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FUNCTIONALLY-SUBSTITUTED *N,N*-DIALKYLAMINOMETHYLLITHIUM COMPOUNDS

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Summary

A variety of functionally-substituted *N*-alkyl-*N*-methylaminomethyllithium compounds, $CH_3(R)NCH_2Li$, have been prepared in moderate to high yields via transmetalation reactions between the appropriate (*N*-alkyl-*N*-methylaminomethyl)tributyltin compounds and n-butyllithium. Also, bis(*N*-lithiomethyl)methylamine was obtained by this synthetic method. *N*-Benzyl-*N*-methylaminomethyllithium (I) was found to readily undergo a 1,2-anionic rearrangement to give *N*-lithio-*N*-methyl-β-phenethylamine, a reaction analogous to the "Wittig rearrangement" of metalated ethers. A synthetically useful nucleophilic methylaminomethylation of an aldehyde [i.e., RCHO to $RCH(OH)CH_2NHCH_3$] has been effected through the use of (I).

In an earlier communication [1] we reported a method for preparing some *N,N*-disubstituted aminomethyllithium compounds, $RR'NCH_2Li$. These aminomethyllithium compounds, in which R and R′ were combinations of simple alkyl and/or aryl substituents, were obtained readily by transmetalation reactions between the appropriate (*N,N*-disubstituted aminomethyl)tributyltin and n-butyllithium. We now report that the transmetalation method has been utilized successfully for the preparation of a variety of novel, functionally-substituted *N*-alkyl-*N*-methylaminomethyllithium compounds (I) - (V), and symmetrically-dilithiated trimethylamine (VI) (eqn. 1).

$$RR'NCH_2SnBu_3 + \text{n-BuLi} \rightarrow RR'NCH_2Li + Bu_4Sn \qquad (1)$$

(I) $R = C_6H_5CH_2$, $R' = CH_3$.

(II)* $R = (CH_3)_2NCH_2CH_2$, $R' = CH_3$.

(III) $R = CH_3(OCH_2CH_2)_3$, $R' = CH_3$.

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* Compound (II) has been obtained in low yields from "self-metalation" of the n-butyllithium—*N,N,N′,N′*-tetramethylethylenediamine complex [2,3].

(IV)* $R = NaOCH_2CH_2$, $R' = CH_3$.

(V) $R = C_6H_5CH{=}CHCH_2$, $R' = CH_3$.

(VI)* $R = LiCH_2$, $R' = CH_3$.

For the purpose of determining yields of (I) - (VI), the transmetalation reaction mixtures were treated with trimethylchlorosilane within 1 - 15 min after mixing the reactants at —65° (eqn. 2) (see Table 1 for specific yields). In addition to the moderate to high yields of silane derivatives, tetrabutyltin was recovered nearly quantitatively from all reactions. It is therefore apparent that the transmetalations are rapid and selective.

$$\underset{\text{(I)-(VI)}}{CH_3(R)NCH_2Li} + ClSi(CH_3)_3 \rightarrow \underset{55\text{-}85\%}{CH_3(R)NCH_2Si(CH_3)_3} \qquad (2)$$

Owing to the predictable inherent instability of (I) - (VI), their rapid use in subsequent reactions is probably imperative. Indeed, it was found that (I), for example, on warming to room temperature and standing for one hour, rearranged to give *N*-lithio-*N*-methyl-β-phenethylamine in 83% yield** (eqn. 3).

$$C_6H_5CH_2\underset{\displaystyle CH_3}{\underset{|}{N}}CH_2Li \xrightarrow{20°} C_6H_5CH_2CH_2\underset{\displaystyle CH_3}{\underset{|}{N}}Li \qquad (3)$$

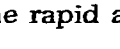
This 1,2-anionic rearrangement*** reaction is formally analogous to the "Wittig metalated ether rearrangement" [2,4,5] and finds precedence in the recently reported decompositions of $C_6H_5CHLiN(C_6H_5)_2$ [7] and C_6H_5-$CHLiN$  $(CH_3)_2$ [8]. The rapid and clean rearrangement of (I) is in marked

