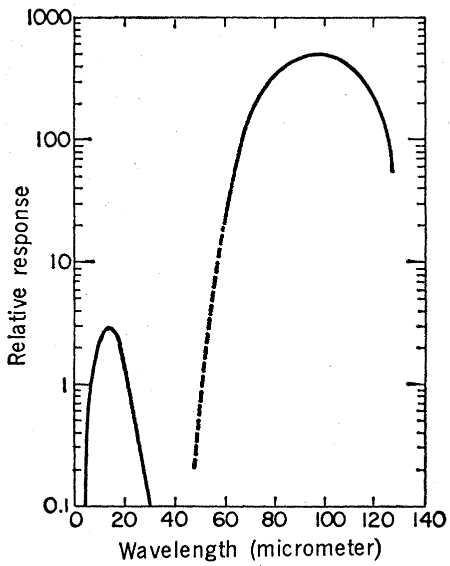

Fig. 2. Spectral response of Ge:Ga detector with wire-mesh Ge interference filter and NaCl crystal 2 mm thick.

over this amount coming from either the Orion Nebula or the Pleiades, but measurements on these sources were hindered by their proximity to the horizon. There appeared to be no strong spatial dependence associated with the flux in the small area of the sky for which contamination by scattered radiation from Earth was small. However, this zenith region was near both the ecliptic plane and the Milky Way.

If the observed signal represents a continuation of the microwave background (*7*), one can set an upper limit to the color temperature and a lower limit to the emissivity ε of the corresponding gray body source: $T \leq 18°K$, $\varepsilon = 1/n \geq 1/6$.

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Moon: Two New Mascon Basins

Abstract. *Lunar gravity data and orbital photography indicate that there is a mascon basin approximately 1000 kilometers in diameter on the farside of the moon and that Mare Marginis is the flooded fraction of a mascon basin approximately 900 kilometers in diameter.*

In the course of an investigation of the association of large, localized subsurface mass concentrations (mascons) with the moon's circular maria (*1*) and the ability of such mascons to explain the differences among the lunar principal moments of inertia (*2*), we examined the existing spherical harmonic expansions of the moon's gravitational potential as one means of determining the magnitude of the mass concentrations.

We chose the expansion of Lorell and Sjogren (*3*) derived from observations of the orbits of four Lunar Orbiter spacecraft. From this description of the selenopotential we derived the distribution of mass density, on a spherical surface 300 km beneath the lunar surface, which would reproduce the spatially varying part of the moon's gravitational field. Similar distributions would hold for other depths. Figure 1 shows the resulting distribution in mass density (*4*). The diagram does show on the nearside mass concentrations at the same general locations as the more precise acceleration data of Muller and Sjogren (*1*). The widely separated mascons associated with Imbrium-Serenitatis, Orientale, and Nectaris are represented by distinct peaks which permit their masses to be estimated with an error typically less than ~ 30 percent.

In Fig. 1 there appear two large mascons which cannot be associated with those reported by Muller and Sjogren: one at the east limb near Mare Marginis and the other a very large feature near the center of the farside disk. We estimate that the masses associated with these features are about 1.4 and 2.8 times, respectively, the mass associated with Imbrium-Serenitatis. The estimate for the farside mascon is in no way dependent on the source of the additional mass in the region, but the narrow profile of the contours does imply that the mass is not dispersed over a very large area.

A unique sequence of photographs taken from Apollo 8 shows the gibbous moon from a subspacecraft selenographic longtiude of about 70°E. The photographs indicate a circular basin ~ 900 km in diameter centered at 91°E, 25°N with Mare Marginis filling the southwest corner. Zond 3 and Luna 3 photographs (*5*) also show some indication of a southwest boundary of the basin, as marked by the interface between the mare fill and the surrounding highlands. The center of the basin coincides with the peak of the mass distribution of Fig. 1, well within the limits of error, and the basin size is close to that predicted from scaling relations (*6*). [Subsequent to the submission of the first version of this report, Whitaker, who questioned the photographic evidence for the boundary of a basin centered at 91°E, 25°N, supplied details of an alternative structure that he and his colleagues discovered in the same area (*7*). It consists of a U-shaped series of scarps running southward along the 75°E meridian, eastward at approximately latitude 16°S, and northward along the 100°E meridian; it thus encloses both Mare Marginis and Mare Smythii, although it is not closed at the northern end, and Whitaker emphasized that he could discern no ridges north of 20°N. This structure, although not circular, is of about the same size as the basin we postulate.] The flooded fraction of the Marginis basin closely approximates the fraction within the nearside hemisphere. This suggests some connection between flooding physics and the gravitational influence of the earth.

