ORIGIN OF THE MOON AND SOLAR SYSTEM; H. C. Urey, University of California, San Diego, La Jolla, California 92037.

I am going to review again my ideas about the origin of the moon and the solar system. I fundamentally assumed that, at the beginning, there was a gaseous nebula of the type assumed by Hayashi. The gas was finally blown away by a high temperature sun, and the moon was captured. The efficiency of the process of making planets was very inefficient. The original nebula had a mass of .6 the mass of the sun. We had lunar gas spheres produced by gravitational instability. The calculations were made assuming the surface temperature was $0^{\circ}K$. If we assume uniform temperature in the gas sphere or a finite temperature at the surface of the sphere, it becomes infinite. These gas spheres of lunar size throughout the solar system give us a number of interesting points which we have observed. (1) The settling of solids from the gas would occur at low temperatures, if the radius of the sphere is sufficiently large. As it contracted, the center would become hot. It also might be true that the central region would remain hot or cold throughout a settling process. (2) The structure of the moon is unknown really, and today, I am assuming that it had a cold center at the beginning and a hot exterior early in its history. This would be provided by this model. (3) The volatiles would be lost if the temperatures got high enough. This was pointed out by Janet Bainbridge 10 years ago. Whether this applies to the moon as a whole, or whether only to the surface, of course, we do not know. (4) The siderophiles would be lost from the surface of the moon as is observed. The reducing of the iron in the outer melted layer would result in the settling of iron through the liquid phase, and this would extract the siderophiles satisfactorily. I do not understand the exceedingly low concentration of gold. (5) Magnetic fields could be produced, if the settling process occurred in the presence of an external magnetic field. This has been developed into an article by Dr. Runcorn and myself. (6) It is not necessary that all the lunar objects should be alike. The moon certainly is not like our meteorites, but I think it is possible that modifications of the process could produce the carbonaceous chondrites, if the temperatures remain cold throughout. The achondrites would require a considerable melting and a solidification process. The chondrites are hard to account for, but I believe even these could be accounted for within this model.

There are difficulties with the gas sphere model. The density of the moon is too low as compared with the earth. However, the people working on the abundances of iron in the sun have a considerable spread of values, including those which could be in agreement with the lunar density. Of course, if the moon represents the primitive material of the sun, we must then account for the high density of the earth and the terrestrial planets. There are methods by which this could be done. This, of course, assumes that we have a captured moon. Of course, the capture is improbable by any process which has been proposed. Fermi used to say that a miracle was anything which had only a 10% chance of occurring, but I think the capture of the moon by the earth is a miracle of several orders of magnitude. There must have been many moons about if this is its origin. The gas sphere model supplies them.