Stereochemistry of the Acetalization of Hexafluoroacetone with a Bromohydrin

By BRUCE M. JOHNSON and JAMES W. TAYLOR*
(*Department of Chemistry, University of Wisconsin, Madison, Wisconsin* 53706)

Summary Acetalization of hexafluoroacetone with *threo*- and *erythro*-5-bromo-octan-4-ol has been shown to be highly *trans*-specific by ^{19}F n.m.r., providing a method for establishing the stereochemistry of bromohydrins and their precursors when they are reacted stereospecifically.

THE stereochemistry of acetal formation from bromohydrins (synthesized stereospecifically[1]) with hexafluoroacetone is established by the equivalence or non-equivalence, respectively, of the trifluoromethyl groups using ^{19}F n.m.r. spectroscopy. *threo*- and *erythro*-5-Bromo-octan-4-ol, derived from *cis*- and *trans*-oct-4-ene, were each treated (1 equiv) with hexafluoroacetone (1·5 equiv) in pentane containing tri-n-butylamine (1 equiv) in a sealed tube for two days at 75° and yielded acetals of greater than 97% isomeric purity.

Based on the scheme (I) → (II) → (III), the reaction would be predicted to proceed *via trans*-addition. The equilibrium (I) → (II) normally lies far to the right[2,3] and would be driven even further in the presence of base. Any conversion of bromohydrin into epoxide is either very small or gives the same products as shown.

The ^{19}F n.m.r. spectra of the isomeric acetals were run on a Varian Associates XL-100 spectrometer at 94·1 MHz as 20% solutions in $(CD_3)_2CO$ with 5% CCl_3F as the fluorine reference and deuterium as the lock signal. At the resolution used in this work, the four isotopic CCl_3F resonances were observed to have chemical shift differences of about 0·5 Hz and near theoretical values for the relative peak intensities.[4] The chemical shifts, at ambient temperature and without correction for concentration and solvent effects, are referenced to the low-field member of the CCl_3F cluster. The spectrum obtained for the acetal derived from *erythro*-5-bromo-octan-4-ol gave a very narrow triplet (ϕ 80·62 p.p.m. produced by H–F coupling (J 0·6 Hz) with the methine protons which collapses to a very sharp singlet when the methine protons are decoupled. The acetal derived from the *threo*-bromohydrin gives a spectrum which indicates non-equivalent CF_3 groups typical of *cis*-geometry. A complex but symmetrical pattern (ϕ 79·88 p.p.m.) indicative of an A_3B_3 pattern complicated by H–F coupling, decoupled to a more complex splitting pattern having narrower lines when the methine protons were irradiated. Further interpretation of these data was not attempted.

Thus, addition of hexafluoroacetone to bromohydrins is a highly stereospecific reaction which is useful for characterizing bromohydrins derived from symmetrical alkenes. Extension to other alkenes is under investigation.

We acknowledge support of the research by the Air Force Office of Scientific Research and by the Wisconsin Alumni Research Foundation. We also thank Professor Paul Bender and Mr. David Hillenbrand for running the n.m.r. spectra and the National Science Foundation for departmental support of the XL-100 n.m.r. spectrometer.

(*Received, September 27th,* 1971; *Com.* 1682.)

[1] D. R. Dalton, V. P. Dutta, and D. C. Jones, *J. Amer. Chem. Soc.*, 1968, **90**, 5498.
[2] H. E. Simmons and D. W. Wiley, *J. Amer. Chem. Soc.*, 1959, **82**, 2288.
[3] C. G. Krespan and W. J. Middleton, *Flourine Chem. Rev.*, 1967, **1**, 145.
[4] P. R. Carey, H. W. Kroto, and M. A. Turpin, *Chem. Comm.*, 1969, 188.