

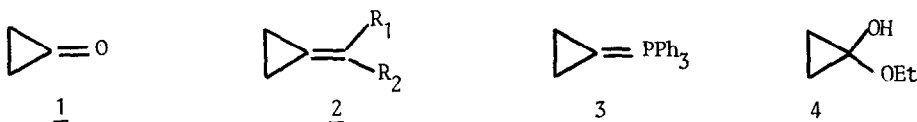
ON THE REACTION OF CYCLOPROPANONE HEMIKETAL WITH WITTIG REAGENTS

J. Salaün\* and A. Fadel

Laboratoire des Carbocycles, ERA 316, Université de Paris-Sud  
Bâtiment 420, 91405 ORSAY, France

**Summary** : Upon treatment with methylmagnesium iodide and benzylidenephosphoranes the ethyl hemiketal of cyclopropanone undergoes Wittig olefination.

Alkylidenecycloalkanes are generally prepared by means of the Wittig reaction either between cycloalkylidenephosphoranes and alkanones or alkylidenephosphoranes and cycloalkanones (1). However, cyclopropanone 1, a too labile three-membered ring ketone, polymerizes at room temperature (2) and does not undergo Wittig olefination reactions with phosphoranes. Then, the preparation of the alkylidene cyclopropanes 2, a convenient key to enter the chemistry of small ring compounds (3), involves the reaction of cyclopropylidene-phosphorane 3 with ketones (4).



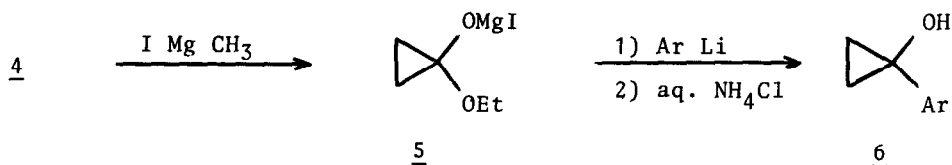
We report our results concerning the behaviour of the now readily available (5) ethyl hemiketal of cyclopropanone 4 with benzylidenetriphenylphosphoranes.

It is known that the hemiketal 4, undergoes reaction with nucleophilic reagents such as Grignard reagents, amines, azides leading to 1-substituted cyclopropanols (5,6). So, it was interesting to investigate the alternate pathway to the cyclopropylidene derivatives 2 from hemiketal 4 and nucleophilic phosphoranes.

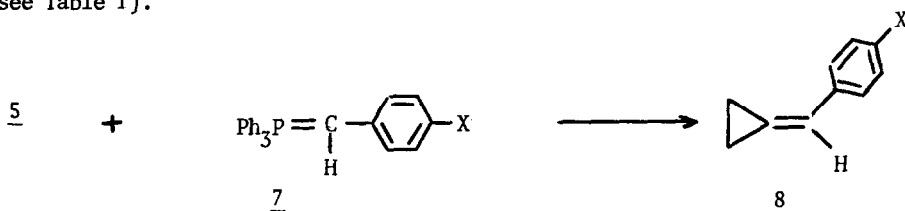
First no reaction was observed between 1-ethoxycyclopropanol 4 and phosphoranes. Thus for instance, the addition of an excess of 4 to a solution of the ylide prepared from benzyltriphenylphosphonium chloride and one equivalent of n-butyllithium in ether did not give the expected benzylidenecyclopropane 2 ( $R_1=C_6H_5$ ,  $R_2=H$ ). The yellow-orange colour of the suspension was not discharged after 65 hr of stirring under reflux and the lack of the desired olefin was checked by thin layer and gas chromatographies.

In the meantime BROWN and RAO have reported that, contrary to the Grignard reagents, the addition of aryllithium to 4 likewise failed. But, treatment of the hemiketal 4 with an equimolar amount of methylmagnesium iodide converted it into a species, probably the magnesium

salt 5, which then was able to react with the desired aryllithium to give the expected 1-arylcyclopropanols 6 in 51-75% yields (7).

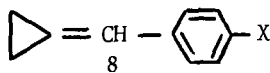


In our hands, the addition of para substituted benzylidenetriphenylphosphoranes 7 to the magnesium salt 5 provided the corresponding benzylidenecyclopropanes 8 in moderate yields (see Table I).



**Typical procedure** : To 60 mmole of methylmagnesium iodide in 250ml of ether, cooled at 0°C in an ice bath, was added dropwise 1-ethoxycyclopropanol (5) (6.12g, 60 mmole). A gas, presumably methane evolved while a white suspension was formed. To 50 mmole (20.19g) of p-methylbenzyltriphenylphosphonium chloride in 100 ml of ether was added dropwise a solution of 50 mmole of n-butyllithium in hexane (1.52N, 32.9mL). After stirring for 2 hr, the yellow-orange suspension was pushed under argon by means of a double-ended needle to the white suspension prepared above and maintained at 0°C. After the addition was over, the orange reaction mixture was brought to room temperature and then refluxed until the colour of the mixture was completely discharged ( $\approx$  40 hr). After usual work-up and removal of solvents, filtration of triphenylphosphine oxide, the distillation of the residue yielded 3,7g (51%) of p-methylbenzylidenecyclopropane 8, bp 52°C (0.1mm) (9).

