chanical properties of the lunar surface, we must clearly avoid forcing the explanation toward unlikely occurrences in order to preserve terrestrial-type surfaces. Rather, we must wonder whether the lunar surface is of a kind that makes this kind of event probable.

Plastic deformation time constants in any kind of rock material are many orders of magnitude longer. No significant deformation can be envisioned that would take a matter of hours to occur and then trigger a movement of larger amplitude. The only exception that we can now suggest would be time constants in the nature of those of an hourglass. If the lunar ground underneath Luna 9, and perhaps underneath most areas, had many hollow spaces, such as those that would be produced by all the many secondary impacts at moderate speeds, then it is conceivable that the additional loading may cause many such cavities to cave in. The time constants of caving in may then be given, just as in the case of an hourglass, by the many small particles that have to fall in sequence before a major structural change is made. If the addition of a new weight on the surface opens up a few new cracks in a very porous structure of not very firmly cemented small particles, then little collapses and landslides may appear until eventually the structural properties are so changed that a major collapse takes place.

The Luna 9 pictures clearly show a great many small holes. It is not clear whether some of these holes go deeply into the ground. A powder consisting of particles that have substantial cohesion would have the property that projectiles at rifle bullet speeds would easily make deep internal channels. The bombardment which is secondary to the larger meteoritic impacts will be of that nature, and the lunar ground may well be in the equilibrium configuration which is obtained by tunneling and collapse caused by primary and secondary impacts. That equilibrium may contain at any time a lot of features that are not far from collapse; under these circumstances, the movements of Luna 9 would be probable events.

This interpretation of the occurrence cannot of course be taken as more than a possibility. The lunar surface may be unusual in ways that we have not yet thought of. While we may refrain from accepting any one explanation of the phenomenon of the movements of Luna 9, we should not at this stage ignore an occurrence that constitutes one of the few pieces of information we have concerning the mechanical properties of the lunar surface.

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Drifting Organisms in the Precambrian Sea

Abstract. *Drag marks in the Upper Precambrian Winnall Beds of central Australia were made by semibuoyant flexible objects at least 15 centimeters long, which presumably were algae. This find extends the range of such marks into the Precambrian era and supplements the discovery of microflora in the same sedimentary sequence.*

While mapping the Henbury meteorite craters, Northern Territory, Australia, in 1963, I noted sedimentary features in Upper Precambrian rocks that indicate the presence of relatively large organisms. The recent discovery of preserved microorganisms in the same sedimentary sequence (*1*) adds interest to these observations.

The best examples of markings were found in fragments of a sandstone bed 15 cm thick that is intersected by crater 4 of the Henbury crater field (*2*), about 11 km WSW of the Henbury homestead. Although the outcrop of the bed is concealed, fragments ejected along ballistic trajectories during meteorite impact (*3*) form an ejecta ray 70 m long on the west side of the crater. The base of the sandstone bed preserves casts of grooves that had been scribed on the smooth upper surface of the bed below—presumably a shale bed.

Some of the grooves (as determined from their casts) are barely perceptible; others are as much as 3 mm across. The larger ones are rounded in cross section, and the smaller ones tend to be more angular. Some single grooves occur, but most of them are in parallel sets. Most sets are nearly straight throughout their length; a few show curves or even abrupt reversals of direction (Fig. 1). The width of the larger sets indicates that the dimension of the

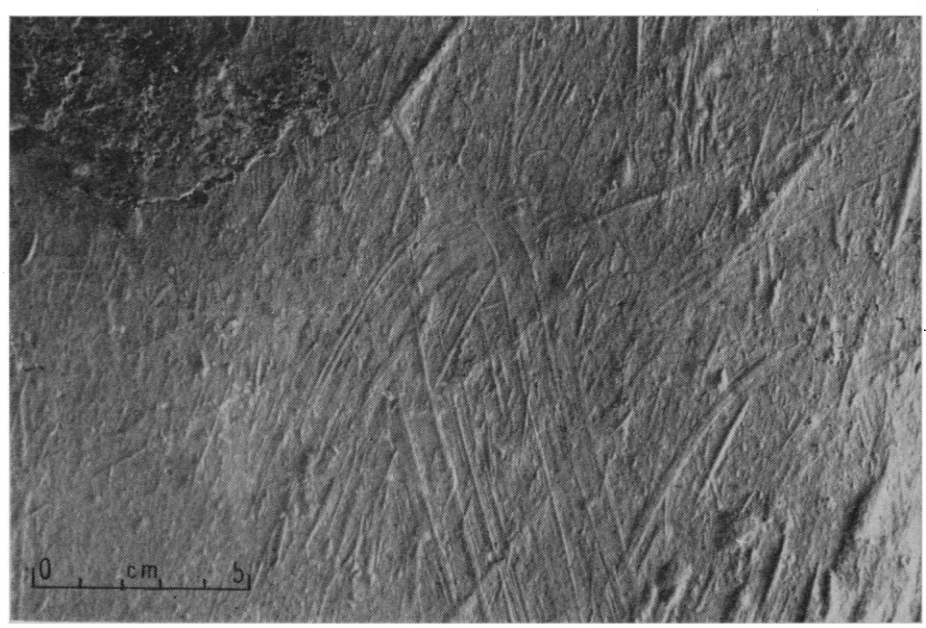

Fig. 1. Drag mark casts on sole of sandstone bed, showing an abrupt change in direction of more than 140°.

