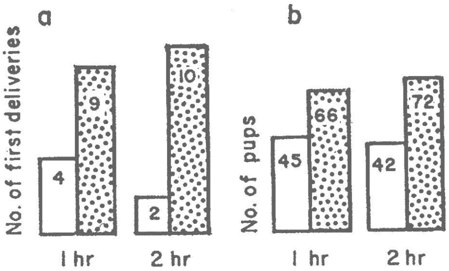

Fig. 1. (*a*) Number of firstborn in relation to type of environment. (*b*) Total number of pups delivered in relation to type of environment. White bars indicate use of unfamiliar glass bowl. Dotted bars represent familiar cage with covered nesting box. Environment was changed every hour and every 2 hours.

four groups. Groups A and B were moved from one environment to the other every hour; groups C and D, every 2 hours. The experiment started at 2 p.m. when groups B and C were removed from their familiar environment to the glass bowl; groups A and D were merely inspected to see if pups had been born before the experiment began. The experimental period continued for 52 hours, during which time half of the adult mice were in the bowl environment and half in the nesting-box environment. Immediately after removal of mice from one type of cage to another, the contents of the vacated cage were inspected; pups were removed and their number recorded. After the experiment the adult mice were killed and autopsied.

Of the 32 mice judged probably pregnant and removed from the nulliparous colony, two mice delivered before 2 p.m. while caged individually in the nesting-box cage and were eliminated. Of the 30 mice that started the experiment, five had no recorded deliveries; two of the five contained two pups each at autopsy, two contained no pups, and one died during the experiment while carrying eight pups. Despite this death, immediate mortality of pups was not high: only 4 out of 87 pups from bowls and 7 of 138 pups from nesting-box cages were judged dead upon removal.

Only the 25 mice whose deliveries were recorded during the experiment were included in the statistical calculations and Table 1; 24 of them had no pups at autopsy, and one still carried two after delivering 11 during the experiment.

In the experiment as a whole, more first-born pups and more total pups were found in the familiar environment with covered nesting box than in the glass bowl environment. Nineteen first pups were delivered in the cage with nesting box, compared with six in the bowl. The probability of these numbers resulting from chance alone is less than .01 (χ^2, 6.76; df, 1). One hundred and thirty-eight pups were born in the familiar nesting-box cage compared with 87 in the glass bowl; by the Wilcoxon matched-pairs signed-ranks test, the probability of this occurring by chance alone is .05 (*4*).

When one breaks down the data into 1- and 2-hour rotation groups, the same trends appear in both parts of Fig. 1; more total pups and more first pups were recorded for the familiar environment with covered nesting box. The differences in these small groups reach statistical significance only for the number of pups dropped in each environment by the mice that were moved every 2 hours, for which the Wilcoxon matched-pairs signed-ranks test shows a probability of .01.

Birth sequence distributions for individual mice (Table 1) show that the birth of pups in some instances was spread over several hours. And in 5 out of 25 instances there appeared to be temporary cessation of effective labor (labor inertia), because 2 hours or more elapsed before additional pups were observed. Such prolonged labors and labor inertias seem atypical for the mouse.

The difference that we report in number of first pups born in each environment covers an earlier part of labor than was previously investigated by us; it suggests that environmental influence may operate before the birth of the first pup. The finding that the total number of pups born differs with the type of environment tends to reinforce our previous finding that labor was 64.7- to 72.1-percent slower between the births of pups 2 and 3 when environmental disturbance was applied (*3*). Viewed together, these findings suggest that environmental factors play an appreciable role in influencing the course of labor.

