Samples of the polymer were irradiated, while sealed under vacuum in polyethylene tubes, in a beam of 2-MeV. electrons from a Van de Graaff particle accelerator. Doses received by the polymer samples were estimated by carrying out elastic modulus measurements at 150° C. upon the polyethylene tubes which had contained the samples[3]. It was found that the number average molecular weight decreased steadily in a manner which may be deduced from the assumption that breaks occur in the main polymer chain at random, and that the number of breaks produced is, initially at least, directly proportional to the radiation dose given to the sample. After a radiation dose of about 50 Mrad, prolonged extraction of the polymer with boiling toluene led to the separation of a cross-linked gel fraction from the soluble, degraded, polymer. The gel showed appreciable swelling in the toluene and a log–log plot of the equilibrium swelling ratio at 25° C. against the radiation dose, corrected for the dose necessary to bring about gel formation, gave a straight-line relationship of gradient −5/3, which is in accordance with the Flory–Rehner relationship for the swelling of cross-linked polymer[4].

From a plot of the values of the sol fraction against radiation dose when compared with the theoretical sol values in the presence of various ratios of cross-linking to molecular degradation as derived by Charlesby[5], it would appear that for every cross-link formed during irradiation, about 1·6 bonds between monomer units are broken.

Fig. 1 shows the variation of the experimental values of the sol fractions with radiation dose ; and, in addition, a plot of the intrinsic viscosity of a solution of the polymer up to the gel point.

Approximate yields (G values) for an energy deposition of 100 eV. are given in Table 1, which compares the yields with those of polyethylene and polyisobutylene.

Table 1

Event	Events per 100 eV. deposition		
	Polyethylene	Polyisobutylene	Polypropylene
Cross-links	6·8	0	0·6
Double bonds	3·4	9·3	3·9
Bonds between monomers broken	3·0	5·0	0·9

An examination of the infra-red absorption spectrum of irradiated polypropylene has shown that the principal chemical change, other than cross-linking and chain fracture, is the introduction of unsaturation of the type $R.R'C=CH_2$ (vinylidene). There is some evidence for the presence of a small amount of vinyl unsaturation, $RCH=CHR'$, but the band is obscured by another absorption band which has not yet been assigned.

It is suggested that the molecular degradation proceeds by the following disproportionation mechanism :
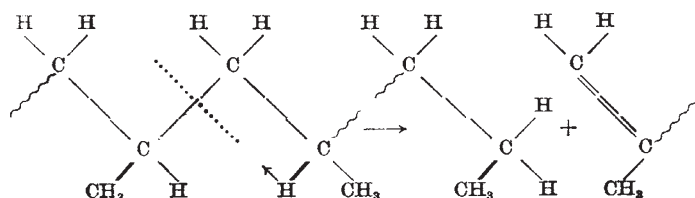
It is hoped to report the results of this investigation more fully at a later stage.

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The Tanberg Effect

IN a recent communication, Robson and von Engel[1] have suggested that Tanberg's explanation of the reaction force on the cathode of an arc in vacuum is incorrect, and that the mass used in his momentum equation should have been a hundred times larger, giving rise to a more 'reasonable' particle velocity of 10^4 cm./sec. rather than 10^6 cm./sec.

It is exceedingly difficult to reconcile this suggestion with the results of Easton, Lucas and Creedy[2], who obtained velocities which agreed fairly well with Tanberg's, by a method which did not directly involve the cathode, but measured the force on a vane facing the cathode some two centimetres away from it. Their results were obtained with rather a poor vacuum (40×10^{-3} mm. mercury).

Experiments have been made in these laboratories in which the force exerted on a vane mounted behind a perforated anode by vapour emitted from the cathode of a vacuum arc has been measured. The vacuum was better than 10^{-3} mm. mercury, the metal vapour cast sharp shadows, and the space potential at the vane was measured to be certain that electrostatic effects were not influencing the vane. The average velocity of the vapour jet from a cathode spot on magnesium was found to be about 2×10^5 cm./sec. and from a cathode spot on copper about 1×10^6 cm./sec. These figures agree well with those quoted by Easton, Lucas and Creedy. While the nature of the experiments is such that the results cannot be expected to be highly accurate, there seems no doubt that the orders of magnitude are correct and that vapour is in fact ejected from the neighbourhood of cathode spots in vacuum, although not necessarily from the metal surface, with these high velocities. These results have been discussed with Drs. Robson and von Engel, whose most recent views are expressed in a paper shortly to be published.

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