TABLE 1

PREPARATIONS AND CHARACTERIZATIONS OF $CH_3(R)NCH_2Li$ AS $CH_3(R)NCH_2Si(CH_3)_3$

R Substituent of $CH_3(R)NCH_2Li$	Yield (%)	B.p. °C(mm)	Analyses[a] of $CH_3(R)NCH_2Si(CH_3)_3$ found (calcd.) (%)		
			C	H	N
$C_6H_5CH_2$	87	130 - 132 (≈20)	69.6 (69.6)	10.2 (10.1)	6.4 (6.8)
$(CH_3)_2NCH_2CH_2$	72	82 (18)[b]			
$CH_3(OCH_2CH_2)_3$	81	67 (0.06)	55.0 (54.8)	11.5 (11.0)	5.5 (5.3)
$HOCH_2CH_2$	43	83 - 84 (20)	52.1 (52.2)	11.6 (11.8)	8.9 (8.7)
$C_6H_5CH{=}CHCH_2$	79	72 - 75 (0.08)	71.2[c] (72.1)	9.8 (9.9)	6.0 (6.0)

[a] All ^{13}C and ^1H NMR spectral data of these compounds were in accord with the structure assignments. [b] Identical to an authentic sample. [c] The methiodide salt of the amine was prepared and analyzed. See the Experimental Section for results.

* The precursors to (IV) and (VI) were $NaOCH_2CH_2N(CH_3)CH_2SnBu_3$ and $CH_3N(CH_2SnBu_3)_2$, respectively.

** Reported earlier by us as an unpublished result in ref. [2], p. 351.

*** As set forth by J.J. Eisch [7], the term anion rearrangement is used to classify a reaction in which both the starting material and product are anions and is not intended to imply that the mechanism of the process is necessarily anionic.

contrast to the decomposition of *N*-methyl-*N*-phenylaminomethyllithium which was earlier shown [1] to give dimethylaniline (≈ 20%), methylaniline (≈ 5%), and a high-boiling nitrogen-containing material during four hours at room temperature. By comparison, *N,N*—dimethylaminomethyllithium is known to be relatively stable [1]. With regard to any mechanistic consideration, it is significant to note that the rearrangement of (I) to *N*-lithio-*N*-methyl-*β*-phenethylamine occurred cleanly even in the presence of an equivalent of n-butyllithium. This finding discounts a mechanism that involves elimination and readdition of benzyllithium [7].

$$C_6H_5\overset{\curvearrowleft}{CH_2}-\underset{\underset{CH_3}{|}}{N}-\overset{\curvearrowleft}{CH_2}-Li \rightarrow C_6H_5CH_2Li + CH_3N{=}CH_2 \rightarrow C_6H_5CH_2CH_2\underset{\underset{Li}{|}}{N}CH_3 \quad (4)$$

The utility of aminomethyllithium compounds as intermediates in the synthesis of tertiary amine derivatives is obvious. However, beyond this potential utility of (I) - (VI), it has been demonstrated that (I), for example, can be used as a nucleophilic methylaminomethylating agent, i.e., as in the conversion of benzaldehyde to *d,l*-$C_6H_5CH(OH)CH_2NHCH_3$ in 50% overall yield (eqn. 5). Thus, in this synthesis, the *N*-benzyl group formally functioned as a "masking" group for the *N*-hydrogen. This method of effecting nucleophilic aminomethylations complements existing analogous methods which employ *N*-nitroso[$CH_3N(NO)CH_2Li$] [9] and diphenylethylidene [$(C_6H_5)_2C{=}NCH_2Li$] [10] masking groups, respectively.

$$(I) + C_6H_5CHO \xrightarrow{H^+} C_6H_5CH(OH)CH_2N(CH_3)CH_6H_5 \xrightarrow{H_2/Pd} \quad (5)$$

$$d,l\text{-}C_6H_5CH(OH)CH_2NHCH_3 + C_6H_5CH_3$$

The precursory (*N*-alkyl-*N*-methylaminomethyl)tributyltin compounds were obtained from reactions of tributyltinlithium with either *N,S*-acetals, isoxazolidines, imidazolidines, or sodium *N,N*-disubstituted aminomethanesulfonate (eqn. 6) (see Table 2 for details). The electrophilic aminomethylating agents in turn were prepared by known condensations of aminomethylols with thiols, alcohols, secondary amines, and sodium bisulfite [1] (eqn. 7).

$$CH_3(R)NCH_2X + Bu_3SnLi \rightarrow CH_3(R)NCH_2SnBu_3 + LiX \quad (6)$$

$$X = SCH_3, SC_6H_5, OCH_3, \overset{+}{N}R'(CH_3)_2, SO_3Na$$

$$CH_3(R)NH + H_2C{=}O \rightarrow CH_3(R)NCH_2OH \xrightarrow{HX} CH_3(R)NCH_2X + H_2O \quad (7)$$

