



Table I

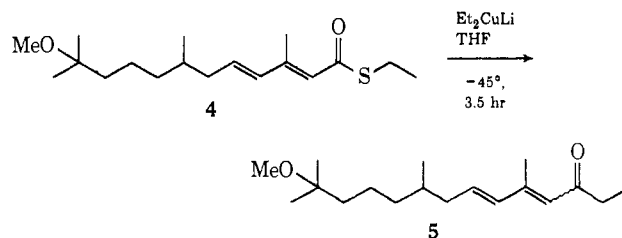
Thioester	Organometallic reagent (equiv)		Reaction conditions <sup>a</sup> Solvent, Temp, Time (°C)	Product (% yield <sup>b</sup> )		
				Ketone CH <sub>3</sub> (CH <sub>2</sub> ) <sub>8</sub> COR	Alcohol CH <sub>3</sub> (CH <sub>2</sub> ) <sub>8</sub> C(OH)R <sub>2</sub>	Re- covered thioester
CH <sub>3</sub> (CH <sub>2</sub> ) <sub>8</sub> COSEt <sup>c,d</sup>	Me <sub>2</sub> CuLi	(0.55)	Et <sub>2</sub> O, -10, 2 hr	R = Me <sup>e</sup> (37) <sup>e</sup>		
	Me <sub>2</sub> CuLi	(1.1)	Et <sub>2</sub> O, -10, 10 min	R = Me (51) <sup>e</sup>		
	Me <sub>2</sub> CuLi	(1.2)	Et <sub>2</sub> O, -78, 2 hr	R = Me (75) <sup>e,f</sup>		
	<i>n</i> -BuMgBr <sup>g</sup>	(1.0)	Et <sub>2</sub> O, 0, 0.5 hr		R = <i>n</i> -Bu <sup>c</sup> (50) <sup>h</sup>	(50) <sup>h</sup>
	<i>n</i> -BuLi	(1.0)	Et <sub>2</sub> O, -78, 0.5 hr		R = <i>n</i> -Bu (50) <sup>h</sup>	(50) <sup>h</sup>
	( <i>n</i> -Bu) <sub>2</sub> CuLi	(0.55)	Et <sub>2</sub> O, -40, 2.5 hr	R = <i>n</i> -Bu <sup>c,i</sup> (89)		
	( <i>n</i> -Bu) <sub>2</sub> CuLi	(1.0)	Et <sub>2</sub> O, -40, 2 hr	R = <i>n</i> -Bu (87)		
	( <i>n</i> -Bu) <sub>2</sub> CuLi	(1.1)	THF, -40, 1.5 hr	R = <i>n</i> -Bu (83)		
	<i>n</i> -BuLi · CuI	(1.1)	Et <sub>2</sub> O, -40 to 0, 20 hr	R = <i>n</i> -Bu (78) <sup>h</sup>		(22) <sup>h</sup>
	<i>n</i> -BuMgBr · CuI	(1.5)	THF, -20, 2 hr	R = <i>n</i> -Bu (83)		
	Ph <sub>2</sub> CuLi	(1.2)	Et <sub>2</sub> O, -40, 1.5 hr	R = Ph <sup>c,j</sup> (74) <sup>e</sup>		
	( <i>i</i> -Pr) <sub>2</sub> CuLi	(1.1)	THF, -40, 4 hr	R = <i>i</i> -Pr <sup>c</sup> (66) <sup>f</sup>		
	( <i>i</i> -Pr) <sub>2</sub> CuLi	(1.1)	Et <sub>2</sub> O, -40, 5 hr			(100)
CH <sub>3</sub> (CH <sub>2</sub> ) <sub>8</sub> COSPh	Me <sub>2</sub> CuLi	(1.1)	Et <sub>2</sub> O, -78, 1 hr	R = Me (72) <sup>e</sup>		
	( <i>n</i> -Bu) <sub>2</sub> CuLi	(1.0)	Et <sub>2</sub> O, -40, 1 hr	R = <i>n</i> -Bu (88)		
CH <sub>3</sub> COSEt	( <i>n</i> -Nonyl) <sub>2</sub> CuLi	(0.7)	Et <sub>2</sub> O, -40, 1.5 hr	R = Me (61) <sup>e</sup>		
PhCOSEt	( <i>n</i> -Nonyl) <sub>2</sub> CuLi	(0.7)	Et <sub>2</sub> O, -40, 1.5 hr	R = Ph (86) <sup>e</sup>		

