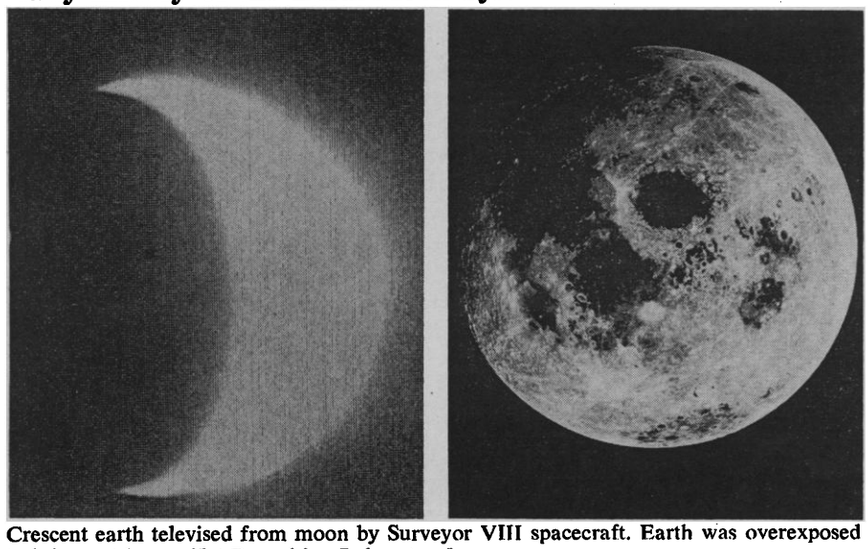
28 December

Early History of the Earth-Moon System



Crescent earth televised from moon by Surveyor VIII spacecraft. Earth was overexposed to bring out lasers. [Jet Propulsion Laboratory]

In spite of centuries of speculation, aided in recent decades by the most refined geophysical and astronomical observations, and now by the direct examination of lunar samples, the question of the origin of the moon continues to be without a generally accepted solution. There appear to be three basic possibilities, and of course all kinds of intermediate possibilities: (i) The moon may have been created entirely apart from the earth although in a similar region of the solar system, and may have been captured by a fortunate happenstance, presumably through the intermediary of tidal action; (ii) the moon may have been created along with the earth essentially as a consequence of the formation of the earth, and in the course of events have ended up in orbit about the earth; or, (iii), the moon may have formed in a fission process, rather later than the earth but out of the earth itself. In all of these cases, there would have been a strong, almost cataclysmic interaction between the moon and earth in their early history, shaping their later development.

These three viewpoints are being hotly contested. There is fairly general agreement that the moon was very close to the earth at one time, within three earth radii or even less, and that its present orbit at about 60 earth radii has developed slowly through tidal interactions with the earth. There is, however, a school of thought that believes that the moon was never closer to the earth than 30 to 40 earth radii, but was acquired "at a distance"; in that case, of course, the moon would have exerted little influence on the development of the earth, and vice versa.

Be this as it may, the time is approaching when the range of speculation for each of the major theories of origin is being narrowed by experimental evidence. The experimental data from the moon itself, combined with the more sophisticated application of geochemistry and petrology, may bring about some general agreement on which of the possibilities for the origin of the moon is most likely to be correct. As the first truly scientific mission to the moon, Apollo 15 may be the watershed for such an event; and therefore a general discussion of the early history of the earth-moon system is likely to be very profitable at this time.

Emphasis has been placed on the earth-moon system rather than the early history of the moon by itself, or the early history of the earth by itself. It is important to recognize that geology and geophysics can illuminate for us questions of the origin of the moon; and in return, the detailed examination of the moon can tell us something about the earliest history of the earth —that portion of its history which has been completely obliterated by a variety of geological processes. A central question to which the symposium addresses itself is: Has the moon ever been very close to the earth, and at what time? What can we say about the time scale of evolution of the lunar orbit based on astronomical, paleontological, and geophysical evidence, using geochronology and geochemistry and all that we can bring to bear from other areas of science? Another set of questions relates more particularly to the structure and composition of the moon's interior and to the lunar surface: How can we use such evidence to study the early history of the moon itself? What has been the thermal history of the moon and what can we learn about its early heating and the nature of the heat sources? Is there evidence for a general melting of the moon and a differentiation similar to that undergone by the earth? Is there evidence for a prehistoric disruption of the moon by the earth's tidal forces, and is there evidence for an assembly or reassembly of the moon from separate pieces, or has this been obliterated? What can we learn about conditions in the solar system four or more billion years ago by examining the lunar surface?

Finally, what can we say about the origin of the moon? How can we delimit the various hypotheses that now exist, and how can we establish the consequences to the earth from a particular hypothesis of lunar origin? Of special significance are such fundamental questions as: Does the earth's moon represent a unique or a commonplace event? If commonplace, such as would be implied by joint formation, then why does Venus not have a moon? If unique, as implied by capture, then can we use the existence of the moon to explain other unique features of the planet earth—and especially its early evolution of an atmosphere and hydrosphere and the evolution of life itself?