Experimental

All reactions involving organometallic compounds were conducted under an atmosphere of oxygen-free argon. The organotin compounds were stored in ampoules fitted with ground glass stopcocks. Tetrahydrofuran (THF) was distilled from lithium aluminum hydride just prior to use. GLC analyses of all distilled silicon derivatives were performed on 5-ft SE-30 columns. With the exception of $C_6H_5CH_2(CH_3)NCH_2SnBu_3$, the organotin compounds could

TABLE 2

PREPARATIONS AND CHARACTERIZATIONS OF $CH_3(R)NCH_2SnBu_3$

R	B.p. °C(mm)	Yield (%)	^{1}H NMR[a,b]	Precursor
$C_6H_5CH_2$[c]	140 - 142 (0.3)	52	^{1}H NMR signal at τ 7.5 for $SnCH_2N$, $J(CH_2—^{117,119}Sn)$ 21 Hz[d]	$C_6H_5CH_2(CH_3)NCH_2OCH_3$
$(CH_3)_2NCH_2CH_2$	95 - 100 (0.02)	50	^{1}H NMR signal at 7.4 τ for $SnCH_2N$, $J(CH_2—^{117,119}Sn)$ 20 Hz[d]	$(CH_3)_2\overset{+}{N}CH_2N(CH_3)CH_2CH_2I^-$
$CH_3(OCH_2CH_2)_3$	142 - 145 (0.03)	22	^{1}H NMR signal at τ 7.4 for $SnCH_2N$, $J(CH_2—^{117,119}Sn)$ 20 Hz[d]	$CH_3(OCH_2CH_2)_3(CH_3)NCH_2OCH_3$
$HOCH_2CH_2$	110 (0.05)	70[e]	^{1}H NMR signal at τ 7.4 for $SnCH_2N$, $J(CH_2—^{117,119}Sn)$ 21Hz[d]	$CH_3NCH_2OCH_2CH_2$
$C_6H_5CH{=}CHCH_2$	[f]	29	^{1}H NMR signal at τ 7.4 for $SnCH_2N$, $J(CH_2—^{117,119}Sn)$ 22 Hz[d]	$C_6H_5CH{=}CHCH_2(CH_3)NCH_2SO_3Na$

[a]Supporting evidence for these structure assignments originates, of course, from their chemical characterization, i.e., their transmetalation reactions with n-butyllithium, and the subsequent conversion of the resulting (I)-(V) to the corresponding silicon derivatives. [b]The NMR spectral determinations were made on solutions of of the compounds in $CDCl_3$ with tetramethylsilane as an internal reference. [c]Analysis found (calcd.)(%): C, 59.7(59.4); H, 9.4(9.2); N, 2.9(3.3). [d]Not resolved. [e]Average of four preparations. [f]Decomposed on attempted distillation. Purified by column chromatography.

not be analyzed by GLC owing to their thermal instability. However, these compounds, except for $CH_3N(CH_2SnBu_3)_2$, $C_6H_5CH{=}CHCH_2(CH_3)NCH_2SnBu_3$ could be distilled under vacuum*. Prior to distillation, the organotin compounds were freed of tetrabutyltin (small amounts) and hexabutylditin (≈ 15 - 20 mole %) by chromatography on Bio-Rad AG-7 neutral alumina or silica gel (Bio-Sil A). These contaminants, which are side products inherent to tributyltinlithium formation [1], were readily eluted from the columns with hexane. The desired compounds were subsequently eluted with chloroform. The ditin compound, $CH_3N(CH_2SnBu_3)_2$, was obtained in > 95% purity (estimated by ^1H NMR spectral analysis) by this method, but appeared to decompose slowly on standing under argon.

The *N,S*-acetal and the aminomethylsulfonate were prepared by variations of methods described earlier (see Experimental Section) [1]. *N,N'* -dimethylimidazoline, $CH_3\overline{NCH_2N(CH_3)CH_2CH_2}$, was obtained from the reaction of *sym-N,N'*-dimethylethylenediamine with aqueous formaldehyde according to a published procedure [13]. Alkylation with one equivalent of methyl iodide gave the corresponding mono-quaternary salt in high yield. 3-Methyloxazolidine was also prepared by a published procedure [14].

