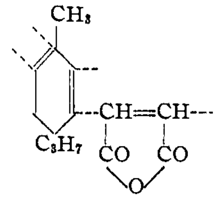
analysis precluded either terpene or maleic anhydride polymers, it seemed highly probable that a polymeric addition product had been obtained in which the average ratio of maleic anhydride to terpene was 4:3 or 5:4. Polymers of probable similar type have been reported by Wagner-Jauregg.[2]

The size of the polymeric α-phellandrene-maleic anhydride molecule and probable excess of anhydride over terpene would seem to exclude any but linear type polymers and would indicate a bifunctional character of the intermediate. An intermediate of the type



would satisfy the requirements of both polyfunctionality and color and would explain the formation of a polymeric material of the type $C_4H_2O_3$ $(C_{10}H_{16}-C_4H_2O_3-)$ $C_4H_2O_3$ in which there is an alternation of terpene and maleic anhydride molecules.

HERCULES POWDER CO.
WILMINGTON, DELAWARE
RECEIVED DECEMBER 10, 1935

---

[2] Wagner-Jauregg, *Ber.*, **63**, 3213 (1930).

COMMUNICATION TO THE EDITOR

THE DECOMPOSITION OF GASEOUS PARAFFINS INDUCED BY ETHYLENE OXIDE

Sir:

Heckert and Mack [THIS JOURNAL, **51**, 2706 (1929)] obtained evidence that *n*-butane and *n*-pentane were "cracked" in presence of decomposing ethylene oxide at temperatures (—400°) at which the normal rate of decomposition of these paraffins is negligible. We have confirmed this observation in the case of *n*-butane, and have in addition shown that isobutane and propane, but not ethane, also undergo appreciable decomposition under like conditions.

Our method consisted in analyzing the gases, pumped from the reaction vessel, for carbon monoxide (acid Cu_2Cl_2) and for total olefins (bromine water). At a total pressure of about 500 mm. and a temperature of 425°, the following results were obtained.

HC.	Initial ratio HC./C_2H_4O	Ratio C_nH_{2n}/CO by anal.
C_2H_6	1.6	<0.05
C_3H_8	1.6	.55
i-C_4H_{10}	1.7	.75
n-C_4H_{10}	1.6	1.2
n-C_4H_{10}	4.1	4.5
n-C_4H_{10}	8.0	12.

It will be noted that the relative amount of olefin increases with the complexity of the paraffin; and also (in the case of *n*-butane at least) with the relative amount of paraffin initially present. Since the C_nH_{2n}/CO ratio can exceed unity, it is evident that reaction chains may be set off in the paraffin.

The rate of pressure increase falls off rapidly as reaction proceeds, which may indicate that the products of the paraffin decomposition are inhibiting reaction. A similar result is obtained in the uninduced decomposition of paraffins [*e. g.*, Pease and Durgan, *ibid.*, **52**, 1262 (1930)].

The effect of temperature on the C_nH_{2n}:CO ratio is not great.

The accelerated decomposition of acetaldehyde in presence of ethylene oxide noted by Fletcher [*ibid.*, **58**, 534 (1936)] has been confirmed.

This work is being continued.

PRINCETON UNIVERSITY
PRINCETON, N. J.
L. S. ECHOLS, JR.
R. N. PEASE
RECEIVED JUNE 24, 1936