

The simplest molecule heretofore available for purposes of comparison of theory with experiment is secondary butyl alcohol.^{1,3,4} In view of the uncertainties introduced by the non-linearity of the ethyl and hydroxyl groups, this substance has proved not too satisfactory. Therefore, α -bromopropionitrile has been prepared in an optically active form, since it appears reasonable to assume that each of the groups attached to the asymmetric carbon atom has cylindrical symmetry. Strong evidence in favor of this assumption in the case of the nitrile group is given by Brockway,⁵ who demonstrated the linearity of C—C≡N in methyl cyanide by the electron diffraction method, and by Weissberger and Sängewald,⁶ who found a zero dipole moment for *p*-dicyanobenzene. The result of Bretscher⁷ attributing a relatively large moment to 4,4'-dicyanodiphenyl has been considered anomalous by Le Fèvre and Vine,⁸ and as not proving any lack of axial symmetry in this molecule.

Kirkwood's theory leads to the following simple expression for the rotatory parameter of an active molecule in terms of the geometrical configuration and the polarizability tensors of its constituent groups

$$g = g^{(0)} + g^{(1)} + \sum_{k=1}^{N+1} g_k$$

In molecules with only one asymmetric center the g_k vanish. Each term in $g^{(0)}$ vanishes if the optical axes of symmetry of the groups are parallel to the respective bonds linking them to the asymmetric carbon atom. The rotatory power must then be sought in higher terms which are considered by Kirkwood to be relatively unimportant. Thus α -bromopropionitrile might be expected to have a small specific rotation.

l- α -Bromopropionitrile was prepared from *l*- α -bromopropionic acid by asymmetric conversion. The rotation of the acid indicated it to be 67.1% levo and 32.9% dextro. It was converted to the amide and the latter dehydrated with phosphorus pentoxide to obtain the nitrile. After one distillation the nitrile had a specific rotation $[\alpha]^{25}_D -5.29^\circ$, and after a second distillation $[\alpha]^{25}_D -5.25^\circ$. The final product analyzed 10.44, 10.50, and 10.49% nitrogen (calcd. for CH_3CHBrCN ,

10.46%). On the assumption that no racemization occurred during the synthesis, the calculated specific rotation for the optically pure compound is $[\alpha]^{25}_D -15.33^\circ$. The true value would, of course, be higher if some racemization had occurred.

On first sight, this result indicates that greater importance should be attached to the higher approximations of the polarizability theory. Kirkwood⁹ points out, however, that it is not unquestionable evidence since lateral optical anisotropy of sufficient magnitude to account for the observed rotation could be induced in the CN group, probably by the C-Br dipole.

Since this molecule is of considerable interest from a theoretical point of view, efforts will be made to prepare it in a state of higher optical purity. The refractive and rotatory dispersion behavior of the substance in the visible region will be determined.

A more unambiguous test of the importance of the higher terms in Kirkwood's theory would presumably be furnished by a molecule having only monatomic groups attached to the asymmetric carbon atom. Because of this fact and its general theoretical interest, fluorochlorobromomethane, CHFCIBr , has been prepared. Attempts are at present being made to resolve it by various methods.

(9) Kirkwood, private communication.

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Desoxycholamine

BY WILLIAM T. CALDWELL

In an article describing the preparation of cholamine by Lindemann's modification of the Curtius reaction,¹ attention was called to the fact that Borsche and Schwarz had distilled with caustic potash the urethan derived from cholylazide without, however, obtaining any of the desired amine by this application of the usual Curtius degradation. It was very interesting, therefore, to receive from Dr. Mihail Vanghelovici, in a private communication which he kindly sent, a description of a desoxycholamine whose preparation he reported to the Rumanian Academy of Sciences. He observed that, since his desoxycholamine had been prepared by the Curtius method, working at a pressure of 2 mm., it appeared to be

(1) Caldwell, *THIS JOURNAL*, **60**, 991 (1938).

(3) Gorin, Walter and Eyring, *J. Chem. Phys.*, **6**, 824 (1938).

(4) Kuhn, *Z. physik. Chem.*, **B31**, 23 (1936).

(5) Brockway, *THIS JOURNAL*, **58**, 2516 (1936).

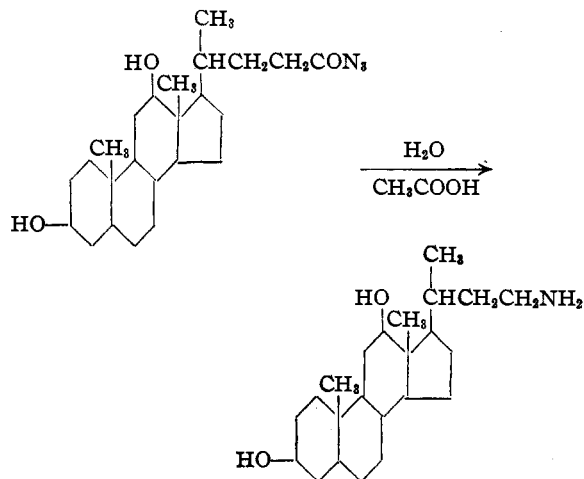
(6) Weissberger and Sängewald, *J. Chem. Soc.*, 855 (1935).

