The Crystal Structure of Phenothiazine

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PHENOTHIAZINE derivatives are used widely in medical practice.[1] Their actions are disparate according to the side chains attached to the phenothiazine nucleus. One group possesses antihistamine activity, another counteracts certain forms of muscular rigidity (Parkinsonism), and a third has what are generically termed "tranquilising" effects.[2] The structural information about these compounds is limited to short accounts of structure analyses[3] and of unit-cell determinations[5] of some phenothiazine derivatives, structure analyses of two phenothiazine charge-transfer complexes,[6,7] and the unit-cell data for an orthorhombic form of phenothiazine.[5,8]

Pale yellow light-sensitive crystals were prepared by evaporation at room temperature from a solution of phenothiazine in acetone and absolute alcohol. Plate and needle-shaped crystal forms were observed. These were shown by mass spectrometry to be chemically identical. The needle-shaped crystals were found to be monoclinic with $a = 7{\cdot}82(3)$, $b = 5{\cdot}93(1)$, $c = 10{\cdot}70(8)$ Å $\beta = 74{\cdot}01°$, $D_m = 1{\cdot}34$ g.cm.$^{-3}$ (assumed equal to density reported for orthorhombic phenothiazine[5]), $Z = 2$ for $C_{12}H_4NS$, $D_c = 1{\cdot}39$ g.cm.$^{-3}$, space group $P2_1$; 918 reflections (51 unobservably weak) were recorded on an automated Supper equi-inclination diffractometer with Ni-filtered Cu-K_α radiation. Absorption corrections were applied ($\mu = 24{\cdot}4$ cm.$^{-1}$). The structure was solved by Patterson and Fourier methods, and refined by anisotropic full-matrix least-squares. The hydrogen atoms were found close to their calculated positions in a ($F_o - F_c$) synthesis. The position of the hydrogen peak closest to the nitrogen atom suggested that the configuration of the bonds about

the nitrogen was a flattened tetrahedron, the N–H bond having a quasi-equatorial orientation with respect to the heterocyclic ring. Further refinement of the parameters of the non-hydrogen atoms led to a final residual $R = 0{\cdot}046$. The molecular structure is shown in the Figure. The mean bond-lengths (and the biggest deviations from them) are C–C, 1·387 ± 0·015; C–N, 1·406 ± 0·002; and C–S, 1·770 ± 0·003 Å. Standard deviations of individual bond-lengths of these types are, respectively, 0·008 Å, 0·007 Å, and 0·005 Å. Bond-angles are C–S–C, 99·6°; C–N–C, 121·5°; all other angles, 120 ± 1·5°.

These dimensions do not differ significantly from those found for phenothiazine in its 3,5-dinitrobenzoic acid molecular complex,[7] and we concur with Fritchie and Trus' comments[7] on their structural implications. On the other hand, we do not agree that phenothiazine "consists of two planar halves folded along the N–S axis". The N and S atoms deviate from the planes of the two aromatic rings by distances which are certainly significant (N, 0·03 Å, − 0·01 Å; S, 0·18, 0·17 Å). The dihedral angle between these two planes is 153·3°.

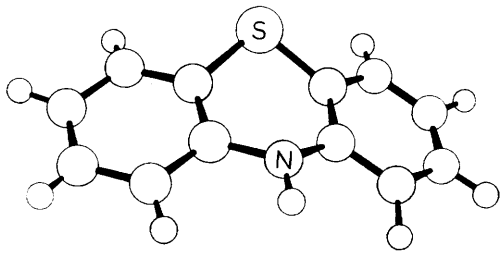

FIGURE. *Perspective view of phenothiazine molecule.*

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