result of lithification in a marine environment and, perhaps, hydrothermal activity during subsequent diagenesis, with production of lignin-cellulose derivatives which are volatile, yet of comparatively high rank (*1*). The process altered the chemical nature of the coal in a direction quite different from that taken by normal vitrinite, and yet left the vitrinitic microstructure mostly intact. Although some apparently resinitic material is identifiable in thin sections, there is by no means enough to account for the high volatile content of the jet; this must depend on the properties of the amorphous organic matter that makes up the tracheids and fills other spaces in the woody structure. This provides a striking example of the proposition that ". . . from a single plant tissue various dissimilar materials may result as products of coalification" (see *7*).

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References and Notes

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9. Recalculated from E. S. Moore, *Coal* (Wiley, New York, ed. 2, 1940), p. 100.
10. We acknowledge the assistance of R. R. Dutcher and J. C. Crelling with reflectance measurements, P. H. Given with infrared absorption spectrum analysis and interpretation, F. J. Vastola with laser mass spectrometer data and interpretation, as well as the advice of J. M. Schopf and the late J. A. Harrison. G. B. Baetcke identified *G. newberryi*, and J. R. Odekirk made preliminary microscopic examinations of samples of the jet.
11. Publication authorized by the director, Utah Geological and Mineralogical Survey.

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Venus: Uniformity of Clouds, and Photography

Abstract. *Photographs of Earth at a resolution of about 600 kilometers were compared to pictures of Venus taken from Earth at about the same resolution. Under these conditions Earth appears very heavily covered by clouds. Since details on the surface of Earth can be recorded from Earth orbit, it may be possible to photograph portions of the surface of Venus, through openings in the clouds, from an orbiting satellite.*

Photography of the surface of Venus from an orbiting spacecraft may be more rewarding than appears from study of our current pictures of Venus. This possibility is suggested by pictures of Earth taken from Moon by Lunar Orbiters I and V; these views show Earth at a surface resolution of about 7 km and with a cloud cover of at least 50 percent. In a picture taken by Lunar Orbiter I on 23 August 1966, gaps in the clouds appear small and widely scattered except for one area, 700 km in diameter, in the South Atlantic Ocean near the African coast. It seemed possible that, if this view of Earth were photographed in a manner similar to that used to record Venus from Earth, the reduced surface resolution (500 to 700 km) might produce a nearly featureless image of our planet.

This idea was explored by photographing a back-illuminated, positive transparency of the LOP-I picture of Earth. The contrast of this transparency was adjusted to a maximum of 6.3:1, measured between clouds and the darkest ocean surface; of course, most adjacent details were usually of much lower contrast. The laboratory photograph was made on Kodak Plus-X film with a lens of 135-mm focal length, stopped to *f*/70 by means of a 1.93-mm aperture. A flame from a cigarette lighter, held in front of this aperture, simulated the terrestrial air turbulence during the 0.5-second exposure. This optical system formed an image of Earth, 4.36 mm in diameter, that showed a limiting resolution of about 600 km. The size, resolution, and effect of film grain in this image are similar to those in an image of Venus made with an Earth-based telescope of 304-mm (12-inch) aperture at a focal ratio of *f*/70.

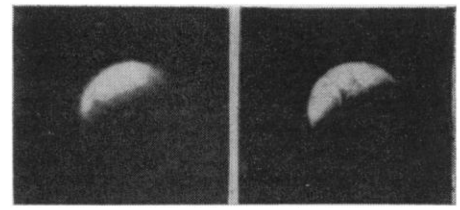

Fig. 1. (Left) Venus photographed in ultraviolet light with 304-cm reflector at Lick Observatory. (Right) Earth pictured by Lunar Orbiter I and rephotographed on Kodak Plus-X film at *f*/70 to obtain an image size of 4.36 mm.

An enlargement of this image was compared (Fig. 1) with a photograph of Venus taken in ultraviolet light with the 304-cm (120-inch) reflector at Lick Observatory. Details on Venus are very faint, even in a high-contrast print made from an ultraviolet record; normal white-light photographs of Venus show on details.

While the low-resolution view of Earth does reveal a few dark areas, it is sufficiently like the picture of Venus to rather firmly discourage an inhabitant of Mars, for example, from ever expecting to record many surface details on either planet.

Furthermore, this same comparison illustrates the need for careful study of orbital photography of Venus before conclusion that such a mission would be useless. Photographs of Earth taken by astronauts and by weather satellites show considerable surface detail through what are essentially holes in a fairly uniform cloud cover. Surface details may also be found in images of Venus taken from orbit by use of a selection of filters in the visible and ultraviolet spectrum with a camera capable of resolution of 1 to 3 km.

Venus would in fact appear quite featureless from Earth even if there were substantial gaps in the clouds. The high surface temperature on Venus eliminates the presence of oceans, which appear very dark in photographs of Earth. Most of the details in low-resolution pictures of Earth, taken from space, are caused by the contrast between oceans and clouds. On Venus, dry land areas would be of low contrast relative to the clouds and would be difficult to record in Earth-based photography.

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