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References and Notes

1. A. I. Csapo, *Lancet* **1961-II**, 277 (1961); N. J. Eastman and L. M. Hellman, *Williams Obstetrics* (Appleton-Century-Crofts, New York, ed. 12, 1961), pp. 373–95, 437–50; A. C. Guyton, *Textbook of Medical Physiology* (Saunders, Philadelphia, ed. 2, 1961), pp. 1108–10; G. H. Arthur, *Wright's Veterinary Obstetrics* (Williams and Wilkins, Baltimore, ed. 3, 1964), pp. 122–3, 187–8.
2. N. Bleicher, *J. Amer. Vet. Med. Assoc.* **140**, 1076 (1962); N. J. Eastman and L. M. Hellman, *Williams Obstetrics* (Appleton-Century-Crofts, New York, ed. 12, 1961), p. 434; M. J. Freak, *Vet. Record.* **74**, 1323 (1962); E. S. E. Hafez, L. J. Sumption, J. S. Jakway, in *Behavior of Domesticated Animals*, E. S. E. Hafez, Ed. (Williams and Wilkins, Baltimore, 1962), pp. 355–6; L. Hersher, J. B. Richmond, A. U. Moore, in *Maternal Behavior in Mammals*, H. L. Rheingold, Ed. (Wiley, New York, 1963), p. 206; I. H. Kaiser and F. Halberg, *Ann. N.Y. Acad. Sci.* **98**, 1057 (1962); G. D. Read, *Childbirth Without Fear* (Harper, New York, 1944) pp. 149–50, 187–237; T. C. Schneirla, J. S. Rosenblatt, E. Tobach, in *Maternal Behavior in Mammals*, H. L. Rheingold, Ed. (Wiley, New York, 1963), pp. 125–6.
3. N. Newton, D. Foshee, M. Newton, *Obstetrics and Gynecology*, in press.
4. S. Siegel, *Nonparametric Statistics: For the Behavioral Sciences* (McGraw-Hill, New York, 1956), pp. 75–83, 247, 254.
5. Assisted by NIH grant FR-5086.

10 November 1965

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Russian Luna IX Pictures: Provisional Analysis

The several pictures transmitted by Luna IX and made available through the wire services show a small area (found below to be roughly 100 m^2), near the western shore of Oceanus Procellarum, according to the releases by Tass, located some 70 km northeast of the center of the crater Cavalerius (*1*). From the approximate coordinates alone it is not certain whether the area is situated in the mare itself or on one of the small offshore islands.

The vertical scan axis of the panoramic camera was apparently tilted about 23°, causing the quasi-horizontal panoramic view to cut the horizon twice, 180° apart, and to dip a maximum of 23° below the horizon halfway between. The direction of maximum dip (that is, of greatest proximity of foreground to camera) was nearly directly below the position of the sun, as inferred from the shadows, and was therefore eastward of the space craft. At least three (partial) scans appear to have been obtained, with the sun elevation increasing from about 7½° to 27°. The camera position appears to have moved at some intermediate point, allowing frames obtained before and after to be combined into stereo pairs. The total assemblage of pictures is very good and the stereo combination, at least for one field, extraordinarily interesting.

The height of the imaging device was reportedly 60 cm above the lunar surface. This figure allows one to determine the dimensions of the visible rocks and the surface texture, on the assumption that the apparent horizon is nearly level with the camera. Since no great departures are found from the horizon geometry thus expected, this assumption is very plausible.

Figure 1 shows the field for which stereo vision is most satisfactory. The rock in the foreground is one-fifth as high as the horizon, and therefore about 10 cm high. It rests on material that is either particulate or cohesive but highly vesicular, with a characteristic vesicle dimension of 1 cm and smaller. The material could, at first sight, be either scoria or cohesive vesicular lava (rock froth), but does not appear to be debris from impacts (apart from the few scattered rocks on top), which would show a frequency spectrum of particle sizes very different from that actually observed. Instead, the texture of the lunar surface material on all frames is strikingly homogeneous in appearance.

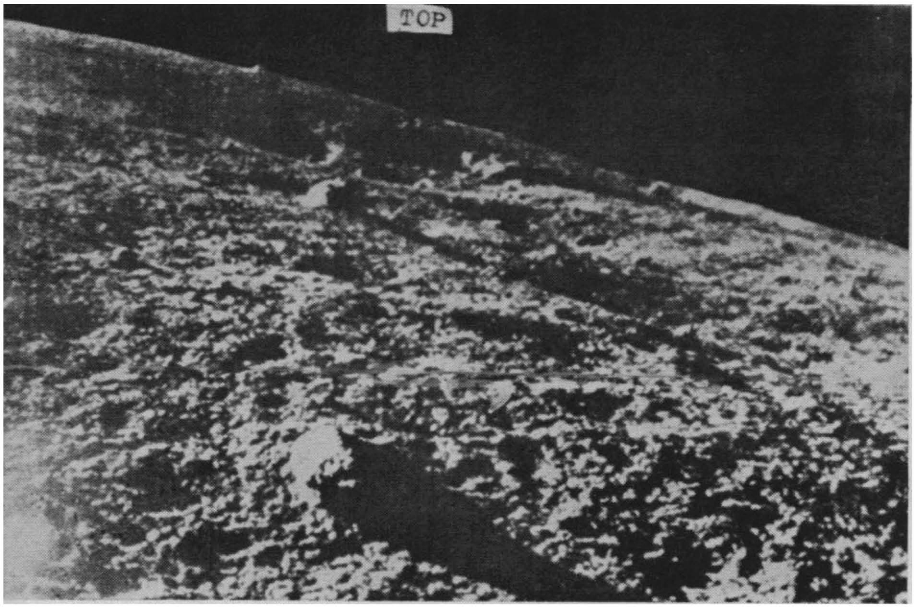

Fig. 1. Section of panoramic view from Luna IX, sun 7½° above east horizon. [Wide World Photo]

Fig. 2. Interpretative sketch of terrain structure shown in Fig. 1, as disclosed by stereoscopy. Numbers indicate distance from camera in meters.

