The Absolute Configurations of Two 3-Phenylnorborn-2-ylamine Hydrochlorides and Some Related Phenylnorbornanes

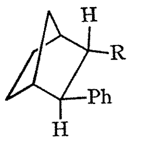
By HOWARD E. SMITH* and T. CHAD WILLIS
(*Department of Chemistry, Vanderbilt University, Nashville, Tennessee* 37203)

Summary The absolute configurations of (+)-*exo*-3-phenyl-*endo*-norborn-2-ylamine hydrochloride and of (−)-*endo*-3-phenyl-*endo*-norborn-2-ylamine hydrochloride have been established as (2*S*) and (2*R*), respectively.

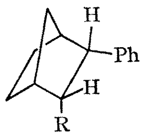
IN connection with our continuing interest in optically active amines,[1] we prepared (+)-*exo*-3-phenyl-*endo*-norborn-2-ylamine hydrochloride[2] [(+)-(I)] and (−)-*endo*-3-phenyl-*endo*-norborn-2-ylamine hydrochloride [(−)-(II)]. The relative configuration of each of these hydrochlorides was established earlier,[3] and now the c.d. of their *N*-salicylidene (Schiff base) derivatives [(+)-(III)] and [(−)-(IV)] establishes their absolute configurations as (2*S*) and (2*R*), respectively.

Since the configuration of [(+)-(I)] has been related[2] to those of (−)-2-phenylnorborn-2-ene, (−)-*endo*-2-phenyl-*exo-cis*-norbornane-2,3-diol, (+)-*endo*-3-phenylnorbornan-2-one and (+)-*endo*-3-phenyl-*exo*-norbornan-2-ol, the absolute configurations of these phenylnorbornanes are also established.

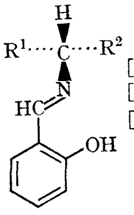
As outlined earlier,[2] resolution of [(±)-(I)] with (+)-tartaric acid gave [(+)-(I)] {$[\alpha]_D^{25}$ + 45° (*c* 1·0, MeOH)} which with salicylaldehyde forms [(+)-(III)] [$[\alpha]_D^{25}$ + 394° (*c* 0·41, MeOH)]. (±)-*endo*-3-Phenyl-*endo*-norbornane-2-carboxylic acid[3] [(±)-(V)] was resolved by fractional crystallization of its cinchonidine salts from abs. EtOH. Decomposition of the least soluble salt {$[\alpha]_D^{24}$ −65° (*c* 1·0, abs. EtOH)} gives [(−)-(V)] {$[\alpha]_D^{25}$ −19° (*c* 4·3, abs. EtOH)}. As described previously for [(±)-(V)],[3] [(−)-(V)] was converted by the Curtius reaction to [(−)-(II)] {$[\alpha]_D^{25}$ −40° (*c* 1·0, MeOH)} which forms the *N*-salicylidene derivative [(−)-(IV)] {$[\alpha]_D^{25}$ −366° (*c* 0·40, MeOH)}.



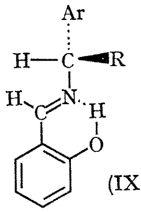
[(+)–(I)]R=NH_3Cl
[(+)–(III)]R=N:CHC_6H_4OH–*o*



[(−)–(II)]R=NH_3Cl
[(−)–(IV)]R=N:CHC_6H_4OH–*o*
[(−)–(V)]R=CO_2H



[(*S*)–(VI)]R^1=Ph,R^2=Me
[(*S*)–(VII)]R^1=CH_2Ph,R^2=Me
[(*R*)–(VIII)]R^1=CMe_3,R^2=Ph



(IX)