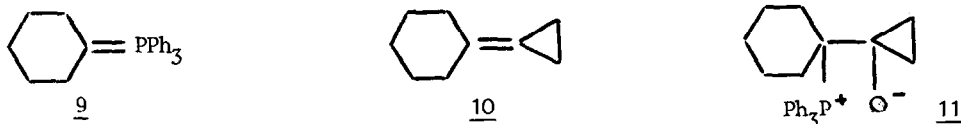
Table I. - Synthesis of Benzylidenecyclopropanes 8<sup>a</sup>.

|  | yield, % from<br><u>5</u> + <u>7</u> | yield, % from<br><u>3</u> + Benzaldehydes |
|---|--------------------------------------|---|
| X = H   | 46                                   | 40 - 70 <sup>b</sup>                      |
| = CH <sub>3</sub>   | 51                                   | 68 <sup>c</sup>                           |
| = OCH <sub>3</sub>  | 34 <sup>d</sup>                      | 46 <sup>c</sup>                           |
| = NO <sub>2</sub>   | 0                                    | 42 <sup>e</sup>                           |

a) Complete spectral characterization confirms the structural assignments.

b) From references 4,8.c) From reference 9. d) Unexpected low yield has also been reported in the Wittig reaction of p-methoxybenzylidenetriphenylphosphorane (IO b). e) This work.

As reported in Table I, the addition of p-nitrobenzylidetriphenylphosphorane 7 ( $X = \text{NO}_2$ ) to the magnesium salt 5 did not lead to the p-nitrobenzylidencyclopropane 8. Furthermore, attempts to react some alkylidene phosphoranes with 5, in spite of experimental effort, did not provide the expected olefins. Thus for example, although on addition to 5 the deep red colour of the phosphorane 9, prepared from cyclohexyltriphenylphosphine iodide (II), was completely discharged on heating at  $40^\circ\text{C}$  for 40 hr, the olefin 10 was not obtained.

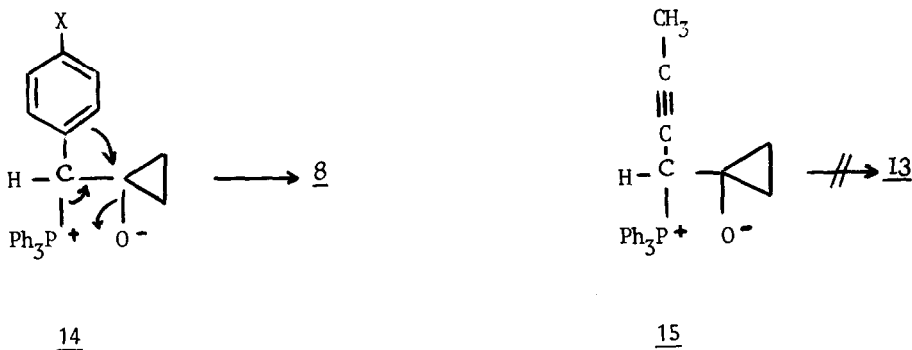


The failure of reaction  $9 \longrightarrow 10$  was carefully checked by chromatography, using a sample of the cyclopropylidencyclohexane 10, univocally prepared from cyclohexanone and phosphorane 3 (4). Nevertheless, the NMR spectrum of the crude white suspension obtained from the reaction of 9 with 5, roughly showed 15 aromatic protons ( $\delta(\text{CDCl}_3)$  : 7.15 ppm) and 14 methylenic protons ( $\delta$ : 0.6 - 2.1 ppm), in accordance with the betaine 11.



The formation of the olefin 13, expected from the reaction of 5 with the phosphorane 12 prepared from 2-butynyltriphenylphosphine bromide (I2), likewise failed.

Finally, it has been checked in all these experiments, that on heating the precipitates of the Wittig reaction in refluxed tetrahydrofuran, benzene, toluene and xylene for days did not provide better yields of the expected olefins.



In summary, the magnesium salt of cyclopropanone hemiketal 5 undergoes Wittig condensation which induces the discharge of the phosphorane colour. However, the second step of the Wittig reaction, *i. e.*, the decomposition of the intermediate betaine (I), only occurs with phenyl substituted betaine 14.

The formation of olefin and triphenylphosphine oxide from 14 would then entail the occurrence of a discrete cyclopropylation, requiring the anchimeric assistance of a phenyl ring (5, 13). This hypothesis seems to be supported by the preventive effect of withdrawing

substituent on the phenyl ring. The triple bond participation, effective in the stabilization of homopropargylic cation (14,15) could be expected to assist the decomposition of 15, adduct from 5 with phosphorane 10. However, the geometrical features of 15 do not seem to favour this assistance.

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