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BASE CATALYZED REARRANGEMENT OF SOME BICYCLIC KETOL ACETATES.[1]

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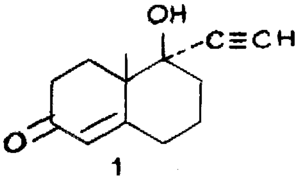
Summary: The ketol 3a and its acetate 3b when refluxed in methanolic potassium hydroxide (5%) were found to rearrange to 4-methyl-8-acetyl-5,6,7,8-tetrahydro-1-naphthol 4. The epimeric acetate 3c also behaved likewise. A mechanism is suggested for the rearrangement.

The base catalyzed rearrangement of δ-hydroxy-α,β-enones of the type 1 and 2 has been studied extensively in our laboratory and found to yield a variety of products[2,3,4].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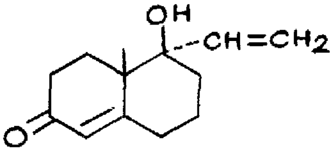
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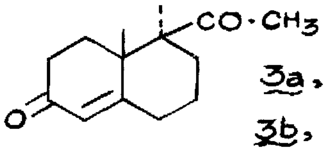
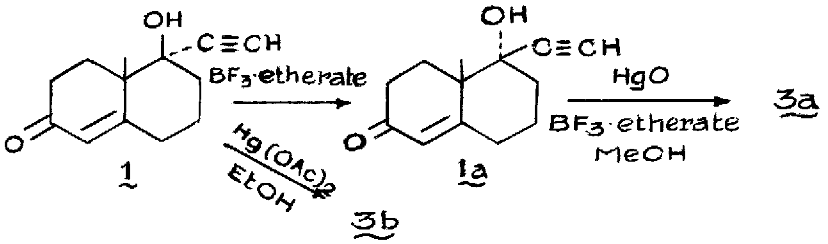
It was of interest to extend these studies to the ketol 3a or its acetate 3b, since steroidal compounds of the same type are known to suffer interesting rearrangements when treated with base[5].

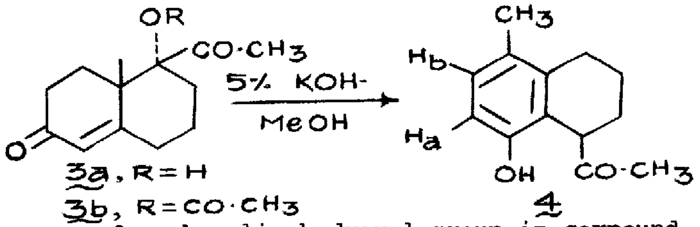

3a, R=H
3b, R=CO·CH$_3$

The ketol 3a is readily obtained[6a] by epimerization of the ethynyl carbinol 1 followed by hydration with Nieuwland's catalyst (BF_3 etherate-red Mercuric oxide in methanol) while hydration of the ethynyl carbinol 1 with mercuric acetate furnished the ketol acetate 3b.[6b]

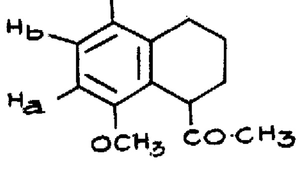


The conversion of carbinol 1 to the ketol acetate 3b has been found[6b] to involve an inversion.

Refluxing either the ketol 3a or its acetate 3b in 5% methanolic potassium hydroxide[4] for 1 hr furnished after work up a solid melting at 132-133°C in 60-75% yield. The IR (KBr) showed a broad band at 3300 (-OH) and a strong absorption at 1700 cm^{-1}(C=O). The NMR spectrum (CDCl$_3$/TMS, δ values) showed the following characteristics: 1.8 - 2.0 (m, 4H, methylene protons), 2.14 (s, 3H, -CO C$\underline{H}_3$), 2.2 (s, 3H, Ar-C$\underline{H}_3$), 2.4-2.8 (m, 2H, Ar.C$\underline{H}_2$), 3.93 (a broad triplet, 1H, methine proton), 6.4 (a distorted triplet, 2H, H$_a$ and OH) and 6.8 (d, 1H, H$_b$). Elemental analysis coupled with mass spectrum indicated a molecular formula of $C_{13}H_{16}O_2$. Further, the compound was found to give a green colour with neutral ferric chloride indicating the phenolic nature of the product. Based on these data structure 4 has been assigned for this compound.



