



N.M.R. ( $\text{CCl}_4$ ):  $\delta$  1.37 (t, 6,  $J=6.8$  Hz,  $\text{CH}_3$ ), 4.12 (2 q, 4,  $J_{\text{H-H}}=6.8$  Hz,  $J_{\text{H-P}}=8.0$  Hz,  $\text{CH}_2-\text{CH}_3$ ), 2.89 (2 d, 2,  $J_{\text{H-H}}=3.5$  Hz,  $J_{\text{H-P}}=5.3$  Hz, ring  $\text{CH}_2$ ), 2.52 (m, 1,  $J_{\text{H-H}}=3.5$  Hz,  $J_{\text{H-P}}=31.5$  Hz,  $\text{CH}$ ).

The general method of determination of oxirane content<sup>4</sup> was not applicable to the epoxide 2.

$\text{C}_6\text{H}_{13}\text{O}_4\text{P}$  calc. C 40.00 H 7.27 P 17.19  
found 39.24 7.24 16.85

From the reaction mixture, the carbonyl compound 3 was isolated by distillation in 4% yield; b.p.  $28-29^\circ/0.04$  mm.

I.R. (neat)  $1640\text{ cm}^{-1}$  (CO).

N.M.R. ( $\text{CCl}_4$ ):  $\delta$  1.39 (t, 6,  $J_{\text{H-H}}=7.2$  Hz,  $\text{CH}_3$ ), 4.14 (2 q, 4,  $J_{\text{H-H}}=7.2$  Hz,  $J_{\text{H-P}}=7.5$  Hz,  $\text{CH}_2-\text{CH}_3$ ), 4.95 (2 d, 2,  $J_{\text{H-H}}=6.5$  Hz,  $J_{\text{H-P}}=22.5$  Hz,  $\text{CH}_2-\text{P}$ ), 6.59 (2 t, 1,  $J_{\text{H-H}}=6.5$  Hz,  $J_{\text{H-P}}=13.7$  Hz,  $\text{CHO}$ ).

**Dialkyl Epoxyethylphosphonates:** The reactions were carried out in a similar manner as described above; Method B was used in the dehydrochlorination step.

*Dibutyl Epoxyethylphosphonate*; yield: 53%; b.p.  $81-87^\circ/0.1$  mm.

*Bis-[2-ethylhexyl] Epoxyethylphosphonate*; yield of crude product: 68% (undistillable).

*Dicyclohexyl Epoxyethylphosphonate*; yield: 13%; b.p.  $105-110^\circ/0.06$  mm.

*Bis-[2-chloroethyl] Epoxyethylphosphonate*; yield: 36%; b.p.  $72-82^\circ/0.06$  mm.

Received: October 13, 1970

<sup>1</sup> V. F. MARTYNOV, V. E. TIMOFEEV, Zh. Obshch. Khim. **32**, 3449 (1962); Engl. Edit., p. 3383.

<sup>2</sup> R. H. CHURI, C. E. GRIFFIN, J. Amer. Chem. Soc. **88**, 1824 (1966).

<sup>3</sup> W. F. BARTHEL, B. H. ALEXANDER, P. A. GIANG, S. A. HALL, J. Amer. Chem. Soc. **77**, 2424 (1955).

W. LORENZ, A. HENGLEIN, D. SCHRADER, J. Amer. Chem. Soc. **77**, 2554 (1955).

M. S. KHARASCH, I. S. BENGELSDORF, J. Org. Chem. **20**, 1356 (1955).

<sup>4</sup> D. SWERN, T. W. FINDLEY, G. E. BILLEN, J. T. SCANLAN, Anal. Chem. **19**, 414 (1947).