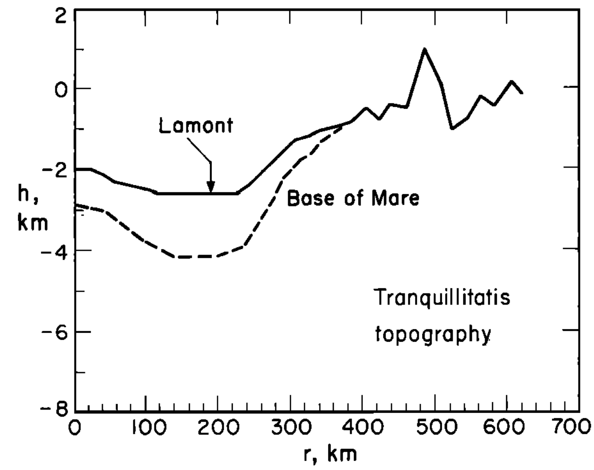

Fig. 10*b*. Topographic profile of the Tranquillitatis basin. The profile (solid line) extends southwest from 8°N, 29°E ($r = 0$) to 0°N, 10°E; topographic data are from Lunar Map 60. The datum $h = 0$ is taken as the characteristic elevation (1738.0 km lunar radius) of nearside highlands in the vicinity of the terminus of the profile. Also shown (dashed line) is the inferred base of the mare basalt fill along the same profile, from the basalt isopach map of *DeHon* [1974]. The Lamont region is an area of anomalously thick mare fill, positive free air gravity, and a concentration of tectonic features, particularly mare ridges; this region has probably subsided relative to the rest of the basin [*Dvorak and Phillips,* 1979].

that define a ring 2000 km in diameter (Figure 12*a*) centered approximately at 50°S, 180°W [*Stuart-Alexander,* 1978]. Limited topographic data were obtained for this basin by the laser altimetry experiment on the Apollo 15 subsatellite [*Kaula et al.,* 1973], which made several nearly east-west traverses of the basin near latitude 25°S, considerably north of the basin center.

The laser altimetry data indicate that the South Pole–Aitken basin is a huge depression with the deepest regions as much as 8 km below the level of the surrounding farside highland terrain [*Kaula et al.,* 1973]. A representative topographic profile, for the portion of the basin for which altimetric information is available, is shown in Figure 12*b*. The large dimensions and relief of this basin, in striking contrast to the Procellarum and smaller pre-Nectarian basins on the frontside of the moon, suggest that the extent of viscous relaxation has been less on the lunar farside than for nearside basins of comparable age. To quantify this result, we need to obtain an estimate of the original topographic profile of the South Pole–Aitken basin by analogy with Orientale. For this purpose we identify the 2000-km ring structure for the South Pole–Aitken basin with the Cordillera Mountain ring of Orientale, although somewhat larger estimates (2500–2600 km) for the outer ring diameter have also been proposed [*Wood and Gifford,* 1980; *Wilhelms,* 1981]. To estimate the topographic relief of South Pole–Aitken prior to any modification, we use the Orientale profile in Figure 1*a* with all horizontal dimensions scaled by 20/9 or 2.2 and all vertical dimensions scaled according to the depth-diameter relation of *Pike* [1980] for large craters; i.e. vertical dimensions scale as $(20/9)^{0.301}$ or 1.27. Such a scaling for vertical relief is only an approximation. For instance, *Pike* [1980] has shown that rim height scales somewhat differently with diameter than crater depth. Further, the initial topography of backside basins may have differed from those on the frontside because of different lithospheric or crustal thicknesses. Considering the large uncertainties inherent in extrapolating existing crater dimensions to 2000-km-diameter basins, the scaling relations adopted here should be regarded only as a reasonable working model.

The Orientale topography, so scaled to the dimensions of the South Pole–Aitken basin, is shown in Figure 13. This profile is compared to the present topography, taken from Figure 12*b* but plotted as a function of radial distance from the assumed basin center at 50°S, 180°W. There is an uncertainty of at least 1 km in the zero elevation datum used to plot the present topographic profile for the South Pole–Aitken basin. Further, there are no topographic data at radial distances from basin center of less than 700 km. Nonetheless, it is clear that the scaled Orientale profile does not provide a good starting topographic model for the South Pole–Aitken basin, which has greater relief than does the scaled Orientale profile at similar radial distance ranges. At fault may be the chosen ring assignment for the South Pole–Aitken basin, or the assumption that the initial topography of this large ancient basin can be simply scaled from that of Orientale.

Also shown in Figure 13 are topographic profiles calculated under the assumptions of an initial profile as shown and a thickness $H = 100$ km for the low-density, high-viscosity layer to account for the generally greater crustal thickness thought to occur on the lunar farside compared to the nearside [*Kaula et al.,* 1973, 1974]. A significant amount of viscous relaxation, which would follow from $t/\eta \geq 10^{-9}$ s/P, yields a predicted topographic profile even less like the present profile than the profile scaled from Orientale geometry with no relaxation. A significant amount of relaxation is also precluded by the present topography if the 2000-km-diameter ring of the South Pole–Aitken basin is the analog of one of the inner rings of Orientale, i.e., if the South Pole–Aitken basin was originally larger and deeper than assumed here.

Thus while viscous relaxation appears to have been an important modification process for impact basins (and large craters) on the lunar nearside, its importance was substantially less for topographic relief on the lunar farside. In

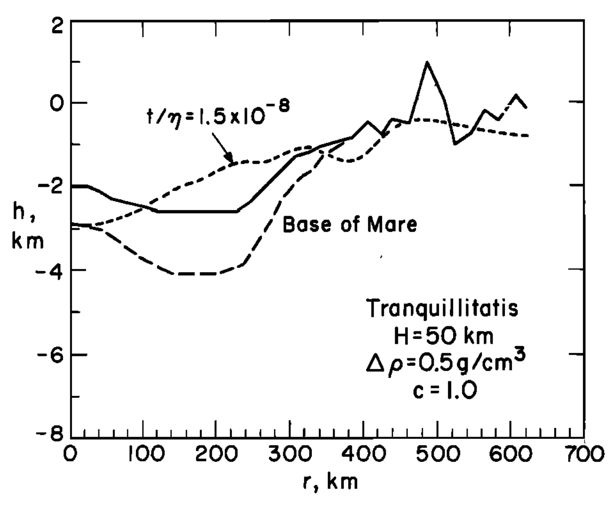

Fig. 11. Comparison of the Tranquillitatis topographic profile from Figure 10 with the profile predicted from viscous relaxation of Orientale, using the model in Figure 8. The predicted profile is shown for $t/\eta = 1.5 \times 10^{-8}$ s/P.