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The assignment of the  $^{13}\text{C}$ -nmr spectrum of phenothiazine was made by comparison with the  $^{13}\text{C}$ -nmr spectrum of 1,9-dideuteriophenothiazine, synthesized *via* repeated lithiations and subsequent deuterations of phenothiazine.

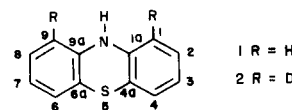
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In our program directed toward the synthesis of conformationally restricted tranquilizers,  $^{13}\text{C}$ -nmr analyses were important for structure determinations. The assignment of the  $^{13}\text{C}$ -nmr spectrum of phenothiazine [1], the precursor for our syntheses, has been reported but the results were not uniform concerning the assignment of the C-2,8 and C-4,6 carbons which have similar chemical shifts [1,2]. Isenbrandt *et al.* tentatively assigned the most deshielded of the two signals to the C-4,6 carbons (1). This assignment has recently been referred to in connection with the analysis of the  $^{13}\text{C}$ -nmr spectrum of pyrrolo[3,2,1-*kl*]phenothiazine [3], a compound which has also attracted our interest [4,5]. Mondelli's group [2], who does not refer to the earlier work of Isenbrandt [1], assigned the low-field signal to the C-2,8 carbons, based on comparison with the  $^{13}\text{C}$  spectrum of 2,3-diazaphenothiazine, in which the corresponding C-6 and C-8 carbons were identified through a LAOCOON3 analysis of the uncoupled  $^{13}\text{C}$ -nmr spectrum. Because of the nearly overlapping signals for pro-

tons H-2,8 and H-4,6 in various solvents, the selective proton-carbon decoupling technique is not easily applicable to the  $^{13}\text{C}$ -nmr spectrum of phenothiazine.

We have made an unequivocal assignment of the  $^{13}\text{C}$ -nmr spectrum of phenothiazine (1) by comparison with the spectrum of 1,9-dideuteriophenothiazine (2). The values from the spectra of 1 and 2 in deuteriochloroform and hexadeuteriodimethylsulfoxide are listed in Table 1. The spectrum of 2 in deuteriochloroform shows that the triplet derived from the C-1,9 carbons was shifted 0.36 ppm, and the quaternary C-1a,9a carbon was shifted 0.23 ppm, upfield. A marked upfield shift (0.19 ppm) of the more deshielded of the two signals corresponding to the C-2,8 and C-4,6 carbons was also observed. Thus, this signal is assigned to the C-2,8 carbons, adjacent to the deuterated C-1,9 carbons [6]. The more upfield signal was almost unaffected (-0.03 ppm) and assigned to the C-4,6 carbons. The same effects were seen in the spectra of 1 and 2 in hexadeuteriodimethylsulfoxide, and hexadeute-

Table 1  
 $^{13}\text{C}$ -NMR Chemical Shifts of Phenothiazine (1)  
and 1,9-Dideuteriophenothiazine (2)



	C-1,9	C-2,8	C-3,7	C-4,6	C-1a,9a	C-4a,6a
1 $\text{CDCl}_3$	114.48	127.40	122.62	126.82	141.79	118.33
2 $\text{CDCl}_3$	114.12 [a]	127.21	122.58	126.79	141.57	118.26
Difference	-0.36	-0.19	-0.04	-0.03	-0.23	-0.07
1 $\text{DMSO-d}_6$	114.34	127.31	121.60	126.09	142.03	116.34
2 $\text{DMSO-d}_6$	114.05 [b]	127.17	121.56	126.05	141.89	116.34
Difference	-0.29	-0.14	-0.04	-0.04	-0.14	-0.00
1 $\text{CD}_3\text{COCD}_3$	114.17	126.99	121.63	125.92	142.06	117.19
2 $\text{CD}_3\text{COCD}_3$	113.85 [c]	126.82	121.55	125.89	141.98	117.19
Difference	-0.32	-0.17	-0.08	-0.03	-0.08	0.00

[a] Triplet,  $J_{13\text{C}2\text{H}} = 24.4$  Hz. [b] Triplet,  $J_{13\text{C}2\text{H}} = 25.1$  Hz. [c] Triplet,  $J_{13\text{C}2\text{H}} = 24.2$  Hz.

rioacetone, although the differences were somewhat less pronounced. Our results thus confirm the assignment made by Mondelli, *et al.* [2].

1,9-Dideuteriophenothiazine (**2**) was synthesized *via* repeated lithiations and subsequent detuenerations of **1**. Gilman, *et al.* established that lithiation and subsequent deuterations of **1** resulted in formation of 1,10-dilithiophenothiazine [7], which can be converted into a variety of 1- and 10- substituted compounds [7,8,9].

#### EXPERIMENTAL

The  $^{13}\text{C}$ -nmr spectra were recorded on a Jeol FX 90Q spectrometer. The  $^1\text{H}$ -nmr spectra were recorded on a Bruker WM-250 NMR spectrometer. Tetramethylsilane was used as internal standard. Mass spectra were recorded on a MAT 311A double focusing mass spectrometer at 70 eV.

#### 1,9-Dideuteriophenothiazine (**2**).

To a solution of 19.9 g (0.10 mole) of phenothiazine (**1**) in 600 ml of dry ether, 151.5 ml (0.25 mole) of 1.65 *N* *n*-butyllithium in hexane was added dropwise at room temperature under a nitrogen atmosphere. After stirring for 20 hours, 9.0 g (0.50 mole) of deuterium oxide was added and the reaction mixture was then poured into water. The organic phase was separated and the aqueous phase was extracted several times with ether. The combined organic phases were washed with water and dried (magnesium sulfate). After filtration of the drying agent, the organic phase was evaporated to a total volume of 600 ml and then transferred to a reaction flask for further addition of *n*-butyllithium. After the lithiation procedure and work up had been repeated five times, the solvent was evaporated and the residue chromatographed (silica, ether) to give 18.0 g (90%) of 1,9-dideuteriophenothiazine (**2**), mp 187-189° (phenothiazine, lit [10] 183-185°); nmr (hexadeuterioacetone):  $\delta$  6.97 (1H, d, H-2), 6.94 (1H, d,

H-4), 6.77 (1H, t, H-3)  $J_{\text{H-2, H-3}} = 7.7$ ,  $J_{\text{H-3, H-4}} = 7.7$  (no traces of either undeuterated or monodeuterated compound could be detected in the  $^1\text{H}$ -nmr or  $^{13}\text{C}$ -nmr spectra); ms: (high resolution) molecular ion  $m/z$  Calcd. for  $\text{C}_{12}\text{H}_7\text{D}_2\text{NS}$  201.0581. Found: 201.0567.

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