Inspection of the lunar farside cartography constructed from Lunar Orbiter photographs (*8*) discloses a variety of small maria and craters, but neither collectively nor individually can these account for the mass of the farside mascon unless some mechanism very different from that causing the nearside mascons is operative. On the other hand, one can discern immediately northward of the center of the farside disk a feature which appears to be the remnant of an enormous circular basin now very heavily eroded. We originally identified this feature from the first and second editions of the Lunar Farside Chart (LFC-2 and LFC-1) and confirmed some of the escarpments from examination of in-

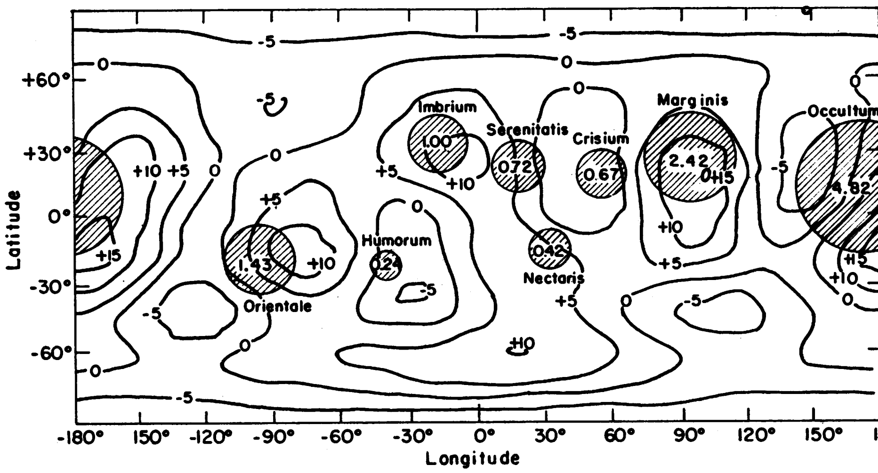
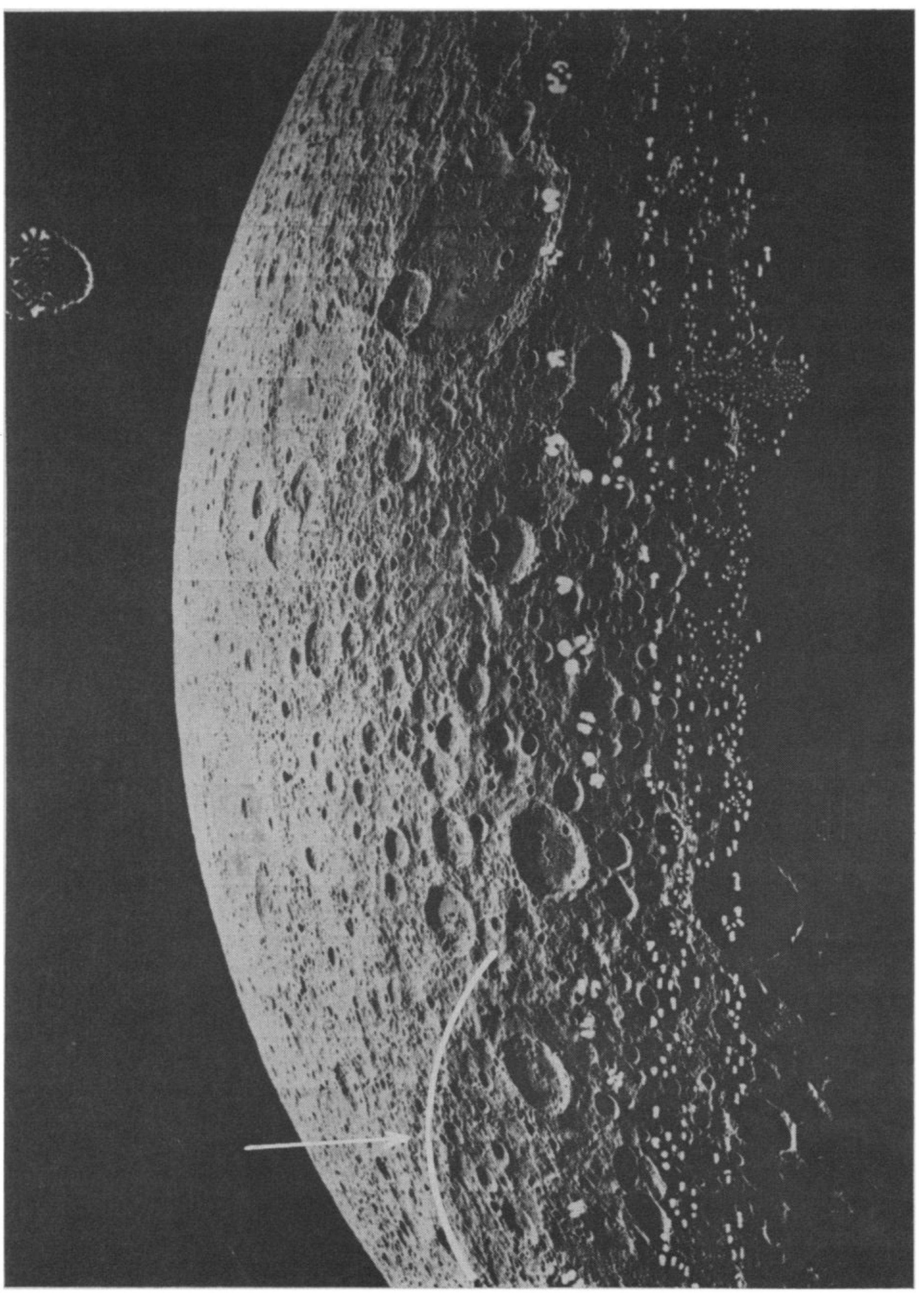


