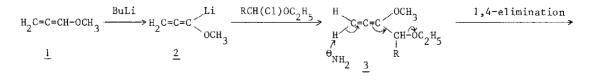
METHOXYALLENE AS A STARTING COMPOUND FOR THE SYNTHESIS OF FURAN DERIVATIVES

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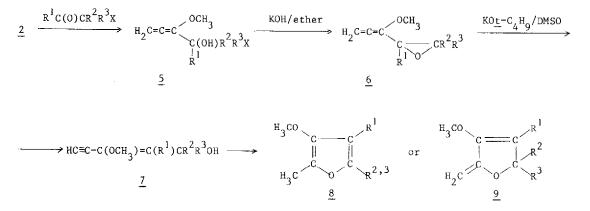
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Previous work from our laboratory has shown the utility of methoxyallene  $CH_3O-CH=C=CH_2$  in organic synthesis. The behaviour of this allene towards organometallic reagents is interesting In tetrahydrofuran organocopper(I) reagents (obtained <u>in situ</u> from Grignard compounds and copper(I) halides) can be added quantitatively with formation of the enolate equivalent  $RCH_2-C(CuX)=CH-OCH_3$  (X=halogen), which upon hydrolysis affords vinyl ethers<sup>1</sup>  $RCH_2CH=CH-OCH_3$ . Interaction between the allenic ether and Grignard reagents in ether in the presence of catalytic amounts of copper(I) halide leads to acetylenes<sup>2</sup>  $RCH_2C=CH$ . With the strong base butyllithium in ether or tetrahydrofuran the only reaction is  $\alpha$ -lithiation. With the obtained acylanion equivalent <u>2</u> a number of syntheses have been carried out in our laboratory<sup>3-7</sup>: coupling with  $\alpha$ -chloroethers for example gives the bis-ethers <u>3</u>, which upon treatment with sodamide in liquid ammonia loose ethanol in a 1,4-elimination with the formation of the enyne ethers<sup>7</sup> 4



 $\longrightarrow HC \equiv C - C (OCH_3) = CHR (after hydrolysis)$   $\frac{4}{2}$ 

Another useful application of the lithiated allenic ether 2 which we wish to report here is its derivatisation into the epoxides 6 and their subsequent transformation into derivatives of furan 8 or dihydrofuran 9, which could be realised using potassium <u>tert</u>-butoxide in dimethyl sulfoxide. We assume that first an E/Z mixture of the enyne ether alcohols 7 is formed by a 1,4- elimination process analogous to  $3 \rightarrow 4$ . Under the strongly nucleophilic conditions intra-



molecular ring closure leads (via intermediates) to the derivatives of furan or dihydrofuran.

#### X=C1 or Br

In support of the intermediate occurrence of compounds  $\underline{7}$  is the detection of their  $\underline{Z}$ -isomers (in mixtures with  $\underline{8}$  or  $\underline{9}$ ) when instead of KO<u>t</u>-C<sub>4</sub>H<sub>9</sub> potassium hydroxide is used. Under these milder conditions probably only <u>E-7</u> can undergo the ring closure because the C-OH and CEC are in a geometrically favourable position. When the mixtures of  $\underline{Z}$ - $\underline{7}$  and  $\underline{8}$  or  $\underline{9}$  were treated with KO<u>t</u>-C<sub>4</sub>H<sub>9</sub> in DMSO all  $\underline{Z}$ - $\underline{7}$  disappeared and a corresponding amount of  $\underline{8}$  or  $\underline{9}$  was produced in addition to the product which was already present. This remarkable cyclisation of  $\underline{Z}$ - $\underline{7}$  into  $\underline{E}$ - $\underline{7}$ (C-OH and CEC in <u>trans</u>-position) under these conditions may be explained by assuming a preceding isomerisation of  $\underline{Z}$ - $\underline{7}$  into  $\underline{E}$ - $\underline{7}$  (or into another cyclisable isomer) via abstraction of a proton in R<sup>1</sup> which is in the allylic position of the double bond. Such an isomerisation is not possible if R<sup>1</sup>=<u>t</u>-C<sub>4</sub>H<sub>9</sub>, thus upon treatment of <u>6</u>, having R<sup>1</sup>=<u>t</u>-C<sub>4</sub>H<sub>9</sub>, with KO<u>t</u>-C<sub>4</sub>H<sub>9</sub> in DMSO both the corresponding  $\underline{Z}$ - $\underline{7}$  and  $\underline{8}$  were isolated.