(7) Bretscher, *Helv. Phys. Acta*, **2**, 257 (1929).

(8) Le Fèvre and Vine, *J. Chem. Soc.*, 1878 (1938).

much stabler than cholamine. The crude base, m. p. about 90° , yielded a microcrystalline solid, m. p. 118° , after repeated purification; it was strongly alkaline to red litmus moistened with methyl or ethyl alcohol and formed a hydrochloride, m. p. 247° , whose aqueous solution was extremely bitter.

Since I had prepared a desoxycholamine which differed from that described by Dr. Vanghelovici in the melting points, both of the free base and its hydrochloride, as well as in the comparative ease with which it could be obtained in nicely crystalline form from methanol, I am submitting a description of its preparation and some of its characteristics. Although there are differences in melting points, the two amines are alike in being strongly alkaline to red litmus moistened with methyl or ethyl alcohol and in the striking bitterness of their hydrochlorides. It appears not illogical to assume that they are stereoisomers; possibly epimerization occurred during the alkaline hydrolysis used in the Curtius degradation, since this type of change is effected by other alkaline reagents such as sodium alcoholate or metallic sodium in xylene.



Experimental Part

Twenty-two grams of desoxycholyhydrazide, m. p. 203° , was dissolved in 67 cc. of normal hydrochloric acid and 400 cc. of water. After adding 400 g. of ice, sodium nitrite (4.2 g.) in 50 cc. of water was added slowly with good stirring. The mixture was then stirred for an additional fifteen minutes and the azide filtered off with suction. The pressed, wet cake containing approximately 150 g. of water was transferred immediately to 210 g. of glacial acetic acid; it did not all dissolve but, upon gently warming on the steam-bath, the undissolved portion melted; evolution of gas began at about 45° , becoming more vigorous in the neighborhood of 60° ; at the same time the amount of oil

decreased but even after heating for four hours a small amount (about 1 g.) was visible. After cooling, the solution was filtered through a sintered glass funnel and cold aqueous potassium hydroxide added until the mixture became alkaline to phenolphthalein. The precipitate was then dissolved in alcoholic potassium hydroxide; after warming, this solution was diluted with a large amount of water and the precipitate washed by decantation with water until the aqueous washings gave no alkaline reaction with red litmus. The residual gum still contained a relatively large amount of non-basic material which was not investigated further; after its removal, the amine was purified by several recrystallizations from absolute methanol, from which it separated easily as fine, white crystals upon chilling and scratching the moderately concentrated solution.

Although these crystals were well formed and homogeneous, they did not melt sharply, their behavior depending upon the rate of heating; after beginning to soften at about 70° , they resolidified upon raising the temperature very slowly; finally, however, the substance melted sharply at $157\text{--}158^\circ$; yield, 3 g. The amine is so insoluble in water that it gives no basic reaction to red litmus moistened with water, at least within a reasonable length of time; on the other hand, it imparts a bright blue color at once to red litmus moistened with methyl or ethyl alcohol.

Analysis of the crystals, dried at room temperature over soda-lime and calcium chloride, indicated that they contained one molecule of methanol of crystallization.

Anal. Calcd. for $C_{23}H_{41}O_2N \cdot CH_3OH$: C, 72.86; H, 11.46. Found: C, 72.63; H, 11.60.

The free base, m. p. $158\text{--}159^\circ$, after warming for three hours in a drying pistol over metallic sodium at 5 mm. and 100° , was analyzed.

Anal. Calcd. for $C_{23}H_{41}O_2N$: C, 75.97; H, 11.36; N, 3.85. Found: C, 75.31, 75.84; H, 11.39, 11.44; N, 3.87, 3.77. Vanghelovici found: C, 75.37; H, 12.00; N, 3.82.

The hydrochloride, made by passing gaseous hydrogen chloride into a methyl alcoholic solution of the base, melted at 306° after sintering slightly at 300° . Unlike the base it is easily soluble in water.

Anal. Calcd. for $C_{23}H_{41}O_2N \cdot HCl$: Cl, 8.88. Found: Cl, 8.48. Vanghelovici calcd.: N, 3.50. Found: N, 3.80.

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The Preparation of Primary Amines

BY ALEXANDER GALAT AND GERTRUDE ELION

The transformation of alkyl halides into primary amines by the formation of a double compound with hexamethylenetetramine, followed by alcoholysis in the presence of hydrogen chloride, affords a very convenient means for the preparation of primary amines.^{1,2,3} As this method has

- (1) Delépine, *Compt. rend.*, **120**, 501 (1895); **124**, 292 (1897); *Bull. soc. chim.*, [3] **17**, 290 (1897); [4] **31**, 108 (1922).
- (2) Mannich and Hahn, *Ber.*, **44**, 1542 (1911).
- (3) Foldi, *ibid.*, **53**, 1836 (1920).