ELECTROSTATIC EFFECTS ON THE LUNAR SURFACE, T. Gold and G. J. Williams, Center for Radiophysics and Space Research, Cornell University, Ithaca, NY 14850.

The large scale electric fields around the Moon and the mean charges of surface grains of the soil can readily be seen to result in forces that are much too small to cause any movement of grains. However there are effects that are expected in the environment of the Moon, where the charge on neighboring grains is quite dissimilar, and where electric fields are set up on a micron-scale. In such circumstances the forces on a grain may well exceed not only gravity but also the adhesive force to the neighbors that are in contact. Surface movement then results and may cause surface transportation of lunar soil on a geologically important scale.

We report here the laboratory experimentation and the theoretical investigation of the effects that set up such intense small scale fields. UV photons from the Sun, the solar wind, and the plasma bombardment in the wake of the Earth all need to be considered. While photon-produced electrostatic effects are not large, they may cause some movement of surface grains on the Moon. The free-stream solar wind has only negligible effects. The electrons that reach energies of several hundred volts in the region behind the Earth's magnetic bow-shock seem the most effective agency for causing surface movement, and such movement caused by locally unstable electron charging is readily demonstrated in the laboratory.

Photoelectrons are very numerous compared with the more energetic electrons of the magnetosheath. It might be thought that their action would be to destroy all the intense small-scale electric fields, and to bring potential differences down to the few volt range of the photoelectrons. This is, however, not so. All localities in the complex surface geometry that can receive electrons from the wide-angle electron bombardment, but not photons from the narrow-angle solar illumination and that charge up negatively cannot be discharged by photoelectrons. A large fraction of the surface grains at any time are in that situation, and therefore electron bombardment effects are expected to be not greatly diminished by the presence of the solar UV.

Magnetosheath electron bombardment provides an explanation for the great difference in the appearance and surface topography between the back and the front of the Moon, if indeed surface erosion by such effects has played a major part in shaping the surface.

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Various interesting effects are noted in the laboratory tests. Such as the sorting of grains according to some features of their chemical composition that influence their secondary emission characteristics, and the impediment to transportation caused by a mixture of certain substances. These effects provide explanations for various seemingly strange properties of the lunar surface that have been noted.