A typical preparation of $CH_3(R)NCH_2Li$ ($R = C_6H_5CH_2$)

To a pre-cooled (—65°) solution of 8.5 g (0.02 mole) of (*N*-benzyl-*N*-methylaminomethyl)tributyltin in 10 ml of THF and 10 ml of hexane there was added in rapid dropwise manner 14.7 ml of 1.5 *M* n-butyllithium (0.22 mole) in hexane (temperature was not allowed to exceed ≈—50°). Within ca. one minute, 3.2 ml (2.7 g, 0.025 mole) of trimethylchlorosilane was added dropwise to the reaction mixture. The resulting temperature rise indicated a rapid coupling reaction. After it had warmed to room temperature, the reaction mixture was poured into chilled dilute acid. An ether extraction removed the neutral components (tetrabutyltin and hexamethyldisiloxane) from the hydrolyzate. The remaining aqueous layer was carefully neutralized with aq. sodium hydroxide and the nitrogen-containing silane was rapidly removed by extraction with ether. Both ether extracts were dried over sodium sulfate, the ether was removed on a rotary evaporator, and the residues were distilled under reduced pressure to give 6.6 g (95%) of tetrabutyltin, b.p. 88 - 93° (0.15 mm) and 3.6 g (87%) of (*N*-benzyl-*N*-methylaminomethyl)trimethylsilane, b.p. 130 - 132° (≈20 mm).

A typical preparation of $CH_3(R)NCH_2SnBu_3$ ($R = HOCH_2CH_2$)

To 0.22 mole of tributyltinlithium [1] in 250 ml of THF, (at room temperature) there was added 10 g (0.22 mole) of the cyclic *N*-acetal, $CH_3\overline{NCH_2OCH_2CH_2}$, which resulted in a warming of the reaction mixture to 50°. After it had been stirred overnight, the reaction mixture was poured into aqueous ammonium chloride**. The hydrolyzate was then extracted twice with

* In general, distillation bath temperatures in excess of 240° resulted in decompositions of the functionally-substituted organotin compounds. Interestingly, these thermal decompositions frequently afforded significant amounts of elemental tin.

** The basic aminomethyltin compounds cannot be separated from the neutral components of the reaction mixture by acidification owing to the hydrolytic instability of $CH_3(R)\overset{+}{N}HCH_2SnBu_3X^-$.

ether. The combined ether extracts were dried over sodium sulfate and the ether was removed on a rotary evaporator. The residue was distilled under reduced pressure to give 2 g of tetrabutyltin, b.p. 100°/0.1 mm, 69 g (83%) of [*N*-(β-hydroxyethyl)*N*-methylaminomethyl] tributyltin, b.p. 110°/0.05 mm, and 13.5 g of hexabutylditin, b.p. 130°/0.05 mm.

Rearrangement of N-benzyl-N-methylaminomethyllithium

To a chilled (0°) solution of 7.2 g (0.017 mole) of (*N*-benzyl-*N*-methylaminomethyltributyltin in 10 ml of THF was added 17.3 ml (0.034 mole) of 19.8% n-butyllithium in hexane. After the temperature of the reaction mixture stabilized, the ice bath was removed and the reaction mixture was allowed to stand for one hour at ≈ 20°. At this time 3.6 g (0.034 mole) of benzaldehyde was added to react with any organolithium reagents present in the mixture, stirring was continued for 15 min, and the reaction mixture was poured into 100 ml of chilled 10% sulfuric acid. The neutral components of the mixture were extracted with ether, dried over sodium sulfate and distilled to give recovered benzaldehyde, butylphenylmethanol, and 5.7 g (96.6%) of tetrabutyltin, b.p. 83 - 88° (0.3 mm). The acidic aqueous layer was neutralized with aqueous sodium hydroxide and extracted twice with ether. The combined ether extracts were dried over sodium sulfate and concentrated on a rotary evaporator. The concentrate, which weighed 2.0 g, was then distilled under reduced pressure to give 1.90 g (83%) of GLC pure *N*-methyl-β-phenethylamine, b.p. 94 - 104° (≈ 20 mm). The amine was identified by comparison of its GLC retention time and ^{1}H NMR spectrum ($CDCl_3$) with those of an authentic sample.

