

RESTRICTED ROTATION IN AMIDES II. STEREOCHEMICAL DEPENDENCE OF THE CHEMICAL
SHIFT NON-EQUIVALENCE OF GEMINAL GROUPS.¹

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Geminal non-equivalence of the N-methylene protons in o-substituted tertiary amides has been observed and reported for one of the methylene groups^{3,4}. We had found that benzamides with a single ortho substituent (substituent = F, Cl, NO₂, Me, OMe) exhibited two AB quartets at low temperatures⁵. Since the chemical shift difference between non-equivalent geminal hydrogens is considerably larger for the downfield methylene group ($\tau=5.3\text{ppm}$; $\delta_{AB} \approx 1\text{ppm}$) than for the upfield one ($\tau=5.8\text{ppm}$; $\delta_{AB} = 0.15\text{ppm}$),⁵ assignment of the resonances to the specific methylene groups becomes of great interest. Bedford *et al.*,³ in agreement with Siddall and Garner,⁴ had assigned the downfield methylene resonance to the group anti to the carbonyl oxygen. By contrast the opposite assignment has been made by us⁶ as well as by Mannschneck⁷ for similar amides.

Theoretical considerations for resonance assignment in amides have been shown to be erroneous and misleading⁸ and the usual experimental methods applied to amides^{8,9} have failed in our systems. No dilution shifts were observed when chloroform solutions of substituted N,N-dibenzylbenzamides were diluted with benzene, presumably due to steric interference. Similarly, no Nickel (II) complexes of these benzamides could be obtained and, therefore, the contact shift method⁸ for assignment of resonances could not be used.

We have applied the Nuclear Overhauser effect (NOE) to 3,5-dinitro-N,N-dibenzyl benzamide and to 2-methyl-3,5-dinitro N,N-dimethyl benzamide¹⁰ following Anet's elegant example,¹¹ and found that irradiation of the upfield N-substituent resulted in increases of 13% and 11% respectively in the integrated areas of the benzoyl *o*-protons. Irradiation of the downfield N-substituents had no effect. Thus, it is the N-methylene group farthest, through space, from the chiral center which shows the larger magnetic non-equivalence. It appears that the assignments made by Bedford³ and Siddall⁴ are in error; we do not wish however, to generalize our results to other systems. A comprehensive study of chemical shift assignments in amides utilizing the NOE method will be reported on separately.

References and Footnotes

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