<sup>a</sup> The thioester was added rapidly to the preformed copper(I) reagent. Reactions were quenched at the stated temperature by dropwise addition of aq NH<sub>4</sub>Cl. <sup>b</sup> Yield after distillation unless otherwise noted. <sup>c</sup> Satisfactory infrared, nmr, and mass spectral analyses were obtained. <sup>d</sup> All thioesters in this report were prepared in essentially quantitative yield from the corresponding acid chloride and 1 equiv of thiol in ether in the presence of 1 to 2 equiv of pyridine. The acid chloride from which 4 was prepared is described by C. A. Henrick, G. B. Staal, and J. B. Siddall, *J. Agr. Food Chem.*, **21**, 354 (1973). <sup>e</sup> Yield after preparative tlc and distillation. <sup>f</sup> Only a trace of aldol could be detected. <sup>g</sup> Cf. the reaction of *S*-(2-pyridyl) thioates with Grignard reagents to give ketones: T. Mukaiyama, M. Araki, and H. Takei, *J. Amer. Chem. Soc.*, **95**, 4763 (1973). <sup>h</sup> Yield by glpc analysis. <sup>i</sup> Mp 25–26° (lit. mp 25.5–26°: V. I. Komarewsky and J. R. Coley, *J. Amer. Chem. Soc.*, **63**, 3269 (1941)). <sup>j</sup> Mp 34.5–35.5° (lit. mp 34.4–35.4°: F. L. Breusch and M. Oguzer, *Chem. Ber.*, **87**, 1225 (1954)).

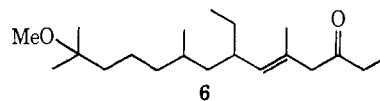
acted with lithium di-*n*-butylcuprate, tertiary carbinol formation was completely suppressed and a high yield of the ketone 2 (R = *n*-Bu) was obtained. Of special synthetic significance is the stoichiometric requirement of only 1 equiv of R (eq 1) for this conversion. Thus, reaction of 1 in diethyl ether with either 0.55 or 1.0 equiv of lithium di-*n*-butylcuprate gave similar yields of 5-tetradecanone. Essentially complete utilization of both the alkyl groups of the organocuprate complex is therefore possible, in marked contrast to the results obtained from reaction of organocuprates with acid chlorides where 3 equiv of R<sub>2</sub>CuLi (6 equiv of R) are required for optimal yields of ketones.<sup>3e</sup> Our observation that 0.55 equiv of lithium di-*n*-butylcuprate reacts completely with 1.0 equiv of 1 suggests that the presumed intermediate complex, lithium ethylthio(*n*-butyl)cuprate, also reacts with 1 to give ketone. Mixed cuprate(I) complexes of this general type have been recently prepared and found useful for the synthesis of ketones from acid chlorides.<sup>5</sup> Reaction of 1 with 1.5 equiv *n*-BuMgBr · CuI in tetrahydrofuran gave 2 in >80% yield.

When the product of the organocopper reaction was a methyl ketone, self-condensation to a β-hydroxyketone<sup>6</sup> occurred to a significant extent at -10°. However, the aldol product could be essentially avoided by using a lower reaction temperature (-78°).

The selectivity of this ketone synthesis was demonstrated by the addition of lithium diethylcuprate to *S*-ethyl (2*E*,4*E*)-11-methoxy-3,7,11-trimethyl-2,4-dodecadienethioate (4). Conversion of 4 (2*E*,4*E* isomer) to 13-methoxy-5,9,13-trimethyl-4,6-tetradecan-3-one (5), obtained in 72% yield as a mixture of 4*E*,



6*E* and 4*Z*, 6*E* isomers in the ratio (3:1), can be carried out by the use of 2 equiv of lithium diethylcuprate in tetrahydrofuran at -45°. Further addition of lithium diethylcuprate to the dienone 5 is not a significant problem (<5%) under these conditions, but the percentage of 6 produced does increase at higher tempera-



tures (cf. ref 3q). In diethyl ether, the formation of 5 from 4 is accompanied by 6 even at -78°.

Our preliminary results<sup>7</sup> from the addition of organocopper(I) complexes to carboxylic acid anhydrides show that such derivatives also act as suitable precursors of ketones. Investigation of the scope of these reactions is continuing.

(7) Reaction of acetic anhydride with lithium di-*n*-nonylcuprate in ether at -40° for 1 hr gave 2-undecanone in over 90% yield with no accompanying aldol product. Reaction of cyclic acid anhydrides with organocuprates gives keto acids. Thus, succinic anhydride and lithium di-*n*-butylcuprate in ether-THF (3:1) at -40° affords 4-oxooctanoic acid in 66% yield after crystallization, mp 52–53°, lit. mp 53–54°: M. S. Newman and J. H. Wotiz, *J. Amer. Chem. Soc.*, **71**, 1292 (1949).

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(5) G. H. Posner, C. E. Whitten, and J. J. Sterling, *J. Amer. Chem. Soc.*, **95**, 7788 (1973).

(6) The aldol product from 2-undecanone was mainly 12-hydroxy-12-methyl-10-heneicosanone.