Inevitably, our speculations have to be constrained by what we can surmise about the early history of the solar system itself, and about the assembly of the planets and planetary-sized bodies such as the moon (if indeed the moon assembled in that way). It is very likely

that the moon can give us an important clue to the early history of the solar system, a clue which certainly should be exploited. Did the moon assemble like the earth? Then how do we account for such obvious discrepancies between the earth and moon as the lower lunar density which is caused by its relative scarcity of iron, as well as the more recently discovered scarcity of volatile substances on the moon?

These and other questions will occupy the symposium on the Early History of the Earth-Moon System. Through a happy coincidence it follows by one day the 400th anniversary of the birth of Johannes Kepler on 27 December 1571. A Kepler Symposium will be held at the Franklin Institute in Philadelphia on 27 December. It would indeed be a fitting tribute to Kepler himself if during his quadricentennial year one of the most fundamental problems of the solar system could be brought toward its solution.

S. FRED SINGER
University of Virginia, Charlottesville

29 December

Communications Technology and Its Effect on People

Communications technology now makes feasible the inexpensive delivery of video, voice, and data channels to the home by coaxial cable. Cable television systems, providing bandwidths at least 10,000 times greater than those of conventional telephone circuits, are being developed or planned commercially in most U.S. cities. Beyond carrying 20 or more television channels one-way into the home, they will evolve into two-way communication networks within the next few years. Other types of wideband communication systems in cities also have been proposed.

To what uses will the new communications capacity be put? Who will use and control it, and how will it affect people's lives, if at all? Estimates of the near-term impact of this technology range from trivial (more television situation comedies to choose from) to profound (a greater sense of community cohesiveness from locally originated television programs with direct viewer response).

Two areas of specific impact may be education and local politics. Instructional television in the home with individual student feedback could be important to both formal and informal education at all levels. Interactive television could lead to direct, immediate opinion polling on local political issues —the "instant referendum." Health care delivery, law enforcement, and other urban services may also be influenced by the availability of new communication channels.

The construction of urban cable communications networks in the 1970's will provide an important example of the interactions between technology, commercial development, and public policy. The social benefits and costs of this technology should be assessed and widely discussed today—before the new systems are in place. This symposium will bring together current research and policy studies on these questions, focusing on developments now under way or likely to be implemented in the next 5 years.

Speakers and titles of their papers are: Edward S. Mason (Sloan Commission on Cable Communications), "The social impact of cable communications"; Peter C. Goldmark (National Academy of Engineering), "New urban applications for communications technology"; and George F. Mansur (Executive Office of the President), "The government role in new communications developments."

WALTER S. BAER
Rand Corporation,
Santa Monica, California

27 December

Technology and the Humanization of Work

The symposium, "Technology and the Humanization of Work," will explore attempts to humanize industrial work, particularly in relation to technological and cultural changes. The issue of the humanization of work is particularly important at a time in which both cultural patterns and technology are in process of change.

Social and cultural changes in the United States have led to rising expectations and demands about life and work. Modes of work acceptable in the past are today considered oppressive by many young workers who want to avoid jobs that are monotonous, repetitive, overcontrolled, and isolated from interaction with others. In contrast, workers seek jobs that require activeness—planning and judgment on the part of the worker—autonomy, variety, and that are demanding enough to stimulate learning. Most workers are also greatly concerned with opportunities for career development. In addition, workers are increasingly concerned that the work be "meaningful"; that it involve clearly useful tasks; and that it require sufficient skill to be worthy of respect. Taken together, these requirements move in the direction of the humanization of work. In contrast, dehumanized work implies a job which transfers the worker into a machine part, totally controlled, fully predictable, easily replaceable, and alienated from himself as a human being.

In some industries, opportunities for the humanization of work have resulted from technological developments. In other industries, the restructuring of work has been stimulated by management's desire for increased productivity and improved labor relations. Some experiments in the humanization of work have led to the satisfaction of both workers and management. Other experiments have been stopped because they stimulate pressures toward a more basic restructuring of industrial life.

Participants in the symposium include social scientists, labor leaders, managers, and government officials. They will describe programs that have been carried out in the United States and Europe. The pressures for change and the constraints on the humanization of work will be considered in particular cases. Some of the speakers have themselves reorganized work situations. Others have studied such programs. Further speakers will report on studies of workers' attitudes. Time will be set aside for questions and contributions from the audience. Members of the audience who have themselves participated in relevant industrial programs are invited to share their experiences at the symposium.

MICHAEL MACCOBY
W. E. Upjohn Institute
for Employment Research,
Washington, D.C.