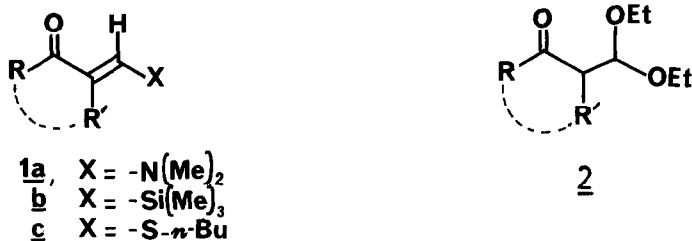


CATIONIC BENZOANNELATION OF ACTIVE METHYLENE
KETONES VIA OXOKETENDITHIOACETALS

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Summary: α -Oxoketendithioacetals are shown to be useful intermediates for benzoannellation of α -methylene ketones by reactions with allylmagnesium bromide followed by cationic cyclizations of the resulting carbinolacetals.

Aromatic annellation from aliphatic precursors constitutes an important synthetic operation. Most commonly employed Robinson annellation¹ or modified Diel's Alder reaction² involve cyclocondensation of two fragments, one with two and the other with four carbon atoms. Recently several new approaches involving the combination of both three carbon fragments, one with two 1,3-electrophilic sites and the other with 1,3-dinucleophilic sites, have also been reported.³ The 1,3-electrophilic fragments employed in these reactions comprise β -dimethylaminoenones (**1a**),³ β -silyloxyenones (**1b**)^{4,5b,5c} and β -ketoacetals (**2**),^{5a} which can be easily prepared from active methylene ketones. Condensation of **1a** or **1b** with 1,3-carbanionic species (or their synthetic equivalents) is reported to give substituted benzene derivatives.



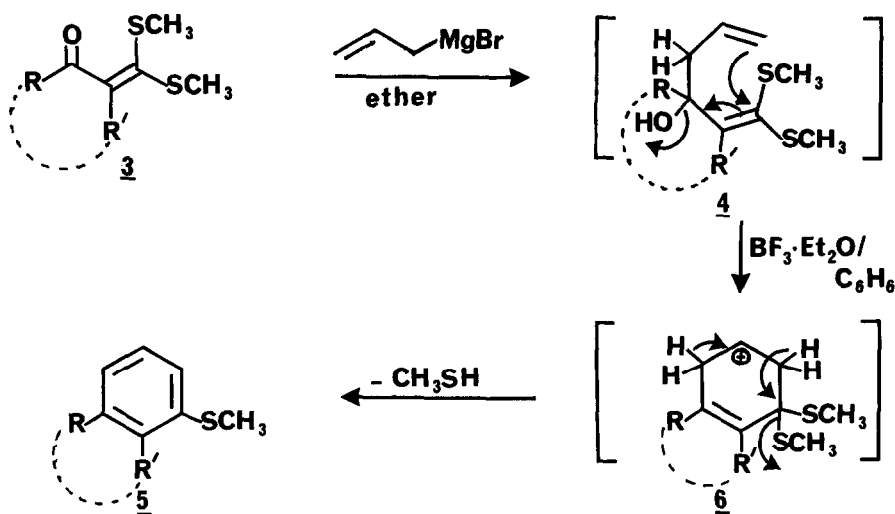
Similarly, the nucleophilic additions of allyltrimethylsilyllithium^{5a} or methylallylmagnesium bromide^{5b} on carbonyl carbon of **2** and **1b** respectively followed by subsequent Lewis acid catalyzed cyclization also afford benzoannellated products. Interestingly, the corresponding thiomethyleneketone (**1c**) did not give the expected benzoannellated product under identical reaction conditions.^{5b}

Our interest in α -oxoketendithioacetals (**3**) as three carbon fragments with well defined 1,3-electrophilic centres, for the synthesis of a wide variety

of heterocyclic compounds is well established.⁶ They have also been shown to be versatile intermediates for 1,3-carbonyl transposition in their reactions with sodium borohydride⁷ and organometallic compounds.⁸ We were therefore prompted to consider these intermediates as potential precursors for aromatic annelation and our preliminary results on the conversion of 3 to 5 are reported in this communication.

