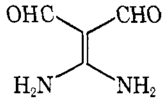
reuse of the same functionality in a second ring formation reaction. This two-step sequence can therefore be directed with equal ease to the synthesis of symmetric and nonsymmetric polycondensed 1,8-naphthyridines depending on whether or not the same ketone is supplied in the second condensation. The general availability of cyclic keto methylenes ensures a successful application of this new sequence for a multitude of polycondensed systems.

Finally, it is interesting to note that this sequence formally represents a double Friedländer condensation of aromatic keto methylenes with the unknown diaminomethylene malonaldehyde.



Acknowledgment. This research was sponsored by the U.S. Army Research Office—Durham, N.C. We wish to express appreciation to Professor M. Szwarc without whose help this investigation would not have been possible. We thank Dr. G. Evens for carrying out some preliminary experiments.

Supplementary Material Available. Experimental details and full analytical and spectroscopic data will appear following these pages in the microfilm edition of this volume of the journal. Photocopies of the supplementary material from this paper only or microfiche (105 × 148 mm, 24× reduction, negatives) containing all of the supplementary material for the papers in this issue may be obtained from the Business Office, Books and Journals Division, American Chemical Society, 1155 16th St., N.W., Washington, D.C. 20036. Remit check or money order for $4.00 for photocopy or $2.50 for microfiche, referring to code number JOC-75-2566.

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Neighboring Group Assistance in Azabicyclic Derivatives. Tremendous Rate Accelerations in 2-Aza-6-halobicyclo[2.2.2]- and 6-Aza-4-halobicyclo[3.2.1]octanes

Summary: The incorporation of a nitrogen atom into the 2 position of bicyclo[2.2.2]octane and the 6 position of bicyclo[3.2.1]octane results in exceptional solvolytic rate enhancements (up to 10^9) of halo substituents located 1,3 from the nitrogen compared to similar carbon–carbon σ bond participation and 1,3-nitrogen participation in alicyclic compounds.

Sir: Although considerable effort has been devoted to investigations of participation and skeletal rearrangements in carbobicyclic structures,[1] relatively limited attention has been accorded analogous systems containing heteroatoms[2–4] in spite of the well-established ability of several atoms to offer neighboring group assistance in solvolytic and related reactions.

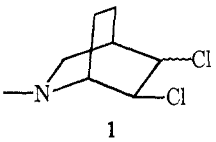
Table I
Rates of Solvolysis of Azabicyclic and Related Compounds in 80% Aqueous Ethanol

Compd	Temp, °C	k, min^{-1}	Rel rate
1	0	8.53	4×10^8
2	75	4.48×10^{-6}	1^a
3	0	6.22×10^{-5}	2.4×10^3
4	85	2.5×10^{-3}	2.8×10^{2a}
5	0	>42	1.7×10^9
6	0	>42	1.7×10^9

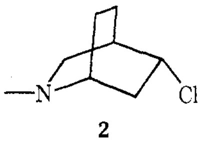
[a] Corrected to 0°.

We wish to report that the incorporation of a nitrogen into the 2 position of bicyclo[2.2.2]octane and the 6 position of bicyclo[3.2.1]octane results in exceptional solvolytic rate enhancement of halo substituents located cross-ring and exo compared to similar carbon–carbon σ bond participation in these systems and even analogous 1,3-nitrogen participation in alicyclic compounds. Table I presents rate data for a variety of compounds chosen to compare various participation possibilities in bicyclic derivatives (**1**, **2**, **4–6**) and the open-chain equivalent (**3**). As evident, the ability of nitrogen to enhance the solvolysis of a 6-*exo*-chloro group is phenomenal, the rate being over *10^8 as fast as a 5-chloro substituent and ca. ~10^5 as fast as N,N-dimethylamino-2-chloroethane (3)*! The effect on a 6-bromo substituent is equally dramatic. Both the bicyclo[2.2.2] and the bicyclo[3.2.1] compounds **5** and **6** were solvolyzed so rapidly (half-lives <1 sec at 0°) that accurate rate data could not be obtained. Nevertheless, a lower limit estimate of ~10^9–10^{10} compared with **2** illustrates that nitrogen possesses super assisting ability in these systems.

Compounds **5** and **6** (and to a lesser extent **1**) were so reactive in the free amine state that they could be isolated only as the HBr salts **5a** and **6a**.[5] Treatment of either **5a** or **6a** with ethanolic ethoxide or hydroxide in aqueous *tert*-butyl alcohol initially gave the *exo*-4-hydroxy derivative **7a** with the latter reagent or the corresponding ethyl ether **7b** with the former. The hydroxy compounds **7a** was converted to the tricyclic ether **8** upon longer reaction time. Reduction of either **7a** or **8** with lithium triethylborohydride ("Super-hydride")[7] afforded 4-*exo*-hydroxyl-2-methyl-2-azabicyclo[3.2.1]octane (**9**).[8] Evidently, release of the free amine by base results in rapid formation of the cyclic aziridinium ion which is opened by base to the more stable bicyclo[3.2.1] derivative **7a**. Further reaction with base furnishes the ether **8** by internal cyclization.