Fig. 1. The mass density corresponding to the spatially varying part of the moon's gravitational potential. Contours are in units of 10^5 g cm^{-2} referred to an arbitrary zero. The area of each basin is proportional to its estimated mascon mass.



dividual Lunar Orbiter photographs (*9*). Since then, Eggleton has examined the Lunar Orbiter photography of the relevant portion of the moon, and he confirms that there is a multiring basin near the center of the lunar farside (*10*). Photograph M-79 from the Lunar Orbiter 5 series (Fig. 2) shows an arc centered at 175 ± 2°E, 15 ± 2°N, which is part of a circle 600 ± 100 km in diameter. Furthermore, since this report was submitted for publication, the feature has been confirmed by Baldwin (*11*), who characterizes it as a set of three concentric rings centered at about 178°E, 15°N with diameters of 750 km, 1000 km, and 1600 km. These estimates of Eggleton and Baldwin are in good agreement with our (*9*) proposed ring 1000 km in diameter centered at 173°E, 11°N. The suggested concentric ring structure is reminiscent of Mare Orientale. If, as for Mare Orientale, we take the middle ring as the appropriate index of diameter, the size of this feature is close to that predicted from scaling relations (*6*) and its center coincides with the peak of the mass density distribution (Fig. 1) within the rather wide limits of error mentioned above. We suggest that this feature be called the Occultum basin. It is outlined by a set of contorted ridges that follow its periphery. Eggleton notes that "a small patch of mare, some pitted plains, and two tumescent fractured crater floors lie within 200 km of the apparent basin center. It might indicate a fair amount of plutonic (perhaps gabbroic) magmatism in the area which could possibly account for the gravity high. . . . Mare material is very scarce in this part of the moon" (*10*). If it is confirmed that the basin contains mare material, we would propose calling it Mare Occultum (the Hidden Sea).

We believe that inferences about the farside gravitational field made from exclusively nearside observation are reliable (*12*). Furthermore, an additional mascon near the center of the lunar farside is an essential addition to any model of the moon which attributes all the nonuniformities in mass to the seven nearside mascons; without this additional mascon the axis pointing toward the earth does not form the axis of

Fig. 2. Lunar Orbiter 5 photograph M-79. The arc of the circular basin ~ 600 km in diameter is apparent in the lower quarter (as indicated by the arrow) of the photograph.

minimum moment of inertia, as required by spin-orbit coupling theory.

Finally, there is the suggestive fact that the lunar moments of inertia can be explained very consistently in terms of a distribution of mascons in which (2) we attribute to the Occultum and Marginis basins mascons of the masses we have derived above.

