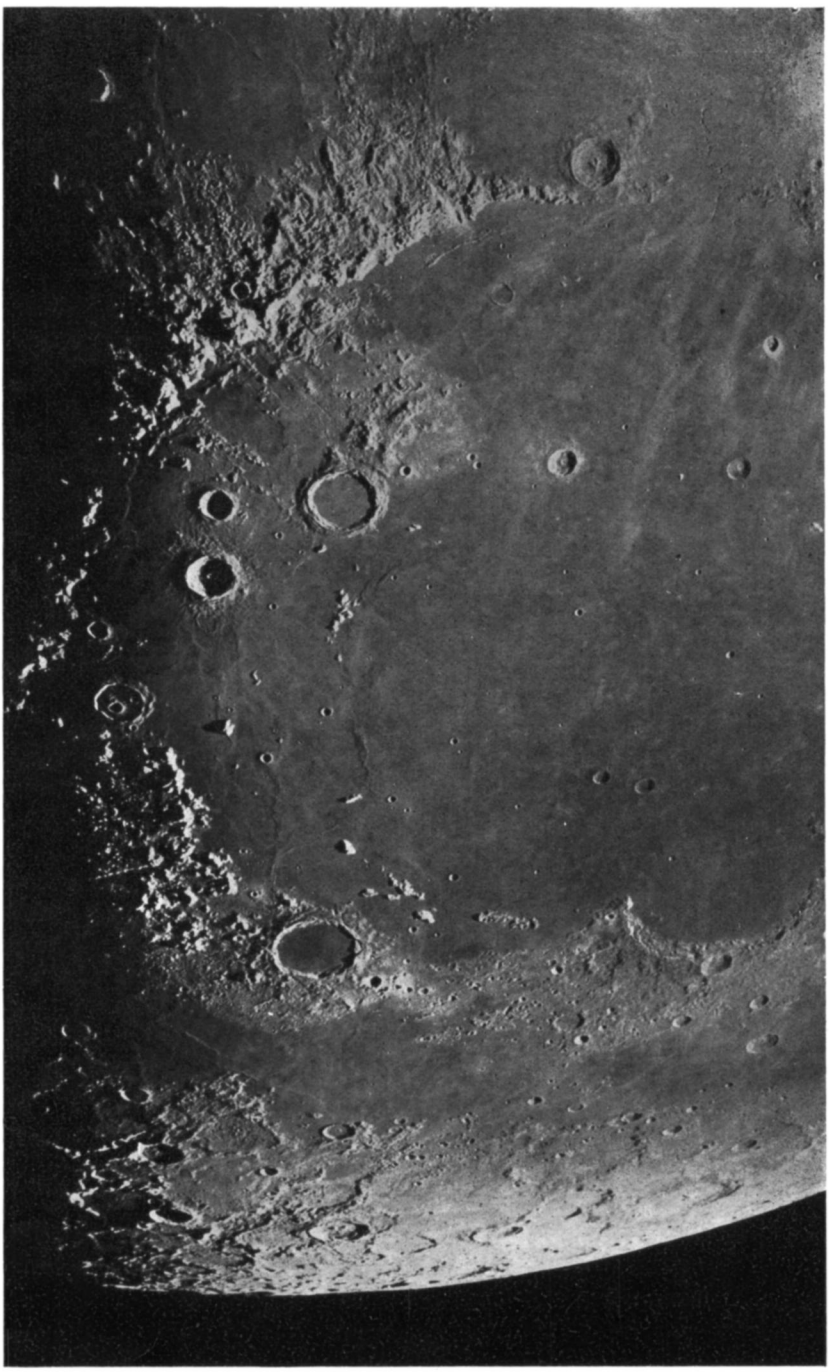
Adequate explanation of these and other remarkable lunar phenomena will certainly demand extensive research. While one is struck by many resemblances between lunar and terrestrial topography the points of difference are no less striking. The curved chain of the Apennines (Plate IV), about 640 miles in length, rising abruptly from the plain on one side and sloping gradually away on the other, recalls the similar structure of the Rocky Mountains and their precipitous descent into the Nevada desert. Huyghens, the highest peak in the range, reaches an elevation of nearly 20,000 feet. The crater Eratosthenes, lying near the eastern extremity of the Apennines, is about thirty-seven miles in diameter, and contains a marked central peak. The eastern wall rises to a height of some 16,000 feet, while the western wall is only two-thirds as high. The floor of the Sinus Estuum to the south and west, said by Webb to show visually two minute craters with a five and a half inch telescope, is marked on our negatives by many much smaller craters, which are also numerous on the slopes of Eratosthenes.

North of the Apennines, bordering the vast smooth area of the Mare Imbrium, is a group comprising three of the most striking craters on the Moon. The northernmost of these, Aristillus, about thirty-five miles in diameter, has been extensively studied by Professor W. H. Pickering. The double "canal" within its western wall, which he considers beyond the reach of large apertures, is easily resolved visually with the Hooker telescope. Indeed it seems possible that its components might be photographed under the best conditions.

The great crater or walled plain, Archimedes, finds no counterpart in magnitude among the most extensive volcanic phenomena of the Earth. Its diameter of fifty miles greatly surpasses that of the crater of Haleakala (Hawaiian Islands), which is only about thirty miles in circumference, but there are important points of resemblance between the two objects. In fact, altho many lunar craters are depressions below the surrounding country, rather than hollows on the tops of mountains, and altho traces of lava streams, so characteristic of our volcanoes, are usually lacking on the Moon, it nevertheless seems to one who has considered the subject only superficially that the present photographs favor the view that the lunar craters are more probably due to volcanic or other internal phenomena than to the fall of meteorites. The fact that minute craters are much more numerous on the slopes and in the vicinity of large craters than in open plains like the Mare Imbrium, and the almost complete absence of evidence indicating impact at angles differing greatly from ninety degrees, are points to be remembered in this connection.

Copernicus, fifty-five miles in diameter, is one of the finest craters on the Moon (Plate V). Seen under a high Sun, as in this photograph, the shadows of its walls and central mountain are not conspicuous, but the inner terraces and the remarkable system of white streaks, centering in the crater, and extending in all directions to great distances, are brought out to the best advantage. The origin of these radial bands, and of the longer ones that center in Tycho, is not easily explained. The enormous number of very minute craters, seen visually with the Hooker telescope on the slopes of Copernicus, has already been mentioned, but attention should be called to the large number of small craters shown in Plate V in the curious region northwest of the great

SOUTH



WEST EAST

NORTH

PLATE V. Region of Mare Imbrium.

Photograph taken at the 134-foot focus of the 100-inch telescope on Mount Wilson on September 15, 1919, by F. G. Pease.
Scale of print, 140 miles to the inch.

crater. This group, one of the strangest of lunar phenomena, will bear careful study.

It goes without saying that any general attack on selenographical problems should take advantage of all effective observational methods and appliances. Visual observations and direct photography should be supplemented by photography with infra-red and ultra-violet light, and polarization tests should be utilized in promising regions. By these and other means it seems probable that competent observers could add materially to our knowledge of the Moon.

Mount Wilson Observatory
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