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# THE SOLVOLYTIC BEHAVIOR OF N-BROMAMINES

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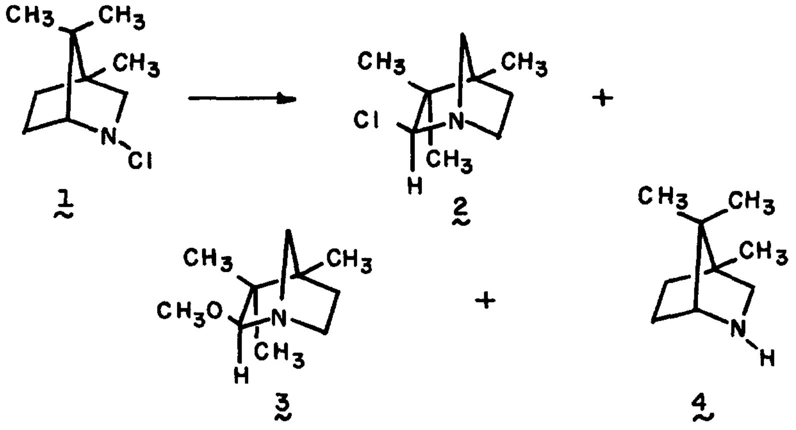
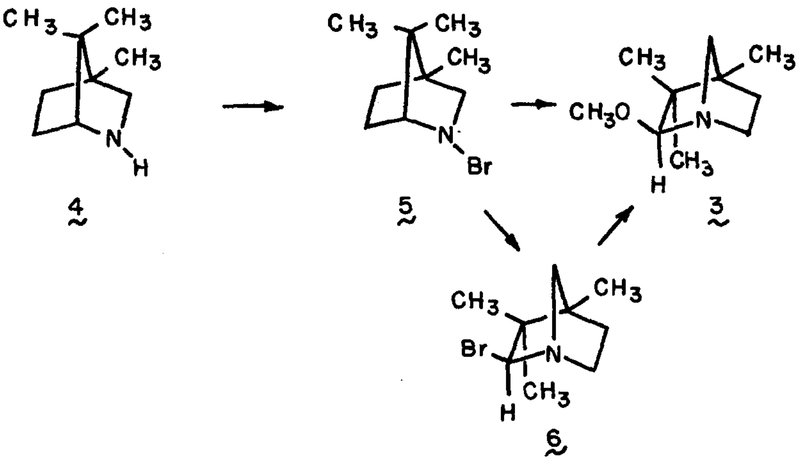
The role of nitrenium ions as the key intermediates in the synthesis and rearrangement of a variety of compounds has recently been demonstrated.[1] In general, the major route to these unique nitrogen cations has involved the heterolytic cleavage of the N-Cl bond of N-chloramines. One drawback in the use of N-chloramines as precursors for nitrenium ions is the considerable amount of internal return of chloride ion observed in certain solvolysis reactions.[2,3] The stability of these rearranged chlorides serves as a deterrent to their use as precursors of other functionalized azabicyclics. In an attempt to avoid this problem, observed in the use of N-chloramines, we decided to investigate the solvolytic behavior of N-bromamines. We now wish to report that N-bromamines can be used to advantage as nitrenium ion precursors.

As previously reported,[2] the silver ion induced rearrangement of 2-chloro-4,7,7-trimethyl-2-azabicyclo[2.2.1]heptane (1) in methanol gave 78% of 2, 8% of 3, and 4% of 4. The

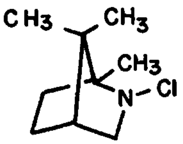


major product of this reaction, 2, was that of internal return of chloride ion to the Wagner-Meerwein rearranged azabicyclic skeleton. These results can be compared with those from the rearrangement of the N-bromamine corresponding to 1.

Reaction of 4 with sodium hypobromite at 0° gave 5 (80-90% yield) which was used without purification. Addition of silver perchlorate to a methanolic solution of 5 at 25° resulted in the formation of 3 as the only isolable product after 30 min. (70% yield). This procedure had clearly circumvented the problem of internal return associated with the solvolysis of 1. However, the mechanistic origin of 3 was not clear. It was possible that all of 3 was formed directly from 5. An alternate possibility would involve the initial formation of 6, followed by solvolysis of 6 under the reaction conditions to yield 3. In order to distinguish between these two possibilities, we solvolyzed 5 at 0° for 30 min. in methanol in the presence of silver perchlorate. Under these conditions we obtained 55% of 6 and 20% of 3. The structure of 6 was established on the basis of chemical analysis, infrared and mass spectral data, and the close analogy of its nmr spectrum to that of 2. At 25°, 6 reacted rapidly with silver perchlorate in methanol to produce 3.