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4. Because it is derived from only 25 coefficients, the spatial resolution is rather poor: a point mass expanded by such a limited set of coefficients will have its mass reproduced to an accuracy of about 80 percent; however, one-half of this mass will appear to lie outside a circular area with selenocentric half-angle 22°. The limited number of coefficients also restricts the number of distinct mascons which can be depicted. In particular, along the equatorial belt a maximum of four separate peaks can be shown. Their locations will be determined by the largest well-spaced mascons in the region; smaller mascons will be merged into these larger peaks and will affect somewhat the masses and location indicated by these peaks.
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Prehistoric Investigations in Southeastern Turkey

Abstract. *An archeological survey of the upper Tigris-Euphrates basin in Turkish Mesopotamia revealed a very early phase farming village and a nearby developed phase farming village. Late prehistoric developments in this region are critical to understanding of the beginnings of trade and metallurgy.*

In 1963 we had undertaken a surface survey for sites which might yield information about the beginnings of food production in the archeologically unknown southeastern provinces of Turkey (*1*). In the spring of 1964, test excavations indicated that the mound called Çayönü (38°16'N; 39°43'E) near Ergani, northern Diyarbakir province, had been occupied by farmers as early as the latter part of the 8th millennium B.C. Çayönü is a low mound of about 200 m in diameter, adjacent to a tributary of the upper Tigris. Our exposures yielded a superficial occurrence of pottery near the surface only, then an inventory of flint, obsidian, ground stone, and bone artifacts, these being objects which are normally found in an early village site in southwestern Asia. The unusual features of the inventory were the stone foundations for at least one rather substantial building and the use of hammered native copper in a context before the appearance of pottery.

In 1968, we reopened Çayönü after an intensive collection of its surface yield on 83 randomly selected 5-m squares. Two of these squares, one with a rather heavy yield of surface potsherds and one with no sherds but with a heavy flint and obsidian yield, were selected for test excavation. The former square contained a stone slab crypt with the flexed skeleton of a juvenile and three pots of the late 3rd millennium B.C. The occupation on the site at this time appears not to have spread over the whole mound nor to a very great depth. In the second test square, the inventory was similar to that of our deeper exposures in 1964, without pottery but with quantities of flint, obsidian, and ground stone tools, and a portion of a curious "grill" plan building (another example appeared in the fifth level of the excavation in 1964).

A pair of larger exposures were made to enlarge architectural clearances begun in 1964. Indication of domesticated wheat is still not specific but impressions of evidently domesticated barley continued to appear in fragments of mud-brick. Sheep, pig, the dog, and very probably the goat are evidenced by the animal bones as domesticates.

A second small mound, Girik-i-Haciyan (38°14'N; 39°58'E), again in northern Diyarbakir province near Ekinciyan village, was tested. Intensive systematic surface surveys of 105 5-m squares confirmed our gross 1963 impression of a Halafian phase occupation and indicated more homogeneity in surface artifact densities than had the mound at Çayönü. Only three 5-m squares were opened, and these to no great depth. The Halafian painted pottery of Girik-i-Haciyan is very similar to that from such Iraqi sites as Arpachiyah and Banahilk (*2*), but is present only in low percentages in the tests (and in the systematic surface collection). The bulk of the Girik-i-Haciyan pottery is simple ware.

Our exposures add to general knowledge of the total inventory of Halafian artifacts in chipped flint, obsidian, ground stone, and bone. Five samples for radiocarbon age determination were collected at Girik-i-Haciyan with which the chronological place of the Halafian phase may be more fully established. Present evidence suggests the time to be in the later 6th or earlier 5th millennia.

The late prehistory of the slopes and piedmont of the Zagros Mountains in Iraq and Iran and of the hill country and higher hinterland of the east Mediterranean littoral is now available in broad outline (*3*). Çayönü and Girik-i-Haciyan lie between these two regions on the piedmont of the southward slopes of the Taurus Mountains. Present evidence would include the Taurus piedmont as one of the typical stretches of the natural habitat zone of the potential plant and animal domesticates of southwestern Asia (*4*). What gives the Taurus piedmont region special interest is its inclusion of or adjacency to sources of obsidian (the basis of the earliest bulk-carrying trade) and of copper. The hammered bits of native copper of Çayönü are hardly true metallurgy, in a pyrotechnical sense, but they presage mankind's general use of metals.

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