Both [(+)-(III)] and [(−)-(IV)] in MeOH as well as the *N*-salicylidene derivatives of (*S*)-α-phenylethylamine [(*S*)-(VI)], (*S*)-α-benzylethylamine [(*S*)-(VII)] and (*R*)-α-phenylneopentylamine [(*R*)-(VIII)] show Cotton effects centred near 255 and 315 nm. (Table).[4] These Cotton effects are associated with absorption bands (log ϵ_{max} 4·1—4·2 and 3·6—3·7, respectively) assigned to transitions of the intramolecularly hydrogen-bonded salicylidenimino-group.[5] They correspond to the absorption bands of salicylaldehyde at 255 and 326 nm. which have been attributed to a charge transfer from the highest occupied orbital of the *o*-hydroxyphenyl group to the π^* orbital of the carbonyl group.[6] The c.d. maximum near 400 nm. has been assigned to a tautomeric form.[5] The large molecular ellipticities of the c.d. maxima near 255 and 315 nm., as compared with the smaller c.d. maxima shown by the *N*-salicylidene derivatives of steroidal amines,[7] indicate that there is a strong, rotationally significant interaction of the π-electron system of the phenyl ring and the salicylidenimino-chromophore,[4] the chirality of which gives the sign to the observed Cotton effects. Thus both [(*S*)–(VI)] and [(*S*)–(VII)] show strong positive Cotton effects near 255 and 315 nm. while those of ([*R*-(XII)] are negative.[4] For each of these three compounds, the molecular ellipticity of the c.d. maximum near 315 nm. is increased in absolute value by 20% when the temperature is lowered from room temperature to −192°.[4]

TABLE

C.d. maxima[a]

λ nm. ([θ])			
[(+)-(III)]		[(−)-(IV)]	
397	(+3300)	403	(−7600)
314	(+22,000)	314	(−21,000)
257	(+82,000)	254	(−25,000)

[a] Cary Model 6001; T 25—28°; *c*. 0·00040—0·041 g./100 ml. MeOH

These observations are in agreement with a conformational equilibrium for the hydrogen-bonded *N*-salicylidene derivatives in which (IX) is the conformer of lowest energy, similar to the preferred conformation of *N*-methylenemethylamine.[8]

A chromophore such as the hydrogen-bonded salicylidenimino-group (point group C_s) is expected to fit a planar sector rule for the prediction of the sign of the Cotton effect shown by a particular enantiomer.[9] Placing a perturbing group on one side of the plane of the π system will give a Cotton effect. Moving the group to the other side will reverse the sign of the Cotton effect. Thus [(*S*)-(VI)] and [(*S*)-(VII)] show strong positive Cotton effects when as in (IX) the phenyl group is behind the plane of the salicylidenimino-group. For [(*R*)-(VIII)] the Cotton effects are negative.

(+)-*N*-Salicylidene-*exo*-3-phenyl-*endo*-norborn-2-ylamine [(+)-(III)] is expected also to have a preferred conformation such that the azomethine carbon atom eclipses the hydrogen atom at C-2. Since the c.d. maxima at 257 and 314 nm. for this enantiomer are both positive and of about the same molecular ellipticity as those of [(*S*)-(VI)], [(*S*)-(VII)] and [(R)-(VIII)], respectively, application of the planar sector rule places the phenyl group behind the plane of the salicylidenimino-chromophore when the latter is oriented as in (IX). Thus the compound is assigned the (2*S*) configuration. Similar considerations are used to assign the (2*R*) configuration to [(−)-(IV)].

We thank the National Science Foundation for a grant supporting this work.

(*Received, May* 16*th*, 1969; *Com.* 693.)

---

[1] H. E. Smith and V. Rajevsky, *J. Heterocyclic Chem.*, 1968, **5**, 715.
[2] C. J. Collins, Z. K. Cheema, R. G. Werth, and B. M. Benjamin, *J. Amer. Chem. Soc.*, 1964, **86**, 4913.
[3] G. I. Poos, J. Kleis, R. R. Wittekind, and J. D. Rosenau, *J. Org. Chem.*, 1961, **26**, 4898.
[4] H. E. Smith and R. Records, *Tetrahedron*, 1966, **22**, 813.
[5] D. Heinert and A. E. Martell, *J. Amer. Chem. Soc.*, 1963, **85**, 183, 188.
[6] J. Tanaka and S. Nagakura, *J. Chem. Phys.*, 1956, **24**, 1274.
[7] H. Ripperger, K. Schreiber, G. Snatzke, and K. Ponsold, *Tetrahedron*, 1969, **25**, 827.
[8] J. T. Yardley, J. Hinze, and R. F. Curl, jun., *J. Chem. Phys.*, 1964, **41**, 2562.
[9] J. A. Schellman, *J. Chem. Phys.*, 1966, **44**, 55.