In the Ranger reports (*2*) it was concluded that the bearing strength of the lunar mare surface is probably about 1 to 10 kg/cm^2, 10^{-2} to 10^{-3} of that of solid basalt. Secondary ejecta (rocks) will then penetrate the surface unless their ejection distance is less than a few hundred meters. This is true for small and larger rocks alike. The rocks seen on the Luna IX frames may therefore be regarded as having originated in an area not much larger than the field of view itself.

Some 60 rocks are readily identified on the Luna IX pictures, and their dimensions have been estimated by the same method as used for the foreground rock of Fig. 1. The size frequency distribution is somewhat less steep than is customarily found for fragmented material, in the sense that small rocks are not as frequent as according to this general law. If this effect is real, it might be due to sputtering, which would decrease the dimensions of small rocks at a faster proportionate rate. At least some of the rocks show the same vesicular fine structure exhibited by the terrain on which they rest. It cannot be readily determined whether the 60 rocks counted belong to a single nearby impact crater, possibly the one just visible in the upper right-hand corner of Fig. 1, or belong to several impacts in the area. Presumably the latter applies. In addition, it is not impossible that some rocks are similar in nature to those observed on the Ranger VIII records in several collapse depressions, and were formed *in situ*.

The Luna IX scans show numerous shallow craters or depressions which together cover a substantial fraction, perhaps half, of the entire surface. A few shallow holes in the foreground, only about 10 cm in diameter, are probably minute impact craters. If so, their rough surface texture, the same as that of the surrounding surface, and the absence of a raised rim, would indicate that the impacts occurred on solid, cohesive, though highly vesicular, material. Most of the larger depressions have the appearance not of impact craters but of collapse depressions; one exception is noted in the upper right part of Fig. 1. No steep elevated rims are seen, only gentle inward slopes, starting at first imperceptibly and then increasingly curving inward, much like the dimple craters observed on the Ranger records. The single frame of Fig. 1 does not show the geometry of these depressions adequately, but the stereo view does quite well. The interpretation based on the stereo is found in the sketch of Fig. 2. Estimated distances to some points in the drawing are indicated, based on the assumed camera height of 60 cm.

Some of the pits observed are probably small impact craters. Small high-velocity impacts on basalt are known to cause the resulting craters to be shallow, rough, and nearly rimless. On the other hand, impacts in scoria would have caused prominent crater rims. To illustrate this, we reproduce in Fig. 3 secondary impact craters in scoria on a gentle slope of crater Laimana, Hawaii, photographed with a higher sun angle than used in Fig. 1 (23° vs. 8°). No such rims are seen in the Luna IX records. It is provisionally concluded that the surface shown by Luna IX is highly vesicular igneous rock, like basalt (rock froth), as expected from a mare deposit *in vacuo* (*2*). This conclusion is strengthened by the presence of some straight and narrow ridges traversing the field covered by Luna IX. These also indicate a cohesive igneous deposit. It is further strengthened by the occurrence of long lines of vesicles occurring in various locations in the surface rock, indicating cohesive and continuing solid structure.

