The reaction of triethyl phosphite with *o*-nitrobenzaldehyde,[7] with benzaldehyde,[8] and with aromatic ketones[9] has been reported. Epoxides and 1:1 adducts (analogous to VII) have been isolated from the reaction of a phosphorus triamide with aldehydes.[10]

Acknowledgment.—We are grateful to Prof. P. C. Lauterbur of this department for advice on P^{31} n.m.r. spectroscopy and to Dr. E. M. Banas (American Oil Co.) and Prof. E. Eliel (University of Notre Dame) for some of the earlier H n.m.r. spectra.

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Radical and Molecular Yields in the γ-Radiolysis of D_2O and H_2O Vapor

Sir:

Recent work[1,2] on the γ-radiolysis of water vapor in the presence of scavengers for H and OH has led to estimates of the 100-e.v. yield $G(H)$ which are different when D_2 is used[1] from those obtained using organic scavengers.[2] The reactions involved are

$$H_2O \longrightarrow H, HO$$
$$H + RH \longrightarrow H_2 + R$$
$$H + D_2 \longrightarrow HD + D$$

and it is assumed that $G(H_2)$ or $G(HD)$ are measures of $G(H)$. The observations[2] also showed the formation of H_2 with a yield of 0.5, even in the presence of benzene which should remove all H without forming H_2, and suggested that, as with liquid water, there is a yield of molecular as well as atomic hydrogen. This we have now confirmed by observations on D_2O radiolysis, and we also confirm that higher $G(D)$ are found using H_2 than using organic scavengers.

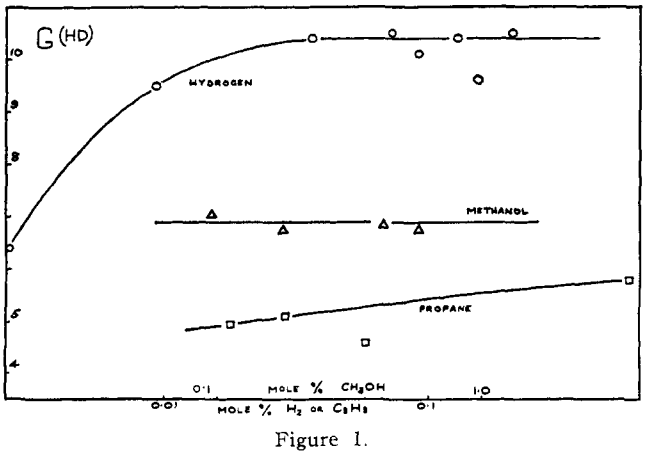

Figure 1.

The experiments were carried out as described previously[2] using doses of $1.5–5.5 \times 10^{19}$ e.v. delivered to the vapor at 116° and about 60-cm. pressure in a 5-l. vessel.

The values of $G(HD)$ obtained with various amounts of H_2, CH_3OH, and C_3H_8 present are shown in Fig. 1. They attain limiting values of 10.5 with H_2 but appear to approach only about 7.0 with CH_3OH or C_3H_8.

Furthermore, we have observed the formation of D_2 which in the presence of the high concentrations of H_2 or C_3H_8 can only originate as molecules from D_2O. For the six experiments with H_2 present, where $G(HD)$ has reached the maximum, we find $G(D_2) = 0.56 \pm 0.07$, and for the four experiments with C_3H_8 present, we observe $G(D_2) = 0.48 \pm 0.05$. Higher values, *viz.*, $G(D_2) = 0.80 \pm 0.02$, are found in the methanol experiments, but we believe the increase over 0.5 can be attributed to the reaction

$$D + CH_3OD \longrightarrow D_2 + CH_3O$$

occurring to a small extent.

The molecular hydrogen may be formed by an excitation process or perhaps from the ion H^-, as proposed by Platzman[3]

$$H_2O + e \longrightarrow H^- + OH$$
$$H^- + H_2O \longrightarrow H_2 + OH^-$$

but if this is the only source, the yield of H^- would need to be about twice the value he suggested.

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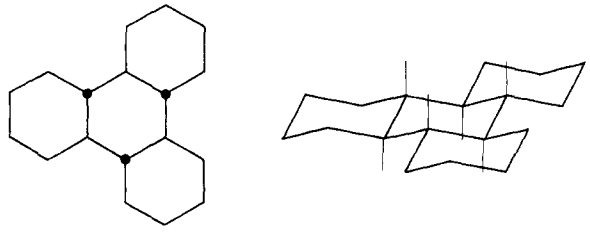
Inclusion Compounds Containing Macromolecules

Sir:

Although several inclusion compounds have been extensively studied recently,[1] little is known about inclusion compounds containing macromolecules. Brown and White[2] succeeded in polymerizing 1,3-butadiene and other monomers when included in urea or thiourea; nevertheless, no direct experimental evidence as to the formation of inclusion compounds with the polymers produced has been given. Recently, Parrod and others[3] verified the formation of an inclusion compound of urea with polyoxyethylene glycol, but attempts to include polyethylene and 1,4-polybutadiene into the same host structure were unsuccessful.

We have now found that several kinds of linear macromolecules such as polyethylene, *cis*-1,4 polybutadiene, *trans*-1,4 polybutadiene, and polyoxyethylene glycol give rise to very stable inclusion compounds with a host molecule of a new kind, the *trans-anti-trans-anti-trans*-perhydrotriphenylene (PHTP) (I). This com-



I a *I b*

pound, recently synthesized in our Institute,[4] has shown a very strong tendency to include, in the crys-

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