diation of the response would seem to be eliminated. Dosages as low as 0.05 μg of carbachol have produced drinking when applied to brain tissue. Equivalent data on injection into ventricles are not yet available.

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Extrusive Lunar Ring Structures?

O'Keefe, Lowman, and Cameron (*1*) argue that the curious morphology—convex profile, evidence of postmare age, and patterned surface—of the slopes of the Flamsteed Ring hills indicate an extrusive flow structure. Their suggestion that the entire Flamsteed Ring is the surface expression of a ring dike would be stronger if it could be shown that the curious morphology is peculiar only to lunar craters similar to the Flamsteed Ring, and is not found in the typical, bowl-shaped craters with sharp, raised rims, widely interpreted to impact explosion pits. However, this is not the case. Figure 1 shows a number of examples of craters with sharp, raised rims that show the same curious convex toe at the rim base where the rim abuts the mare surface.

There are three working hypotheses: (i) neither the Flamsteed Ring nor the majority of other craters are extrusive, and the morphology discussed by O'Keefe, Lowman, and Cameron is not related to crater genesis; (ii) the Flamsteed Ring (and similar structures) is extrusive but the majority of other craters aren't; (iii) all craters' rims are formed by extrusive flow.

Those who see in the majority of lunar craters a continuous sequence of structures having a single mode of origin (hypotheses i and iii) see in the Flamsteed Ring a damaged crater nearly destroyed in the "flooding" process which formed the maria. Examples of craters partly destroyed by invading mare material abound. On the other hand, the hypothesis of O'Keefe *et al.* suggests that while most lunar craters are thought to result from impacts, the Flamsteed Ring, with its circular pattern of curiously formed hills, may be extrusive.

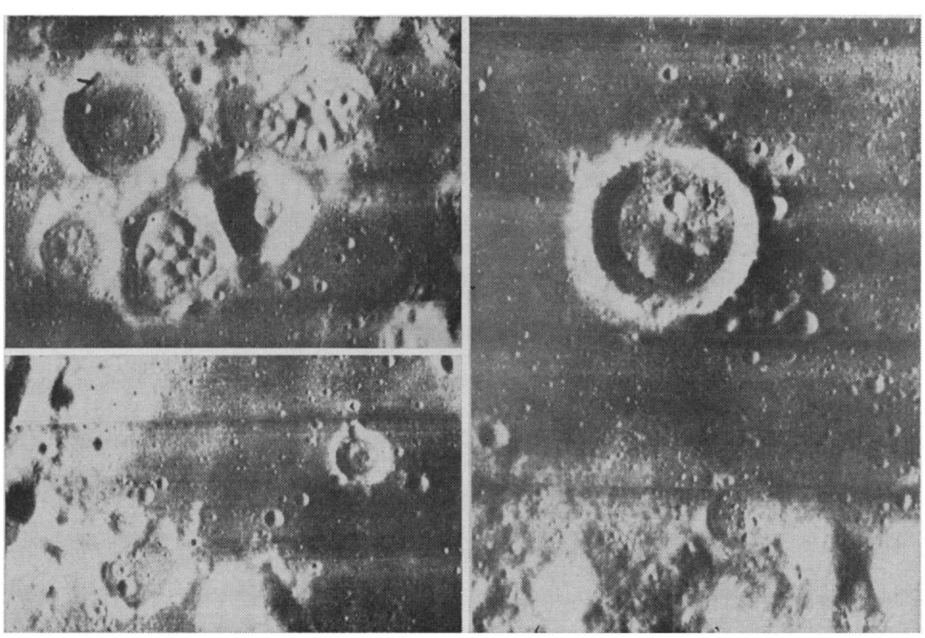

Fig. 1. Examples of craters showing peculiar convex toe at the bottom of wall slopes. Although partly flooded by mare material, many of these have well-preserved, sharp, raised rims characteristic of ordinary, "fresh" lunar craters. [Photo, courtesy NASA]

Figure 1 shows that the patterned ground described by O'Keefe *et al.* is common to many structures, even classic sharp-rimmed flooded craters. This observation effectively eliminates the argument of O'Keefe *et al.* for hypothesis (ii). For this reason, as well as for the reasons listed by Milton (*2*), and Goles and Taylor (*3*), hypothesis (ii) is rejected in favor of some form of mass wasting as the proper explanation of the morphology of lunar slopes. Available evidence indicates that this morphology occurs in conjunction with the mare material, suggesting that the process of emplacement of the mare material may enhance the mass wasting. The mare material is probably some form of volcanic material, judged by its association with tectonic structures, and hence moonquakes or plastic slumping due to contact heating or partial melting come to mind as agents. To my knowledge, this morphology has not been found in a non-mare environment, though the majority of photos are of mare regions. The craters in Fig. 1 can thus be interpreted as typical bowl-shaped impact craters, partly filled with mare material, and with slumped walls.

That there are no known terrestrial cases of simple, extrusive, crater-like ring structures on earth argues against hypothesis (iii). It continues to appear that lunar surface relief is a mixture of impact craters, collapse and maar-type pits (often in chains) fault and graben structures, and vast, flat lava flows. There is still no conclusive published evidence that any major positive relief structures are the result of extrusion, and the morphology noted by O'Keefe *et al.* is probably indicative of some other process.

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