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THE PREPARATION AND TRANSFORMATIONS OF AN INTERESTING BRIDGEHEAD NITRILE OXIDE

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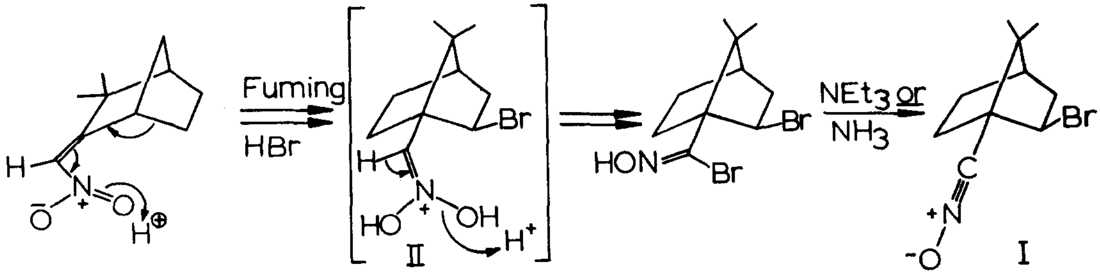
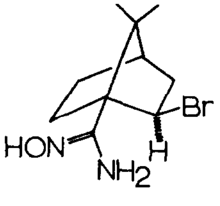
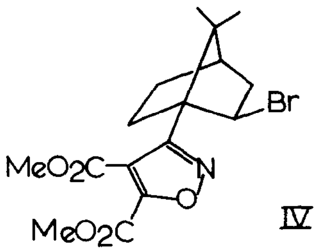
In view of current interest in sterically encumbered nitrile oxides (1) and nucleophilic participation from bridgehead position (2), we feel that our work on the preparation and novel transformations of the singularly stable nitrile oxide I is noteworthy. Compound I(3)* was prepared by a two-step sequence from ω-nitrocamphene (4)**.



The nitrile oxide I is unchanged on melting, on treatment with boiling hexane, absolute methanol at room temperature and excess ammonia for few minutes; however I was converted in quantitative yields to compounds III and IV(3)*** on overnight treatment in ether with ammonia and acetylenedicaboxylicacid dimethylester respectively.



III



IV

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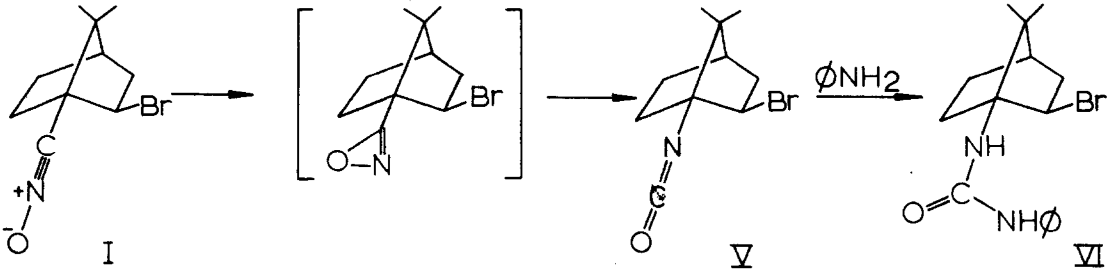
* I, mp 123-125°; IR(λ_{max}(KBr) 4.41 ($-C\equiv\overset{+}{N}-\bar{O}$), 7.52 (N-O)μ); NMR (δ $CDCl_3$ 4.15(q, non-bridgehead t-proton)).

