THE IMPACT-THEORY INTERPRETATION OF THE
DISTRIBUTION OF MARIA ON THE LUNAR SURFACE

RALPH METCALFE and N. A. BARRICELLI*
Dept. of Mathematics, MIT Cambridge, Mass., U.S.A.

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Abstract. The satellite impact interpretation of the surface distribution of lunar maria is presented according to Barricelli and Metcalfe (1969). It is emphasized that the formation of molten rock (lava) which, according to the Apollo 11 findings, seems to have been the origin of the material of which maria are composed, can be the result of heat developed by the impacts which created the respective maria (Gilbert 1893) and does not necessarily imply a volcanic or internal origin of this material.

The distribution of mascons and some of its possible interpretations are discussed.

1. The Surface Distribution of Maria

The asymmetric distribution of lunar maria is one of the most significant characteristics of the Moon's surface which has recently been revealed by spacecraft photography. It has been noted that many current theories which attempt to explain the formation of Earth side maria such as Imbrium, Serenitatis, and Crisium are unable to explain the absence of large size maria on the far side (Kopal, 1966). However, the hypothesis that the large maria were created by the impact of small Earth satellites upon the lunar surface yields predictions consistent both with the features of the observed maria and with their actual distribution on the Moon. The basic hypothesis, that many of the lunar maria are primarily regions of solidified lava originally produced by the impacting of early Earth satellites, was first proposed by Gilbert (1893) and later supported by Darney (1933), Urey (1952, 1962), and many others.

Because of tidal effects, the distance between the Moon and the Earth has been steadily increasing. Earlier, perhaps some four billion years ago, the Moon may have been much closer to the Earth than it is today. Any other Earth satellites which were present at this time may have been eliminated from the Earth-Moon system, as the Moon spiraled out, by colliding with the Earth or Moon, or by escaping into space. Collision with the Moon, resulting from the increasing diameter of the Moon's orbit, is actually the most likely possibility for a satellite moving around the Earth in roughly the same direction as the Moon itself (Barricelli and Metcalfe, 1969).

2. Lava-Formation by the Heat Produced in Satellite Impacts

To analyze the possible formation of some of the lunar surface features it is essential to distinguish between satellite impacts and meteor impacts. The former are due to

* Present address: Oslo Universitet, Dept. of Mathematics, Blindern, Norway.
collisions involving objects in orbit around the Earth, while the latter are due to collisions involving objects which are not Earth satellites, such as meteors and comets. The energy generated in a satellite impact is primarily created through the acceleration of the impacting object by the Moon’s gravitational field. So the collision velocity of a satellite impact is usually close to the lunar escape velocity, 2.4 km/sec. On the other hand, the meteor impact velocity, which can vary substantially, tends to be one order of magnitude greater than the lunar escape velocity. The energy generated during a meteor impact is often sufficient to vaporize a substantial portion of the material involved in the collision, causing an explosion and creating a saucer-shaped crater similar to the large meteor craters on Earth (Marshall, 1943). On the other hand,