(k is the slope of the curve of growth). Then the height $\bar{z}$ of the surface above a suitably defined mean level is introduced into the expression

$$R = \text{constant } (\eta)^k \exp(-k\bar{z}/H) \quad (3)$$

Here H is the scale height in the atmosphere, which we have taken as 10 km. Our 1967 data indicated that $k = 0.72$ for lines in this band, and we have taken $R = 0.12$ at $\eta = 2$ to define a mean level for the surface. This choice of zero level is, at the present stage of reduction, quite arbitrary and we are not able to assign a specific value of the partial pressure of CO_2 to it; the most we can say is that our previous value of 5 millibars seems to be roughly consistent.

On the evening of 1 June/2 June (Mountain Standard Time) we were fortunate enough to have moderately fair skies and excellent seeing, which allowed us to obtain data on the regions surrounding and including the very dark feature Syrtis Major. (After 4½ years of observing Mars with the solar telescope this was the first time that we could easily recognize features on the planet.) Figure 1 shows the distribution of heights which was obtained from the data by means of Eq. 3. The numbers are given in kilometers. By linearly interpolating between the data points we constructed a contour map of the region: lines are drawn at 2-km intervals. It is important to note that much of the detail that appears in the contours is due to the numerical interpolation and is probably unreal (*7*). What should be significant is the general trend and direction of the slopes. The spatial resolution element is also shown on the diagram. The following preliminary conclusions can be drawn: (i) Syrtis Major is part of a high ridge that has relatively steep slopes. According to the one measurement that was precisely centered on the feature there was essentially no detectable CO_2 above it. (ii) Highlands are not restricted to the dark areas. This is in accordance with the radar data of Counselman *et al.* (*5*). (iii) The vertical scale of height variations is of the order of 10 km, which is also in agreement with the radar data. (iv) In several regions dark areas coincide with strong slopes (*8*).

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8. Contribution No. 461 from the Kitt Peak National Observatory, operated by the Association of Universities for Research in Astronomy, Inc., under contract with the National Science Foundation. We thank A. L. Broadfoot, I. R. Gordon, and P. Carlson for important contributions.

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Massive Internal Fracture of an Amorphous Polyester

Abstract. *When amorphous polyethylene terephthalate is subjected to a tensile load of 2 to 4 × 10⁸ dynes per square centimeter within the approximate temperature range 40° to 70°C, an unusual optical effect occurs. The transparent polymer film is suddenly transformed into a brilliantly reflecting strip with the luster of silver. Extensive formation of voids accounts for the unorthodox behavior.*

An unusual optical effect can be observed when amorphous polyethylene terephthalate film is dead-loaded in tension. This report describes the effect, its possible nature, and the stress-temperature conditions under which it occurs.

Polyethylene terephthalate (PET) is usually available in semicrystalline form, and it is in that state that it finds use as textile fiber and as film for electrical and other applications. When cooled rapidly below the melting point (265°C), PET can be fabricated into relatively rigid, transparent film or fiber that diffracts x-rays in the manner characteristic of amorphous liquids. Amorphous PET fibers can be stretched homogeneously at constant extension rate until a constriction (or "neck") forms that becomes stable when the cross section of the fiber drops to about 30 percent of the original area (*1*). Once formed, the neck travels along the specimen and consumes it in a process known as cold-drawing (*2*) (Fig. 1).

We deformed rectangular strips of amorphous PET film (*3*) in the temperature region 40° to 70°C by deadloading rather than by stretching at constant elongation rate. When the stress imposed was sufficiently low, the specimen responded in elastic manner at first by elongating rapidly, but thereafter extended very slowly and apparently homogeneously in the manner characteristic of rigid viscoelastic bodies in creep. Such behavior was observed in the region of the stress-temperature plane which is marked "homogeneous creep" in Fig. 2. When the stress exceeded a certain threshold (Fig. 2), cold-drawing, rather than homogeneous creep, occurred after a waiting period which ranged from 1 second to about 15 minutes. Further increase of the load led to a sudden and remarkably fast elongation of the specimen to several times its original length and its simultaneous conversion from a transparent to a brilliantly reflecting strip with the luster of silver (Fig. 1). This rapid optical transformation occurred under stress-temperature conditions which are labeled "internal fracture" (Fig. 2). At even higher stresses, the specimens became lustrous, but then almost immediately failed ("compound fracture," Fig. 2). Additional increase of the stress invariably led to rapid

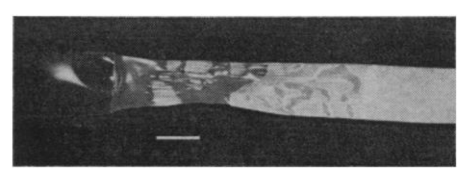

Fig. 1. A strip of amorphous polyethylene terephthalate subjected to a dead tensile load of 2.55×10^8 dynes/cm² (about 3700 psi) at 63.5°C. (Extreme left) Transparent undrawn specimen; (middle) cold-drawn translucent section containing patches of opaque, lustrous material; (right) highly reflecting, silvery material. Scale, 1 cm.