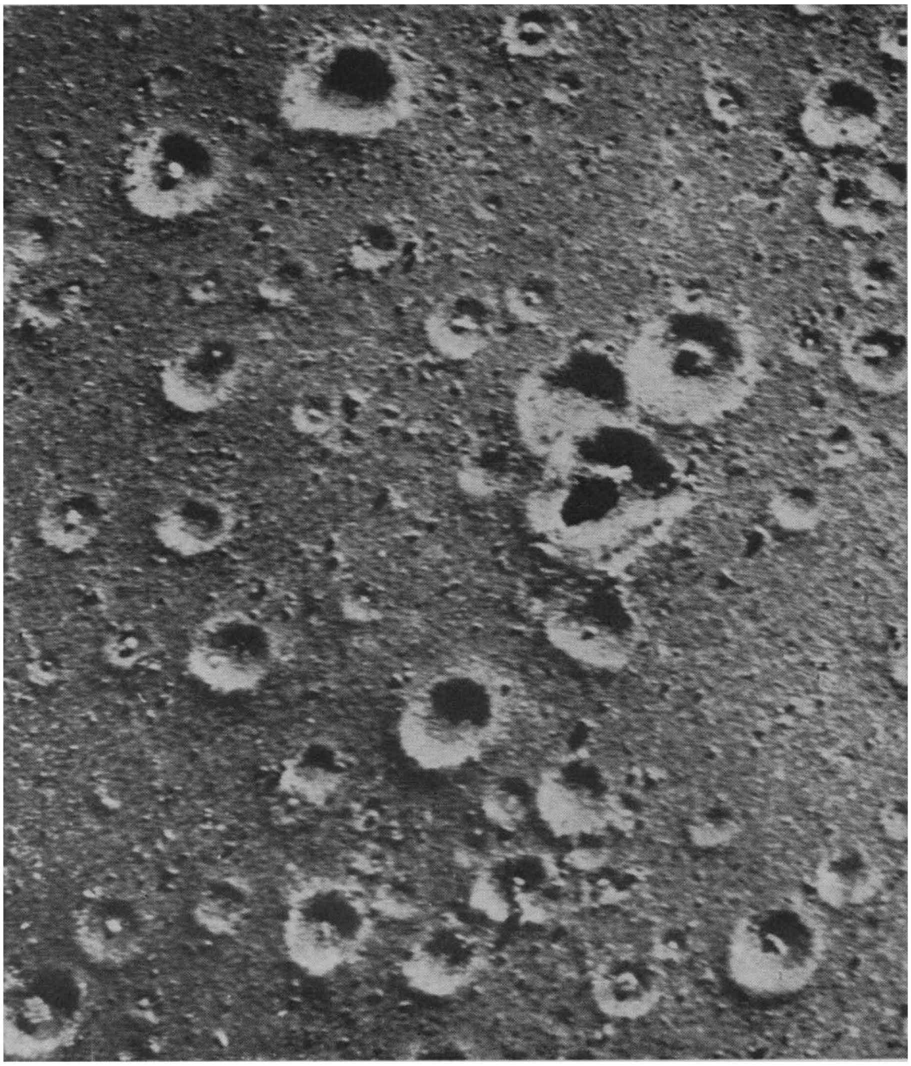

Fig. 3. Secondary impact craters in scoria, showing prominent elevated crater rims produced by loose material.

The same conclusions are reached independently from inspection of the thin metal piece shown near the center of the panoramic view, close to two shallow impact craters, each approximately 10 cm in diameter. This blade-like arm apparently rests on one corner and yet has not visibly penetrated the lunar surface. This shows that the surface is neither dust nor loose scoria nor debris, but hard, cohesive, though clearly very vesicular, rock. The arm is free from any visible dust deposit (upper limit perhaps 1 mm).

It had been feared by some students of the moon that a landing craft might immediately be covered with dust by the action of electrostatic forces. There is no evidence that this process is important, since the Luna IX components visible on the record appear in a very clean condition. Also, the camera pictures are clear and sharp and no stray light appears above the horizon. Apparently the optics remained clean upon exposure a few minutes after landing. The cleanness of the lunar surface also may explain the absence of a visible dust cloud from the impacts of Rangers VI, VII, VIII, and IX.

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References

1. *Pravda*, editorial (6 Feb. 1966); New York *Times* (6, 7, 8, 11, 13 Feb. 1966); *Assoc. Press* (10 Feb. 1966).
2. G. P. Kuiper, "Ranger VII: Pt. 2, Experimenters' Analyses and Interpretations," *Jet Propulsion Lab. Tech. Rept. No. 32-700* (1965), pp. 11 ff; *Sky and Telescope* **29**, 308 (1965); ———, R. G. Strom, R. Le Poole, "Ranger VIII-IX: Experimenters' Analyses and Interpretations," *Jet Propulsion Lab. Tech. Rept.*, in press.

28 February 1966

Water-Drop-Producing Equipment

Experiments on transience in water drops similar to those shown by Ross Gunn [*Science* **150**, 695 (1965)] can be accomplished in another way by using a 60-cycle vibrating pump (No. 19003, United States Plastic Corp., 1550 Elida Road, Lima, Ohio). Figure 1 shows a drop-display apparatus with a circulating water system. The steadiness of the flow is apparent in the close-up photograph. A small amount of fluorescent dye (fluorescein disodium salt) can be