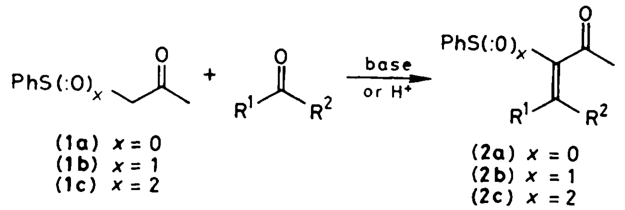
The Use of 1-Phenylthioprop-1-yne as an Equivalent of Phenylthiopropanone in Aldol Condensations[1]

Alexander J. Bridges* **and Ralph D. Thomas**

Department of Chemistry, Northern Illinois University, DeKalb, Illinois 60115, U.S.A.

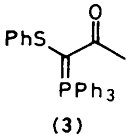
Addition of 1-lithio-1-phenylthiopropa-1,2-diene (**7**) to ketones, followed by trifluoroacetylation, a 3,3-rearrangement, and methanolysis of the resulting dienol trifluoroacetates, leads to the C-3 homologated α-phenylthioenones (**2a**) in 31—66% overall yields.

Although a directed aldol reaction between an α-phenylthiomethyl ketone (**1a**), or the corresponding sulphoxide (**1b**) or sulphone (**1c**), and a second ketone would be a very direct route to acyclic α-sulphur substituted enones (**2a**—**c**), such reactions have been very little used, presumably owing to the low nucleophilicity of the ketones (**1a**—**c**). The ketones (**1a**—**c**) are reported to condense with electron-deficient aromatic (non-enolisable) aldehydes to form the enones (**2a**—**c**, R^1 = aryl, R^2 = H) in good yields,[2,3] and the ketone (**1c**) condenses with carbon disulphide to give the enone (**2c**, $R^1 = R^2$ = SMe) after methylation.[4] Acid-catalysed formylation of (**1c**) with triethyl orthoformate gives the enol ether (**2c**, R^1 = H R^2 = OEt).[5] The corresponding phosphorane (**3**) has been prepared,[6] but apparently not used in a Wittig olefination, although the isomeric phosphorane (**4**)[7] [and selenomethyl analogue (**5**)[8]] have been used in Wittig reactions, but only with aldehydes, presumably reflecting the rather low reactivity of such systems.

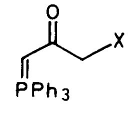


(**1a**) $x = 0$
(**1b**) $x = 1$
(**1c**) $x = 2$

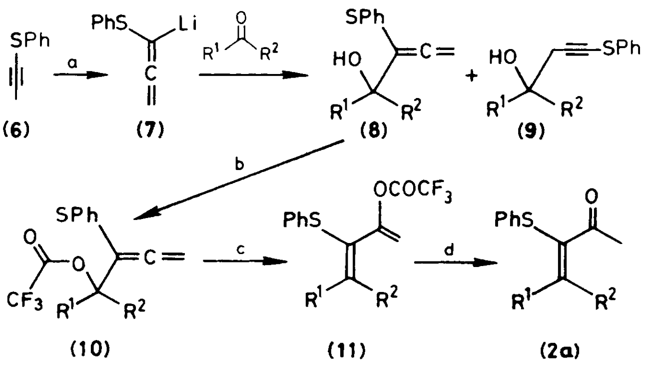
(**2a**) $x = 0$
(**2b**) $x = 1$
(**2c**) $x = 2$



(**3**)



(**4**) X = SPh
(**5**) X = SeMe



Scheme 1. Preparation of the enones (**2a**) from the acetylene (**6**). *Reagents*: a, Bu^nLi, tetramethylethylenediamine, tetrahydrofuran, −78 °C; b, $(CF_3CO)_2O$, NEt_3, CH_2Cl_2, 0 °C; c, 65 °C or room temp. for several days; d, K_2CO_3, MeOH, 20 °C, 15 min.

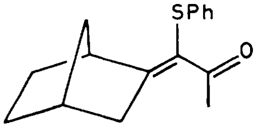
Table 1. Ketone adducts and phenylthioenone (**2a**) formation.

Entry	Ketone R^1	Ketone R^2	% Yield of (**8**)	(**8**):(**9**)[a] ratio	Overall % yield of (**2a**)
1	Me	Me	48	6:1	31
2	Me	Et	46	10:1	41[b]
3	Et	Pr^n	57	5:1	50[b]
4	$-[CH_2]_5-$		66	4:1	66
5	$-[CH_2]_4-$		49	10:1	47
6	Norbornan-2-one		69	10:1	53[b,c]
7[d]	$-[CH_2]_5-$		(25)	—	(15)[d]
8[d]	Me	Me	(28)	—	(26)[d]

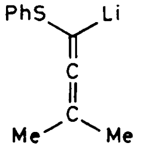
[a] Ratios in the presence of hexamethylphosphoric triamide. [b] *E–Z*-Mixture, ratio undetermined. [c] Product is (**12**). [d] Reaction of (**13**); product is (**14**).