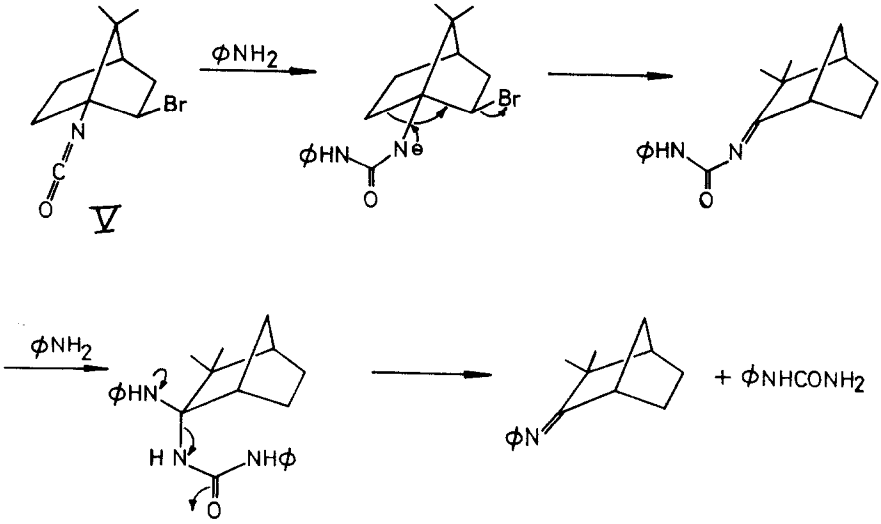
** In an earlier communication (S. Ranganathan, A. Goel and B. B. Singh, Tetrahedron Letters, 3299 (1968)) precursor similar to II and related to I was suggested as a possible intermediate in the acid induced change of ω-nitrocamphene to a cyclic sulfate.

*** III, mp 154-55°d; IR(λ_{max} (KBr) 6.06, 6.35μ); NMR (δ $CDCl_3$ 4.34 (q, non-bridgehead t-proton)). IV IR (λ_{max} (KBr)5,73, 5.78(C=O) μ); NMR (δ CCl_4 4.6(q, non-bridgehead t-proton), 3.91, 3.8 ($-OCH_3$)).

A dry xylene solution of I held at reflux for 4 hr gave, cleanly, the stable bridgehead isocyanate V(3)*. We feel that this facile transformation of stable nitrile oxides (5) proceeds through an oxazirine intermediate.



Unexpectedly, attempted characterization of pure V by means of the corresponding urea VI by reaction with excess aniline (~5 equivalents) gave, at room temperature, aniline hydrobromide (50%), phenylurea (36%) and a mixture of products that could not be separated. This reaction, rationalized in terms of addition of aniline, intramolecular bromine displacement with skeletal change, addition of another mole of aniline and elimination of phenylurea, has lead to identification of some extremely facile transformations involving bridgehead participation.



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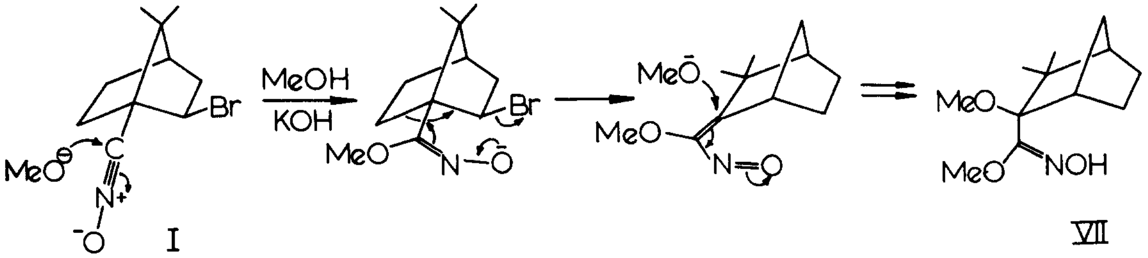
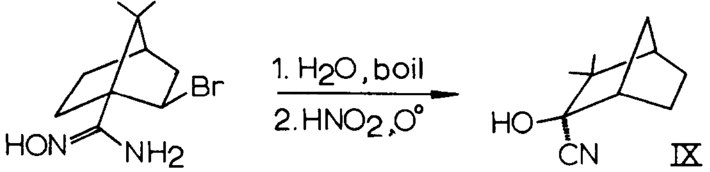
* V, mp 80-82°; IR (λ_{max} (CCl_4) 4.4 (-N=C=O) μ); NMR (δ CCl_4 4.2 (q, non-bridgehead t-proton)).

