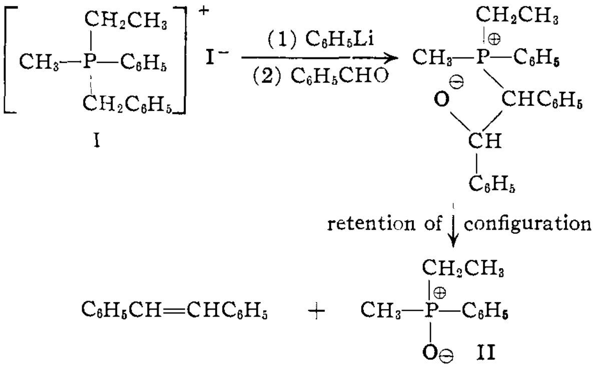
benzaldehyde to the resulting orange mixture, gave a white precipitate of an adduct of II and lithium iodide. Decomposition of the adduct by the action of sodium hydroxide solution, extraction of the phosphine oxide into benzene, and distillation of the extracted material *in vacuo*, gave a 70% yield of II, m.p. 46–50°, $[\alpha]^{25}_D$ 21.5 ± 1.0° (*c*, 2.128 in water).

*Anal.* Calcd. for $C_9H_{13}PO$: C, 64.30; H, 7.73; P, 18.46. Found: C, 64.54; H, 7.91; P, 18.22.

From the ether filtrate there was isolated *trans*-stilbene in 84% yield and *cis*-stilbene in 5% yield.

When levorotatory I was subjected to the Wittig reaction, there was obtained a 68% yield of II, m.p. 47–51°, $[\alpha]^{25}_D$ −21.0 ± 1.0°, an 82% yield of *trans*-stilbene and a 6% yield of *cis*-stilbene.

Since the available evidence indicates that the Wittig reaction takes place by way of a *quasi*-four-membered ring transition intermediate,[4] it may be assumed that (+)-I and (+)-II belong to the same configurational family. This leads to the conclusion that the decomposition of the phosphonium hydroxides takes place with inversion of configuration since (+)-I gives (−)-II in this reaction.



Consistent with the stereochemical and kinetic data, it may be reasoned that a hydroxide ion can add in a reversible manner to any one of the four faces of the tetrahedral phosphonium cation. Also, the conjugate bases of any of the four trigonal bipyramidal intermediates may be formed by a reversible reaction with a second hydroxide ion. However, owing to the relatively greater stability of the benzyl anion over phenyl, methyl or ethyl anions, only the conjugate base of the pentacovalent phosphorus intermediate in which the negatively charged oxygen atom is colinear with the benzyl group and the phosphorus atom is capable of further reaction to produce II and the benzyl anion. Thus, the stereo-electronic requirements of the decomposition of methylethylphenylbenzylphosphonium hydroxide lead to inversion of configuration of the phosphorus atom.

$$\begin{tikzcd}[column sep=huge, row sep=large]
(+)\text{ Salt} \arrow[r, "\mathrm{OH}^-", "\text{(inversion)}"'] \arrow[d, "\text{Wittig}", "\text{(retention)}"'] & (-)\text{ Oxide} \\
(+)\text{ Oxide} & (-)\text{ Salt} \arrow[l, "\mathrm{OH}^-"', "\text{(inversion)}"] \arrow[u, "\text{Wittig}", "\text{(retention)}"']
\end{tikzcd}$$

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(4) U. Schollkopf, *Angew. Chem.*, **71**, 260 (1959).

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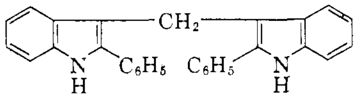
## ON THE SYNTHESIS OF 2,2'-DIPHENYL-3,3'-DIINDOLYLMETHANE

*Sir:*

In a recent paper Leete[1] suggested without evidence that 2,2'-diphenyl-3,3'-diindolymethane (I), m.p. 184–185°, which was synthesized in these laboratories[2] from 2-phenylindole (II) and formaldehyde, was identical with the starting material II (m.p. 187–188°). No definite conclusions about the structure can be drawn from the analytical data as the difference in the percentage composition between I and II is very small. However, these other facts will make the case clear.



I

(a) The melting point of an admixture of I and II is depressed considerably (150–160°).

(b) The infrared and ultraviolet spectra of I and II show beyond a doubt that the two compounds are not identical.

(c) Treatment of an indole unsubstituted in the 3-position with a 3-dialkylaminomethylindole in glacial acetic acid was found to yield 3,3'-diindolylmethanes.[2] 2,2'-Diphenyl-3,3'-diindolylmethane (I) also can be obtained in this way from 2-phenylindole and the Mannich base 3-(dimethylaminomethyl)-2-phenylindole. The product formed in this reaction is identical with I prepared from II and formaldehyde and different from II (m.p., mixed m.p. and infrared spectra).

It can be concluded, therefore, that the product with m.p. 184–185° from 2-phenylindole and formaldehyde is a new compound and not the starting material.

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(1) E. Leete, THIS JOURNAL, **81**, 6023 (1959).

(2) R. Dahlbom and A. Misiorny, *Acta Chem. Scand.*, **9**, 1074 (1955).

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## THE SOLVOLYSIS OF *EXO* AND *ENDO*-7-ISOPROPYLIDENEDEHYDRONORBORNYL TOSYLATES

*Sir:*

Although the stability of homoallylic cations has been well established, the structure and bonding in these intermediates is still a matter of much