Preparation of $C_6H_5CH(OH)CH_2NHCH_3$

To a cold (—65°) solution of 0.02 mole of *N*-benzyl-*N*-methylaminomethyllithium was added dropwise a solution of 2.4 g (0.023 mole) of benzaldehyde in THF which resulted in an exothermic reaction and the formation of reddish-brown color. After warming to room temperature, the reaction mixture was poured into dilute hydrochloric acid. The neutral components of the mixture were extracted with ether and distilled to give 6.6 g (95%) of tetrabutyltin, b.p. 85 - 90° (0.05 mm). The aqueous layer was neutralized with aqueous sodium hydroxide and was then extracted several times with ether. The combined ether extracts were dried over sodium sulfate and the ether was removed by means of a rotary evaporator to give 4.8 g of an oil. A ^{1}H NMR spectral analysis of the oil revealed it to be essentially pure, *d,l*-$C_6H_5CH(OH)CH_2$-$N(CH_3)CH_2C_6H_5$ as evidenced by the highly characteristic ABX pattern for the $-C(OH)(H_X)CH_AH_BN<$ moiety [1].

The oil was dissolved in 80 ml of methanol and subjected to 50 psi hydrogen in the presence of 5% Pd/C catalyst for 18 h at 50°. Removal of the catalyst, methanol, and toluene, afforded 3.0 g of crude *d,l*-$C_6H_5CH(OH)$-CH_2NHCH_3. A distillation gave 1.5 g (50%) of product, b.p. 81 - 84° (0.08 mm), m.p. 71 - 74° (lit. [12] m.p. 75 - 76°). Also the IR, ^{1}H and ^{13}C NMR spectra of the compound were identical to those of an authentic sample.

Preparation of $(Bu_3SnCH_2)_2NCH_3$

To 0.36 mole of tributyltinlithium in 500 ml THF there was added 28 g (0.18 mole) of $(CH_3SCH_2)_2NCH_3$ at room temperature. After it had been stirred overnight, the reaction mixture was poured into aqueous ammonium chloride and extracted twice with ether. The ether extracts were combined, dried over magnesium sulfate, filtered and evaporated. The residue was transferred to a distillation apparatus to distill off the tetrabutyltin (b.p. 90°/0.04 mm) and hexabutylditin (b.p. 125°/0.04 mm) (by-products from the preparation of the tributyltinlithium). The residue of 90 g represented a crude yield of 78%. A final purification of the product was accomplished by column chromatography on Bio-Sil A. The structure assignment was based on a characteristic ^{1}H NMR signal at τ 7.5 for $SnCH_2N$, $J(CH_2—^{117,119}Sn)$ 22 Hz and a ^{13}C NMR signal at 141.8 ppm for $SnCH_2N$. The compound appeared to decompose slowly on standing in the absence of air as evidenced by the formation of a small amount of a polymer-like precipitate. The chemical characterization of this compound was performed on a sample of ca. 95% purity [see preparation of $CH_3N(CH_2Li)_2$].

Preparation of $CH_3N(CH_2Li)_2$

To a solution of 19 g (0.03 mole) of $(Bu_3SnCH_2)NCH_3$ (≈ 95% pure) in 100 ml of THF, was added 37 ml (0.06 mole) of 1.6 molar n-butyllithium in hexane at —65°. Within a 5 min period, 6.5 g (0.06 mole) of trimethylchlorosilane was added dropwise to the reaction. The reaction was exothermic with the temperature rising to —40°. The cooling bath was removed and the mixture was stirred an additional thirty minutes and then poured into dilute acid and extracted with ether to remove the neutral components (tetrabutyltin and hexamethyldisiloxane). The aqueous phase was neutralized with aqueous sodium hydroxide and the product was recovered by extraction with ether. Both ether extracts were dried over magnesium sulfate and the ether was then removed on a rotary evaporator. Vacuum distillation of the neutral fraction gave 20.1 g (97%) of tetrabutyltin, b.p. 80 - 85° (0.05 mm). Distillation of the basic fraction gave 2.1 g (52%) of bis(*N*-trimethylsilylmethyl)methylamine; the structure assignment was based in part on a characteristic ^{1}H NMR signal at τ 8.2 for $SiCH_2N$ and a ^{13}C NMR signal at 137.0 ppm for $SiCH_2N$. A methiodide salt of the amine melted at 192.5 - 194°. (Found: C, 35.0; H, 8.3; N, 4.1. $C_{10}H_{28}INSi_2$ calcd.: C,34.8; H, 8.1; N, 4.1%.)