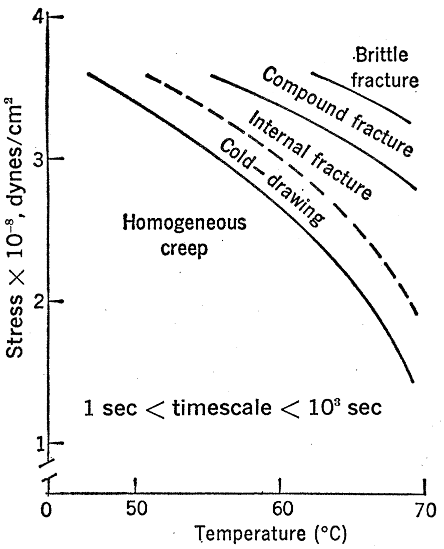

Fig. 2. Modes in which amorphous polyethylene terephthalate deforms. Definition of terms is given in the text. The broken line indicates that the boundary separating areas is not sharp and that two different modes of deformation can occur simultaneously, as in Fig. 1. The time interval during which these observations were made ranges from 1 to 1000 seconds following the application of load.

failure of the transparent strip (*4*) ("brittle fracture," Fig. 2). Specimens that deformed in more than one of the modes described above could also be prepared when stress and temperature were properly chosen (Fig. 1) (*4*, *5*).

The transformation of an optically clear polymer film to one that is highly opaque, indeed reflecting, is undoubtedly evidence of large-scale heterogeneity of the refractive index in the interior. We have observed that such heterogeneity disappears and the strip again becomes transparent whenever pressed firmly against a hard surface with a sharp edge (even with a fingernail). Furthermore, we find that the x-ray photograph of a lustrous film specimen does not show any crystalline reflections.

These findings are consistent with the conclusion that specimens of amorphous polyethylene terephthalate are capable of massive internal fracture, leading to void formation, while remaining macroscopically whole. Whether PET undergoes internal craze formation in the manner described for other polymers (*6*) is unknown, but the optical effect produced with PET is nevertheless remarkable, both in the suddenness with which it appears and in the brilliance achieved.

This phenomenon can be explained tentatively and qualitatively, if one recalls that amorphous polyethylene terephthalate is capable of crystallization under stress (*5*). The precise structural features of the crystallites so formed are still an unsettled issue. However, these centers of superior chain alignment are denser than the surrounding matrix and are, therefore, placed under tension by it. Should the lateral chain order induced by external stress give rise to a few, sufficiently large crystallites, the tension acting on them could be readily relieved by chain segment motion if the polymer were above its glass transition temperature, T_g. Such relief would not be forthcoming within the timescale of our experiments if the polymer were below T_g. The tension exerted on the crystallites by the matrix could then rise sufficiently to cause fracture of these crystallites and simultaneous nucleation of voids. The growth rate of such voids could be considered to be much faster than the rate of their nucleation, in which case these few voids would grow rapidly, coalesce, and cause the macroscopic failure of the specimen (brittle fracture). If, by contrast, the rate of void nucleation were much faster than the growth rate, voids would spread rapidly over the entire specimen, converting it into a highly extended and foamlike solid, but leaving it macroscopically intact (internal fracture). Should the void nucleation and growth rates be comparable in magnitude, intermediate cases might exist (compound fracture). Finally, both the void nucleation rate, as well as the growth rate, could be very slow compared to the duration of the experiment; in such a case, the polymer would simply form a neck and elongate extensively without forming voids, thereby preserving its transparence (cold-drawing).

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Coesite from the Richat Dome, Mauritania: A Misidentification

Abstract. *The "shattered sandstone" from Richat reported to contain coesite is a tectonic breccia and probably represents a shear zone developed during the structural doming. An optical and x-ray examination of concentrates from this breccia demonstrated that the supposed x-ray reflections of coesite are actually due to barite, introduced into the permeable crushed zone by groundwater.*

Aside from the actual recovery of meteoritic material, the most definitive evidence of an impact origin for a large circular geomorphic structure is the presence of shock-induced metamorphic effects in the rocks and minerals of the structure. The most common features encountered in the field are impact glasses, shock breccias, and shatter cones. In the laboratory one looks for changes in the minerals themselves. The principal changes, any or all of which may be present, include intense random shattering of mineral grains; planar features (sets of closely spaced fractures lying along unusual crystallographic directions) in quartz, feldspars, pyroxenes, amphiboles, and carbonates; complete or partial vitrification of one or more minerals without melting (for example, maskelynite); kink-banding in micas; and the high-pressure polymorphs of silicon dioxide, coesite, and stishovite (*1*).

Richat—a dissected dome, 38 km in diameter, situated in the Mauritanian Adrar—has long been considered a possible astrobleme, mainly because of its circular symmetry and the occurrence of extensive breccia deposits near the center of the structure. In 1964, Cailleux *et al.* (*2*) reported the presence of coesite in a "shattered sandstone" (*grès secoué*) collected close to the center of the Richat structure. Their identification was made on the heavy fraction of a