1
1a HCl salt



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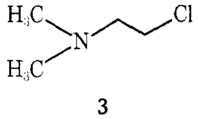
2a HCl salt



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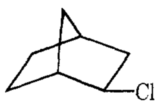
3a HCl salt



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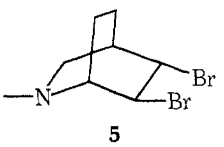
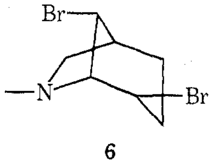
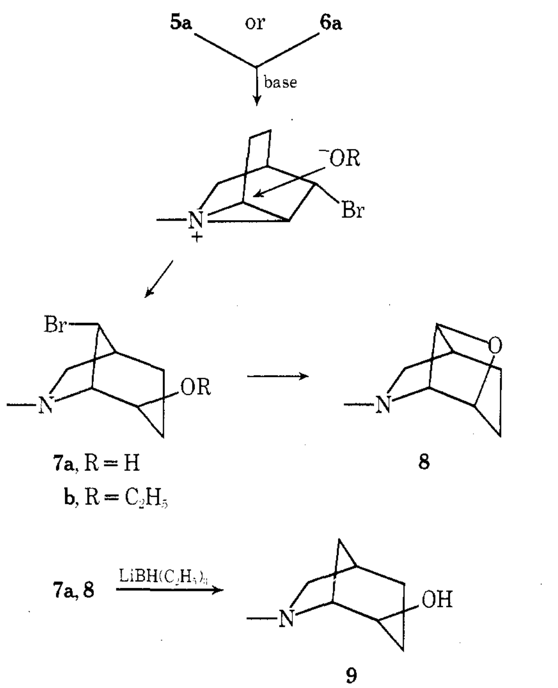


5
5a HBr salt



6
6a HBr salt



The astounding rate enhancement observed for **1a**, **5a**, and **6a** is reminiscent of the acceleration found for bicyclic α-amino halides compared with carbocyclic analogs ($\sim 10^3$–10^8)[2g–i] and the observation that most α-amino halides exist in the iminium salt form.[9] Apparently, favorably disposing nitrogen for displacement of halogens results in extremely rapid reactions. In the present case, locking the geometry such that the departing halogen and the attacking nitrogen are rigidly held antiplaner provides an especially favorable orientation for facile participation.[10]

Acknowledgment. The authors wish to express their gratitude to Dr. Grant Krow for a spectrum of **9** and helpful discussions. L.R. expresses his thanks to NDEA for a fellowship.

Supplementary Material Available. The synthesis and characterization of the compounds employed in this investigation along with other experimental details will appear following these pages in the microfilm edition of this volume of the journal. Photocopies of the supplementary material from this paper only or microfiche (105 × 148 mm, 24× reduction, negatives) containing all of the supplementary material for the papers in this issue may be obtained from the Business Office, Books and Journals Division, American Chemical Society, 1155 16th St., N.W., Washington, D.C. 20036. Remit check or money order for $4.50 for photocopy or $2.50 for microfiche, referring to code number JOC-75-2567.

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(5) Bromination of the parent alkene 2-methyl-2-azabicyclo[2.2.2]oct-5-ene in CCl_4 followed by treatment of the resulting dibromo-*N*-bromine complex witlh acetone gave **5a**. Refluxing **5a** in acetone gave essentially complete conversion to the rearranged salt **6a**. A similar predominance of the [3.2.1] over the [2.2.2] ring system was noted by Huffman and coworkers[2a] with isoquinuclidones. Apparently, the bicyclo[3.2.1] skeleton is the more thermodynamically stable as is the case with the carbocyclic analog.[6] However, Büchi has observed[2e] that nitrogen migrations in certain iboga alkaloid intermediates favor the bicyclo[2.2.2] system. Ostensibly, other (probably steric) factors play a decisive role in determining the stability in these complex derivatives.

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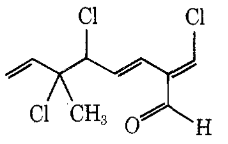
Plocamene B, a New Cyclic Monoterpene Skeleton from a Red Marine Alga

Summary: A nonisoprenoid trichloromonoterpene, plocamene B, has been isolated and characterized from Northern California collections of the red alga *Plocamium violaceum*.

Sir: Very recently we reported an acyclic polychlorinated monoterpene aldehyde **1** as a major component from the red alga *Plocamium cartilagineum*.[1] Our observation that semipurified extracts from this alga possess marked anti-insecticidal activity against mosquito larvae[2a] prompted us to examine a related, less common alga, *P. violaceum*. We report below the characterization of a major metabolite from this latter alga, plocamene B (**2**), which has a nonisoprenoid monoterpene skeleton and displays moderate toxicity to lab test fish.[2b]



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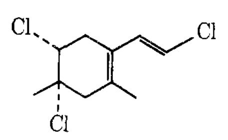

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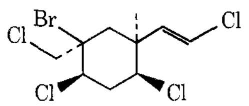

3

Collections were made of *P. violaceum* in the fall of 1974 [week of Sept 15] from several different intertidal locations north of Santa Cruz. Separate extractions ($CHCl_3$) of each batch of frozen thalli yielded about equal amounts of essential oils. Preliminary analysis of the crude, nonpolar fractions for halomonoterpenes by GC/MS showed (see