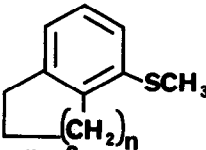

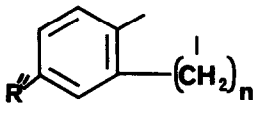
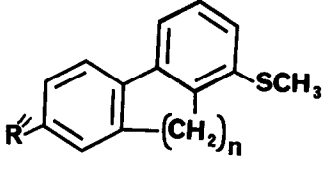
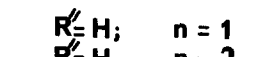
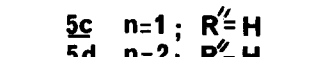
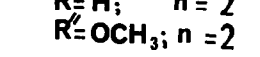
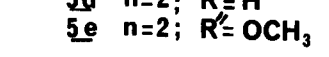
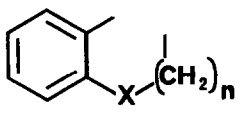
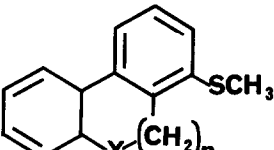
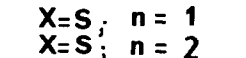
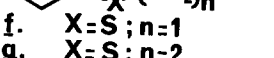
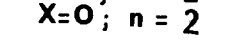
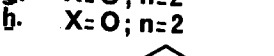
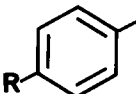
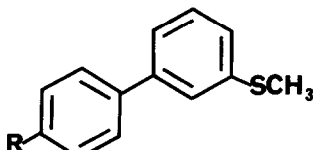
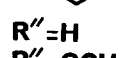

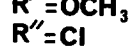


When the allylmagnesium bromide was reacted with 3a, the corresponding carbinolacetal 4a was obtained in almost quantitative yield (> 95%); which without further purification was cyclized in presence of borontrifluoride etherate to give benzoannellated product 5a in 74% yield. The other benzoannellated products and their yields are given in the table. When the allylmagnesium bromide was similarly reacted with dithioacetals 3i-l, the corresponding biphenyl derivatives 5i-k and substituted toluene 5l were obtained in comparatively lower yields (39-45%).

Apparently the reaction proceeds through intramolecular participation of allylic double bond with the formation of carbonium ion intermediate 6 which on loss of proton and methylmercaptan yields 5. Availability of active methylene ketones with their wide structural diversity and their easy conversion to α -oxoketen dithioacetals in one pot reaction, makes this method attractive for the preparation of aromatic and benzoannellated products. It is pertinent to note that earlier attempts for benzoannelation of cyclic ketones via *o*-trialkylsilylmethyleneketones with either allylmagnesium chloride or (allyltrimethylsilyl)lithium afforded low yields of benzoannellated products along with other side products.^{5b}



Scheme

Table

Entry	Starting material	R	R'	Product ^b	Isolated yield ^a %
1	<u>3a</u>	$-(\text{CH}_2)_4-$		 <u>5a</u> , n = 2	74
2	<u>3b</u>	$-(\text{CH}_2)_3-$		 <u>5b</u> , n = 1	64
3	<u>3c</u>		$\text{R}'' = \text{H}; n = 1$	 <u>5c</u> n=1; $\text{R}'' = \text{H}$	54
4	<u>3d</u>		$\text{R}'' = \text{H}; n = 2$	 <u>5d</u> n=2; $\text{R}'' = \text{H}$	68
5	<u>3e</u>		$\text{R}'' = \text{OCH}_3; n = 2$	 <u>5e</u> n=2; $\text{R}'' = \text{OCH}_3$	67
6	<u>3f</u>		$\text{X} = \text{S}; n = 1$	 <u>5f</u> . $\text{X} = \text{S}; n = 1$	59
7	<u>3g</u>		$\text{X} = \text{S}; n = 2$	 <u>5g</u> . $\text{X} = \text{S}; n = 2$	67
8	<u>3h</u>		$\text{X} = \text{O}; n = 2$	 <u>5h</u> . $\text{X} = \text{O}; n = 2$	64
9	<u>3i</u>		H	 <u>5i</u> , $\text{R}'' = \text{H}$	45
10	<u>3j</u>		$\text{R}'' = \text{OCH}_3$	 <u>5j</u> , $\text{R}'' = \text{OCH}_3$	39
11	<u>3k</u>		$\text{R}'' = \text{Cl}$	 <u>5k</u> , $\text{R}'' = \text{Cl}$	40
12	<u>3l</u>	$-\text{C}_2\text{H}_5$	$-\text{CH}_3$	 <u>5l</u>	40

^aYield of the pure isolated product.

^bAll the compounds were characterized by their spectral and analytical data.

In a typical experiment, a solution of 1a (3.03g, 0.015 mol) in 20 ml of dry ether was added to a solution of allylmagnesium bromide (0.03 mol) in 50 ml of ether at 0-5°C under nitrogen current. The reaction mixture, after further stirring for 45 min, was decomposed by saturated ammonium chloride solution (35 ml), extracted with ether, dried and evaporated to give crude carbinol 4a (3.6g, 95%) which was dissolved in dry benzene (50 ml) and BF₃ etherate (2 ml), and refluxed for 30 min. The reaction mixture after cooling was poured on saturated NaHCO₃ solution, extracted with CHCl₃ (2x100 ml), washed (H₂O), dried and evaporated and the residue was passed through silicagel column (hexane as eluent) to give 5a (1.97g, 74%) as viscous liquid (T.L.C. single spot); M⁺(mass) m/z: (178); i.r. (neat): 1580, 1440 cm⁻¹; ¹H-n.m.r. (CCl₄) δ 1.80-2.25 (m, 4H); 2.32 (s, 3H, SCH₃); 2.52-2.92 (m, 4H, CH₂); 6.65-7.10 (m, 3H, aromatic).

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