We now report that the simple 3-step procedure, outlined in Scheme 1, allows 1-phenylthioprop-1-yne[9] to be used as a substitute for phenylthiopropanone (**1a**) in the preparation of enones (**2a**) from ketones in 31—66% overall yields.

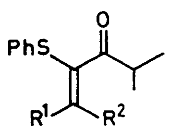
Lithiation of the acetylene (**6**)† produced the α-lithioallene (**7**)[10,11] which was treated with ketones at −78 °C. Upon quenching, the desired allenyl alcohols (**8**)[10] were obtained, along with large quantities (usually > 30%) of starting materials, and the unwanted γ-alkylation adducts (**9**). This latter reaction could be adequately suppressed by addition of hexamethylphosphoric triamide (HMPA)[12] (Table 1), and the allenyl alcohols (**8**) could be obtained in the yields shown in Table 1 after chromatography. However, both acetophenone and benzophenone gave low yields with poor α:γ ratios (the α-addition products decomposed in the subsequent step), so this procedure is presumably unsuitable for aromatic ketones. The allenyl alcohols (**8**) were all cleanly trifluoroacetylated by trifluoroacetic anhydride–triethylamine, as shown by n.m.r. analysis. The initially formed trifluoroacetates (**10**), however, were not stable, and during several days at 20 °C or several hours at 60 °C, they underwent a 3,3-rearrangement (probably *via* an ion pair[13]) to the dienol trifluoroacetates (**11**), a process which could be conveniently monitored by n.m.r. analysis. Methanolysis of the enol esters (**11**) occurred under very mild conditions to give the α-phenylthioenones (**2a**) cleanly, and in near-quantitative crude yields, from the alcohols (**8**). The enones (**2a**) appeared to be rather unstable and large losses were experienced on preparative t.l.c.



(**12**)



(**13**)



(**14**)

We also examined the lithioallene (**13**) derived from 1-phenylthio-3-methylbuta-1,2-diene in this sequence. Condensation with propanone and cyclohexanone occurred under the same conditions as previously, but in rather low yields, owing to extensive enolisation. However the adducts underwent satisfactory rearrangement with trifluoroacetic anhydride to give the corresponding isopropyl enones (**14**) (Table 1, entries 7 and 8), suggesting that this should be a quite general sequence for terminal thioallenes.

Acknowledgment is made to the donors of the Petroleum Research Fund, administered by the American Chemical Society, and to Research Corporation for partial support of this research.

Received, 1st February 1983; Com. 162

References

1 An initial report on this work was presented on June 6th, 1982, at the 16th ACS Midwestern Regional Conference, Normal, Illinois.
2 E. Wehinger, F. Bossert, H. Meyer, W. Vater, A. Heise, S. Kazda, and K. Stoepel, Ger. Offen. 2 616 995 (*Chem. Abs.*, 1978, **88**, 50661).
3 E. Wehinger, F. Bossert, G. Frankowiak, and H. Meyer, Ger. Offen. 2 658 808 (*Chem. Abs.*, 1978, **89**, 109 133).
4 K. Kashima, S. Hidaki, Y. Tominaga, Y. Matsuda, G. Kobayashi, and K. Sakemi, *Yakugaku Zasshi*, 1979, **99**, 38.
5 V. M. Nepleyuev, T. A. Sinenko, and P. S. Pel'kis, *Zh. Org. Khim.*, 1977, **13**, 1456.
6 E. Zbirbal and E. Werner, *Monatsh Chem.*, 1966, **97**, 1797. The corresponding methylthio compound has also been prepared. E. Vilsmaier, W. Spruegel, and W. Boehm, *Synthesis*, 1971, 431.
7 V. Rosnati, A. Salia, and G. Zacchi, *Gazz. Chim. Ital.*, 1976, **106**, 641.
8 N. N. Magdesieva, R. A. Kyandzhetsian, N. G. Chovnikova, and N. N. Emelyanova, *Zh. Org. Khim.*, 1981, **17**, 340.
9 G. Pourcelot, P. Cadiot, and A. Willemant, *C. R. Acad. Sci.*, 1961, **252**, 1630.
10 R. C. Cookson and P. J. Parsons, *J. Chem. Soc., Chem. Commun.*, 1978, 821, 822.
11 S. Hoff, L. Brandsma, and J. F. Arens, *Recl. Trav. Chim. Pays-Bas*, 1968, **87**, 916, 1179.
12 F. E. Ziegler, J. M. Fang, and C. Chan Tam, *J. Am. Chem. Soc.*, 1982, **104**, 7174.
13 A. J. Bridges and R. D. Thomas, unpublished results.

---

† Although the lithioallene (**7**) has been obtained by metallation of the corresponding allene we found this unsatisfactory as 1-phenylthiopropa-1,2-diene is very susceptible to aerial oxidation and has an extremely limited shelf-life (*ca.* 1 day), unlike the acetylene (**6**) which shows no signs of decomposition after 2 years at −20 °C.