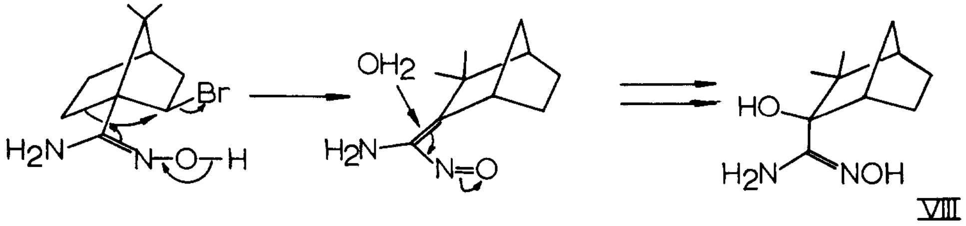
Such an extremely facile rearrangement takes place on leaving the nitrile oxide I in a methanolic KOH solution for two days at room temperature. This reaction which gave VII(3)* should be considered remarkable since it demonstrates the capability of substituted bridgehead oximes to effect intramolecular displacement reactions under mild conditions and in strongly alkaline media.



A similar path provides explanation of the otherwise perplexing transformation of amidoxime III to camphenilonecyanohydrin IX(4)



The rearranged hydroxyamidoxime VIII(3)**, expected on basis of oxime participation, could readily be isolated and gave IX(3)*** on treatment with $NaNO_2$/HCl****, *****.



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* VII, mp 102°; IR(λ_{max} (KBr) 3.03(OH), 6.06(C=N) μ); NMR(δ $CDCl_3$ 7.79 (OH), 4.12, 3.16 (-OCH_3), no non-bridgehead t-proton).

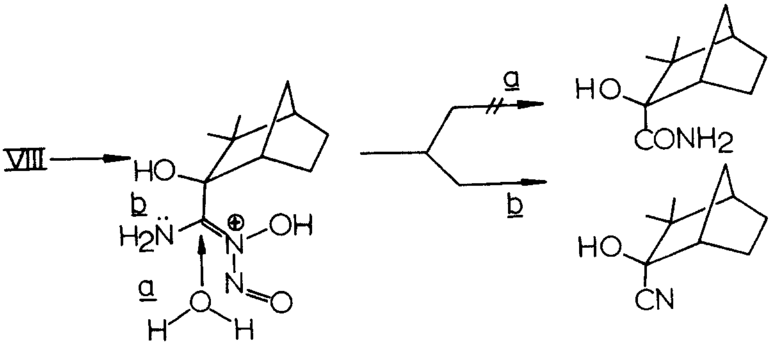
** VIII, mp 181°; IR (λ_{max} (KBr) 3.05, 6.2 μ); NMR(CF_3COOH, no non-bridgehead t-proton).

***IX, mp 137-139°; IR(λ_{max} (KBr) 2.95(OH), 4.5(CN)μ); NMR (CCl_4, no non-bridgehead t-proton).

**** compound VIII could also be obtained from III with methanolic $AgNO_3$

***** Direct treatment of III with $NaNO_2$/HCl gave the unrearranged cyano 2-exo bromo-apocamphane (3). mp 152-154°; IR (λ_{max} (KBr), 4.5(CN)μ); NMR (δ CCl_4 4.1 (q, non-bridgehead t-proton).

Another novel feature of the VIII→IX change is the nitrous acid induced transformation of an amidoxime to a nitrile (path b), since, as a rule, this reaction leads to the rapid formation of the corresponding amide (6) by addition of elements of water to the nitrosated intermediate (path a). We account for the formation of IX on the basis of an intramolecular decomposition of the initially formed insoluble yellow nitrosated product X (path;b).



We are inclined to believe that simple bridgehead nitrile oxides should also be quite stable, since, models do not reveal involvement of either the exo Br or gem dimethyl in the steric protection of $-C\equiv\overset{+}{N}-\overset{-}{O}$ in I. The preparation of such systems and a more sophisticated examination of substituted oxime participation is currently receiving attention.

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