A less pronounced contrast was obtained when the silver ion promoted rearrangements of 7[4] and 8 were compared. Both N-halamines produced mixtures of 9-12. However, the product ratios differed considerably. The silver perchlorate promoted reaction of the N-chloramine, 7, gave 13% of 9, 5% of 10, 64% of 11, and 12% of 12. The comparable reaction of the N-bromamine, 8, produced 11% of 9, 10% of 10, and ca. 67% of a mixture of 11 and 12. The ratio



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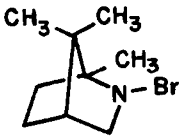

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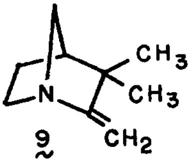
of 11 to 12 in the N-bromamine route varied considerably, with 11 being 29 ± 10% and 12 being 38 ± 10%. It would appear that under the reaction conditions some interconversion of 11 and 12 was occurring.[5]



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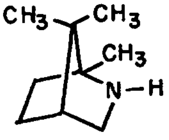

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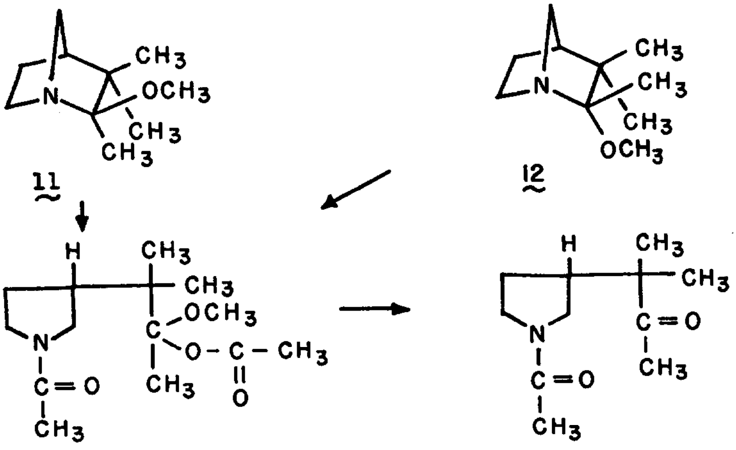

11

12

13

14

The epimeric nature of 11 and 12 was demonstrated through reaction of each compound with acetic anhydride in chloroform at reflux to produce diastereomeric mixtures of 13 which were relatively unstable and which were not readily purified. Reaction of both mixtures with p-toluenesulfonic acid in methanol produced 14.[4,6]

The basic assignment of the exo-methoxyl group to 11 and the endo-methoxyl group to 12 was based on a detailed nmr study of both compounds which included a comparison of the nmr spectra of 11 and 12 with those of 3 and its epimer.

In conclusion, it has been demonstrated that N-bromamines are highly desirable precursors for certain types of nitrenium ion reactions. A major advantage of the use of N-bromamines is derived from the inherent reactivity of those products which result from internal return of bromide ion.

We are continuing to investigate the use of N-bromamines as nitrenium ion precursors.

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## References

1) P. G. Gassman, Accounts Chem. Res., 3, 26 (1970).

2) P. G. Gassman and R. L. Cryberg, J. Amer. Chem. Soc., 91, 2047 (1969).

3) P. G. Gassman and G. A. Campbell, ibid., 93, 2567 (1971).

4) P. G. Gassman and R. L. Cryberg, 157th National Meeting of the American Chemical Society, Minneapolis, Minn., April 14-18, 1969; Abstracts p. O-14.

5) This interconversion was experimentally verified. We are continuing to investigate the detailed aspects of the epimerization of these systems.

6) The detailed proof of the structure of 14 will be presented in the full paper on these solvolytic studies.

7) P. G. Gassman and R. L. Cryberg, J. Amer. Chem. Soc., 91, 5176 (1969).