scribing objects at right angles to the direction of transport reached at least 15 cm—a limit fixed by the size of the available sandstone blocks. The dimension parallel to the direction of transport, as indicated by the spread of turning points of separate grooves within curved sets (Fig. 1), attained at least 3 cm. The pattern of the grooves within a set does not reflect any regular structure in the scribing objects. Rigid transparent overlays fitted to the points of inflection of grooves in curved sets cannot be moved along the sets, which shows that they were scribed by nonrigid objects (*4*), even though the approximate parallelism of the grooves suggests some degree of rigidity. The short length of some sets, as well as a 10-cm gap in one set where it crosses a trough 2 cm deep in the bedding surface, indicates that the scribing objects were semibuoyant and had a specific gravity at most only slightly higher than that of sea water. The scribing objects were apparently not heavy stones in the holdfast of seaweeds, but drifting organisms—probably algae, perhaps with small stones or sand grains attached. The variety of orientations of intersecting sets, as well as the changes of direction of individual sets, indicate that the objects were moved by random currents or, more probably, waves. Irregular oscillation ripple marks on the upper surface of the sandstone bed suggest wave action. Unlike similar drag marks described by Kuenen (*5*), these marks were not scribed by objects moved by turbidity currents, the absence of which is indicated by lack of either graded bedding or fluted soles in the sandstone bed.

The formation in which these markings occur has been mapped as the Winnall Beds (*6*), which near Henbury are laterally transitional into the Pertatataka Formation. These beds unconformably underlie the Pertaoorrta Formation, which contains Cambrian fossils. A potassium-argon age of 760 ± 33 million years has been obtained on a shale sample of the Pertatataka Formation (*6*). About 200 km from Henbury, Barghoorn and Schopf (*1*) found actual preserved microorganisms (interpreted as filamentous green and blue-green algae) in the Bitter Springs limestone, several hundred meters stratigraphically below the Pertatataka Formation.

The markings described here fit the definition of drag mark casts (*7*), if the association with turbidites emphasized in the original use of the term (*5*) is not considered essential. They have also been given a variety of Linnaean names by those who regarded them as fossils. The reported range of these forms extends from Cambrian to Recent time (*8*). This find extends the range into the Precambrian and indicates that before the beginning of the Paleozoic era life had evolved beyond the microscopic forms described by Barghoorn and Schopf into organisms as large as much of the seaweed in modern seas.

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Absence of Short-Term Variability of CTA 102

Abstract. *Short-time variations in intensity of about 40 percent, with a period of the order of 100 days, have been reported for the quasistellar radio source CTA 102 at 32.5-centimeter wavelength. We have observed CTA 102 at 25.5-centimeter wavelength over a 67-day period and have detected no significant variations of intensity.*

Sholomitskii (*1*) has measured rapid variations in the 32.5-cm wavelength emission of CTA 102 during the period from August 1964 to February 1965. The observations indicated that the intensity varies periodically over at least the range 1.39 to 1, with a period close to 100 days. However, Maltby and Moffet (*2*) found no evidence for variations in the intensity of CTA 102 at 31.3-cm wavelength in a number of observations from August 1959 to September 1961. Also, Caswell and Wills (*3*) observed no significant difference in intensity at 168-cm wavelength in measurements in July and August 1964 as compared to measurements in September and October 1964, where the central dates for the two periods differed by only a few days from times of minimum and maximum predicted by Sholomitskii's observations. CTA 102 has been identified with a quasistellar object by Sandage and Wyndham (*4*).

We observed 135 sources, including CTA 102, at 25.5-cm wavelength between 7 October and 13 December 1965 in a program to measure their linear polarizations. Twenty of the sources, including CTA 102, were observed on nearly every day of the 67-day observing period. The remaining sources were observed during either the first or last half of the period.

The measurements were obtained with the National Radio Astronomy Observatory 300-foot (90-m) transit telescope at Green Bank, West Virginia. Two identical radiometers were connected to orthogonal, linearly polarized outputs of a rotatable circular-waveguide feed antenna at the focus of the reflector. The radiometers were the same ones used previously for polarization in the 300-foot reflector (*5*) except that the center frequency for our observations was 1175 Mcy/sec. Each radiometer accepted power in two bands 3.5 Mcy/sec wide, separated by 20 Mcy/sec.

The observations consisted of simultaneous measurements of source antenna temperatures at orthogonal polarizations once each day with the feed antenna orientation fixed. The averages of the uncorrected antenna temperatures measured on two polarizations are plotted in Fig. 1 as a function of date (U.T.) for CTA 102 and the comparison sources 3C 205, 3C 418, 3C 436, and 3C 444. The straight lines in Fig. 1 are least-square fits. Similar plots and least-square fits have been made for all of the sources. Inspection of these plots indicates no change in the intensity of any source that is significant compared to the measurement errors over this relatively short time base. The observations are not sensitive to relatively long period variations such as have been observed in the quasistellar sources 3C 273B, 3C 279, and 3C 345 by Dent (*6*), and in 3C 273B by Maltby and Moffet (*7*).

In particular, inspection of Fig. 1 shows no change in the intensity of CTA 102 for a single observation greater than ± 4 percent from the