Quaternization of $C_6H_5CH=CHCH_2N(CH_3)CH_2Si(CH_3)_3$

A solution of the amine in methylene chloride was reacted with an excess of methyl iodide in methylene chloride to give the quaternary salt, m.p. 158 - 159° (after a recrystallization from a hexane/ethanol mixed solvent). (Found: C, 48.6; H, 7.3; N, 3.8. $C_{15}H_{26}INSi$ calcd.: C, 48.0; H, 6.9; N, 3.7%.)

Preparation of N-benzyl-N-methyl-N-methoxymethylamine

To a mixture of 81 g (1.0 mole) of formaldehyde (37% in water) and 32 g (1.0 mole) of methanol there was added dropwise 121 g (1.0 mole) of *N*-benzyl-*N*-methylamine which resulted in a mildly exothermic reaction. The reaction mixture was stirred for an additional 1.5 h at room temperature and then

extracted twice with ether. The combined ether extracts were dried over sodium sulfate, the ether was removed by means of a rotary evaporator, and the residue was distilled under vacuum to give 135 g (76%) of product, b.p. 61 - 69° (0.15 mm). The compound was positively identified by ^{1}H NMR spectral analysis with peaks centered at δ 2.4 (s, 3, NCH_3), 3.3 (s, 3, OCH_3), 3.7 (s, 2, NCH_2), 4.0 (s, 2, OCH_2), and 7.3 ppm (m, 5, aryl protons).

Preparation of sodium N-methyl-N-(3-phenylprop-2-en-1-yl)aminomethane sulfonate

To 15.6 g (0.15 mole) of sodium bisulfite in 40 ml of water there was added slowly 12.2 g (0.15 mole) of 37% aqueous formaldehyde. The bisulfite adduct of formaldehyde was then treated with 22.4 g (0.15 mole) of the secondary amine which resulted in an exothermic reaction. The reaction mixture was then stirred for an additional 0.5 h and the majority of the water was removed from it by means of a rotary evaporator. A crystallization of the residue from a mixture of acetone and water gave 35.5 g (90%) of a product that did not melt but which slowly decomposed at a temperature in excess of 250°. The solid was then thoroughly dried in a vacuum oven (70°) overnight. A ^{1}H NMR spectral analysis of the aminomethane sulfonate in D_2O (TMSP reference) confirmed the structure assignment with peaks centered at δ 2.5 (s, 3, NCH_3), 3.4 (m, 2, NCH_2), 3.75 (s, 2, NCH_2SO_3), 6.2 (m, 2, CH=CH), and 7.25 ppm (m, 5, aryl protons).

Preparation of N-methyl-bis(N-methylthiomethyl)amine

To a chilled (0°) solution of 77.5 g (1.0 mole) of 40% aqueous methylamine, there was added 16.2 g (2.0 mole) of 37% aqueous formaldehyde solution by means of an addition funnel. Subsequently, 96 g (2.0 mole) of methyl mercaptan was bubbled into the solution over a 1 h period. The aqueous solution, after standing overnight at ambient temperature, was extracted three times with ether. The ether extracts were combined and dried over magnesium sulfate and the ether was then removed under aspirator vacuum. Vacuum distillation of the residue through a 6″ Vigreaux column gave 134 g (89%) of $CH_3N(CH_2SCH_3)_2$, b.p. 35° (0.1 mm). The compound exhibited ^{1}H NMR signals centered at δ 3.9 (NCH_2S), 2.5 (SCH_3), and 2.2 ppm (CH_3N).

Preparation of $CH_3(OCH_2CH_2)_3N(CH_3)CH_2OCH_3$

To a solution of 17.7 g (0.1 mole) of $CH_3(OCH_2CH_2)_3NHCH_3$ in 25 ml of methanol there was added 8 g (0.1 mole) of 37% aqueous formaldehyde. The reaction mixture was stirred one hour at room temperature and then the water and methanol were stripped off under aspirator vacuum. Vacuum distillation of the residue gave 5 g (22%) of $CH_3(OCH_2CH_2)_3N(CH_3)CH_2OCH_3$ b.p. 93° (0.08 mm). The compound exhibited ^{1}H NMR signals centered at δ 4.1 ($NC\underline{H}_2OCH_3$), 3.4 ($C\underline{H}_3OCH_2CH_2$), 3.3 ($NCH_2OC\underline{H}_3$), a triplet centered at 2.8 ($OC\underline{H}_2CH_2N$), 2.4 ($NC\underline{H}_3$), and 3.4 ppm for the remaining ethylene oxy protons in the correct area ratios.

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