TABLE IV

Material	Vickers hardness (kg mm^{-2})	
	With soot	No soot
2024-T351 Al alloy	172 ± 19	192 ± 6
Soda-lime glass	741 ± 80	710 ± 25
Koldmount resin	18.3 ± 0.9	20.4 ± 0.6

TABLE V

Material	Yield strength/ Young's modulus
2024-T351 Al alloy	$\sim 5 \times 10^{-3}$
Soda-lime glass	$\sim 4 \times 10^{-2}$
Koldmount resin	$\sim 2 \times 10^{-2}$
Medium volatile bituminous coal	$\sim 2 \times 10^{-2}$
Semianthracite	$\sim 3 \times 10^{-2}$

a more densely soot-covered specimen is surrounded by a "halo", the extent of which generally increases as the ratio of the yield strength of the substrate to its Young's modulus increases (See Table V and Figs. 1 to 3). Accordingly, it is suggested that this halo is the result of local disintegration of the soot film under the action of the elastic tensile stresses generated during indentation in the surface regions of the substrate immediately outside the area of contact with the indenter. Note, however, that the formation of such haloes can be supressed by reducing the thickness of the soot coating (Fig. 3).

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Nucleation and growth of crazes in polycarbonate exposed to ethanol

In a previous publication the effect of ethanol on the environmental stress crazing of polycarbonate was described [1]. It was shown that both the nucleation and growth of crazes generated around a centrally located hole were controlled by the major principal strain. Photographic slides of the material being crazed, illustrations of which are shown in [1], were taken in time intervals of from 5 min to 9 h. Thus we have a record of the length of all crazes generated in the plates as a function of time.

It was found that new crazes initiated during the course of the experiment and that the frequency of craze nucleation was a function of time. Fig. 1 shows the average frequency of craze formation in a 3.2 mm thick polycarbonate plate containing a centrally located 12.7 mm diameter hole under a stress of 2.5 k.s.i. and exposed to ethanol.

The resultant distribution is not normal and, in fact, is highly skewed toward longer induction times. Since crazes nucleate at flaws, a craze that nucleates at a small flaw could grow for a long time before it reaches a "visible" size and is counted, while a craze emanating from a severe flaw might be detected much earlier.

A plot of the number of crazes formed as a function of time (Fig. 2) shows that the number of crazes first increases with time and then appears to reach a plateau. Continued exposure to solvent, however, appears to generate a new group of crazes after an additional induction period. Each craze appears to have a different growth rate and it is noted that some of the crazes show intermittant growth in which the crazes grow, arrest and then start to grow again. The reasons for these phenomena are not clear but it is known that crazes can interact with each other in a complex fashion.

Fig. 3 shows the total length of all crazes formed as a function of time, which is a measure of the cumulative damage in the sheet. The data plot to a straight line with a slope of one on log–log coordinates. The functional form is thus $x(t) = kt$, at least after a short initial period where it is

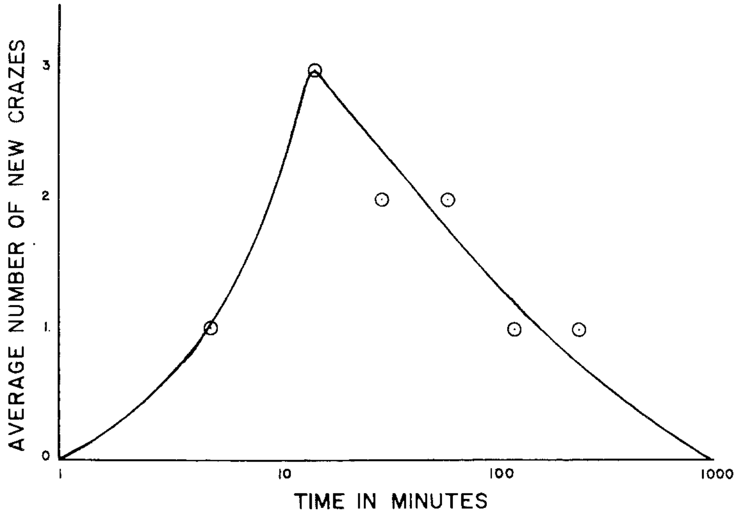

Figure 1 Frequency of craze initiation in polycarbonate plate containing 12.7 mm hole at 2.5 k.s.i. in ethanol.

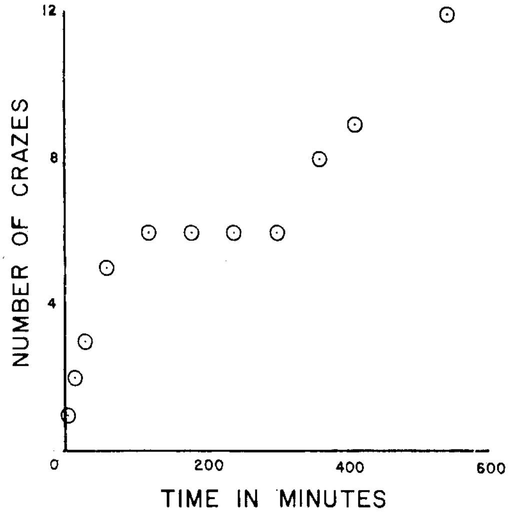

Figure 2 Cumulative nucleation of crazes in polycarbonate plate.

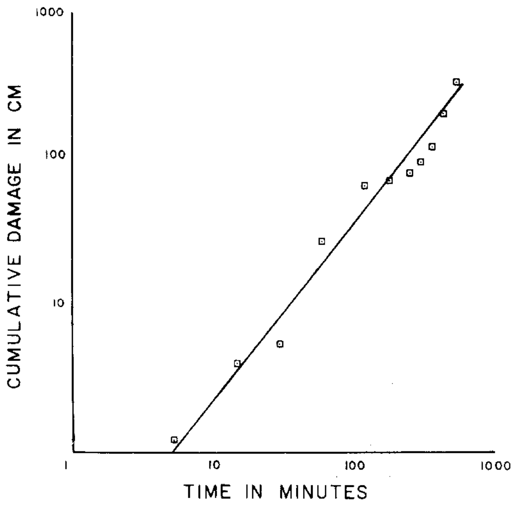

Figure 3 Cumulative damage in polycarbonate plate.

difficult to measure the total craze length. This corresponds to a cumulative damage model for a linear growth process [2].

It would be interesting to compare this result with those obtained for crazing in air and in other solvents since the constant k should be a function of the accelerating effect of the solvent, stress and temperature and could be used as indication of the severity of a solvent at a given stress level and temperature.

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