### General procedure for the preparation of the allenic epoxides 6

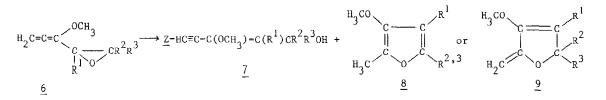
To a solution of 0.25 mole of methoxyallene in 100 ml of dry THF cooled at  $-40^{\circ}$  was added dropwise 0.25 mole of butyllithium in 150 ml of ether. Ten minutes later 0.25 mole of the  $\alpha$ -haloketone was added at  $-30^{\circ}$  over a period of 30 minutes. After an additional period of 15 minutes the reaction mixture was poured into ice water. The ethereal extracts were dried over  $K_2CO_3$ . Finely powdered potassium hydroxide (0.50 mole) was then added in small portions to the stirred extract, keeping the temperature between  $0-5^{\circ}$ . After 30 minutes the mixture was poured into ice water. The usual work up afforded the epoxides 6. The yields varied between 50 and 75% For further data see Table 1.

# Conversion of 6 into the enyne alcohols 7, furan 8 or dihydrofuran 9

To a solution of 0.10 mole of potassium <u>tert</u>-butoxide in 120 ml of dimethyl sulfoxide was added in 15 minutes 0.10 mole of the allenic epoxide <u>6</u>. The temperature of the mixture was kept between 20 and  $30^{\circ}$ . After an additional period of 30 minutes the reaction mixture was poured into 300 ml of ice water and the products were extracted with ether. The extracts were washed with water and dried over MgSO<sub>4</sub>. For further data see Table 1.

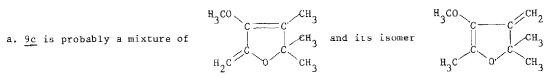
### Table 1

Conversion of allenic epoxides  $\underline{6}$  with  $KO\underline{t}-C_{\underline{4}}H_{\underline{9}}$  in DMSO.



	Starting compound					Reaction products				
R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>	Nr	B.p. <sup>o</sup> C/mm Hg	n <sub>D</sub> <sup>20</sup>	Nr	B.p. <sup>o</sup> C/mm Hg	n <sub>D</sub> <sup>20</sup>	Yield%	Remarks
CH <sub>3</sub>	Н	H	<u>6a</u>	57/17	1.4660	<u>8a</u>	42-3/17	1.4510	75	
сн <sub>3</sub>	СНЗ	Н	<u>6b</u>	65-70/17	1.4680	<u>8b</u>	55-7/17	1.4580	76	}
сн <sub>3</sub>	СНЗ	CH3	<u>6c</u>	63-5/17	1.4600	<u>9c</u>	66-7/17	1.4762	87	а
с <sub>6</sub> н <sub>5</sub>	н	Н	<u>6d</u>	88-9/0.001	1.5517	<u>8d</u>	83-5/0.001	1.5566	51	Ъ
<u>t</u> -C <sub>4</sub> H <sub>9</sub>	Н	н	<u>6e</u>	80-5/17	1.4640	<u>8e</u>	73-5/17	1.4557	56	
						<u>7d</u>	108-10/17	1.4895	35	

All compounds were shown to have a purity of at least 95% by PMR and GLC and elemental analyses were satisfactory.



b. The <u>Z</u>-enyne alcohol  $HC \equiv C - C(OCH_3) = C(C_6H_5)CH_2OH \underline{7d}$  could be detected in the crude reaction mixture by PMR. The low yield of  $\underline{7d}$  is probably caused by its polymerisation.

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