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## Advances in Chalcogene Glycerophosphate Chemistry

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$$\left[ \begin{array}{c} \text{O} \\ \diagup \quad \diagdown \\ \text{O} - \text{CMe}_2 \\ \diagdown \quad \diagup \\ \text{O} \end{array} \right] \text{P} \left( \begin{array}{c} \text{O} \\ \diagup \quad \diagdown \\ \text{O} \\ \diagdown \quad \diagup \\ \text{O} \end{array} \right) \text{X} \xrightarrow[\text{X=S, Se}]{\text{RPPh}_2\text{Hal}^\oplus} \left[ \begin{array}{c} \text{O} \\ \diagup \quad \diagdown \\ \text{O} - \text{CMe}_2 \\ \diagdown \quad \diagup \\ \text{O} \end{array} \right] \text{P} \left( \begin{array}{c} \text{O} \\ \diagup \quad \diagdown \\ \text{O} \\ \diagdown \quad \diagup \\ \text{X} \end{array} \right) \xrightarrow[2. \text{RCOCl (ZnCl}_2\text{)}]{1. \text{NMe}_3} \left[ \begin{array}{c} \text{OCOR} \\ \text{OCOR} \\ \text{OPX(CH}_2\text{)}_3\text{NMe}_3^\oplus \\ \text{O} \end{array} \right]$$
$$\left[ \begin{array}{c} \text{O} \\ \diagup \quad \diagdown \\ \text{O} \quad \text{CMe}_2 \\ \diagdown \quad \diagup \\ \text{OP} \quad \text{O} \\ \parallel \quad \diagdown \\ \text{X} \quad \text{N} \\ \quad \quad \text{Me} \end{array} \right] \xrightarrow[\text{X=O, S}]{\text{NMe}_3} \left[ \begin{array}{c} \text{O} \\ \diagup \quad \diagdown \\ \text{O} \quad \text{CMe}_2 \\ \diagdown \quad \diagup \\ \text{OP} \text{---} \text{N}^+ \text{CH}_2 \text{CH}_2 \text{CH}_2 \text{NMe}_3 \\ \parallel \quad \diagdown \quad \diagup \\ \text{X} \quad \text{O}^- \quad \text{Me} \end{array} \right] \xrightarrow[2. (\text{RCO})_2\text{O}]{1. \text{H}_2\text{O} (\text{H}^+)} \left[ \begin{array}{c} \text{OCOR} \\ \diagup \quad \diagdown \\ \text{OCOR} \\ \diagdown \quad \diagup \\ \text{OP} \text{---} \text{N}^+ \text{CH}_2 \text{CH}_2 \text{CH}_2 \text{NMe}_3 \\ \parallel \quad \diagdown \quad \diagup \\ \text{X} \quad \text{O}^- \quad \text{Me} \end{array} \right]$$
$$\text{Cyclohexane ring with an oxygen atom at the top and a } \text{P}(\text{OPh})(\text{X}) \text{ group at the bottom} \xrightarrow[\text{2. [H]}]{\text{1. RCOOK}} \text{RCOOCH}_2\text{CH}_2\text{CH}_2\text{OP}(\text{OH})_2(\text{X})$$