VELOCITY DISTRIBUTION OF EJECTA FROM IMPACTS INTO POWDERY REGOLITHS: PRELIMINARY EXPERIMENTAL RESULTS, William K. Hartmann, Planetary Science Institute, Tucson, Az., 85719

Data reduction is proceeding on a series of impact experiments in which basalt and pyrex projectiles were fired into basalt and pumice powder targets in vacuo at impact velocities of 5 to 2320 m/s. The powder mechanically resembled lunar regolith. A primary objective is to extend knowledge of ejecta velocity distributions. Such information is presently sparse, but critical to the problem of whether an impact event yields net accretion in the planet growth process.

As sketched in Figure 1, ejecta were collected on annular rings around the center, so that travel distances would be determined. Collectors on the "right half" and "left half" were set up with alternating radii, so that two independent sets of measures were obtained, one for each side. High-speed films of the impact events provide information about the ejecta velocity and launch angle; mass vs. distance give a velocity distribution, assuming ballistic trajectories.

Figure 2 shows a frame of such film, showing the conical ejecta sheet from experiment 253 (800120), the impact of a 1/8" diameter 0.044 g pyrex sphere into pumice powder at 2132 m/s. The ejecta appears to be launched at a restricted angle near 45°.
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Figure 3 shows a preliminary reduction of data from an experiment similar to that shown in Figure 2. This was shot 250 (800118) in which the same size pyrex sphere impacted the same powder at 1418 m/s. A launch angle of 43° was assumed. The format of the diagram is similar to that used by Gault et al. (1) in early experimental results and Greenberg et al. (2) in their application to models of planet growth.

The results agree fairly well with a behavior assumed by Greenberg et al. for similar conditions: Their assumption was based on impact experiments by Stoffler et al. (3) who studied impacts at about 6 km/sec into sandy targets, finding much lower ejecte velocities than for Gault's solid basalt targets. The data as reduced here suggest that not more than one projectile mass escaped in the form of ejecta at speeds faster than 2.5 m/s. In other words, a planetesimal larger than about 2.1 km radius with a powdery regolith surface would have gained mass when hit by a solid projectile at our speed of 1.4 km/s.

A remaining problem is the observation of a curious vertical jet of higher speed material which is emitted from the impact site in impacts at 5 1 km/s. This is observed in the films to rise in a tight column (width < 1 crater diameter) and then dissipate in a twisted or irregular form as the conical ejecta sheet forms. The remnant of such a column can be seen left of center in the conical sheet in Figure 2. This suggests that some mass was ejected in a higher velocity (~ 4 m/s?) spurt than recorded in Figure 3, and fell back into the crater and onto the rim, thus not being measured in the data reduction used here. I suspect that the mass involved is significantly less than in the conical sheet, but that it may provide a rightward-extending, high-velocity tail in the lower right of Figure 3. More such data are needed to understand collisions of planetesimals; further results extending those above are anticipated from this program, with a wider velocity range than in previous work.

REFERENCES
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Figure 3. Comparison of preliminary experimental velocity distribution (circles and triangles) with curves derived by Greenberg et al. (2) from earlier data.