The presence of a phenolic hydroxyl group in compound 4 was confirmed by conversion to the methyl ether 5 by treatment with dimethyl sulfate and alkali.



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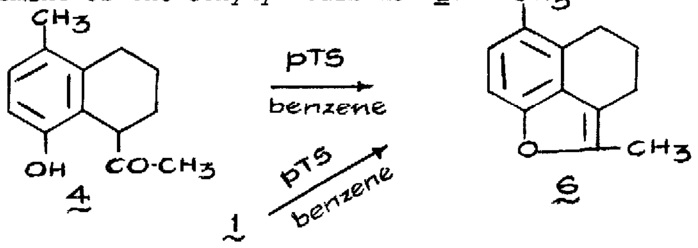
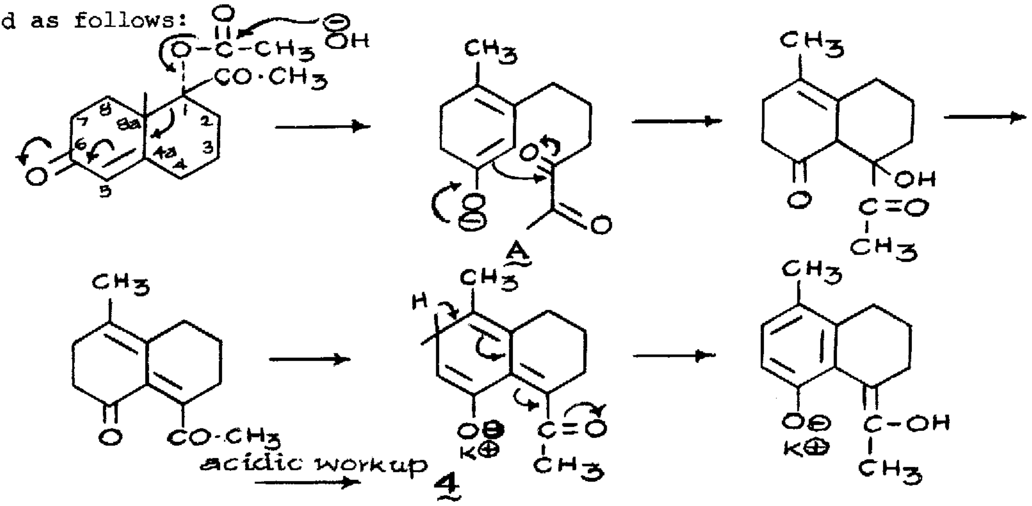
The NMR spectrum of the compound 5 ($CDCl_3$/TMS, δ values) showed a sharp signal at 3.8 (s,3H, $-OCH_3$) and a doublet at 6.4 (1H, H_b) resulting from the disappearance of the central leg of the distorted triplet present in the phenol 4. These findings further corroborate the structure 4 assigned to the rearranged product.

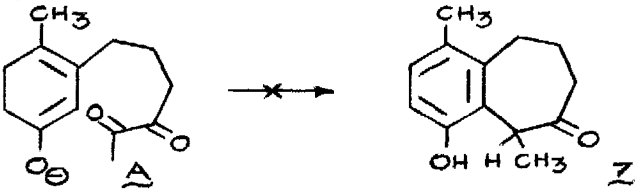
Compound 4 when refluxed in benzene with a catalytic amount of p-toluene sulfonic acid was found to give the benzofuran 6 obtained earlier[7] by similar treatment of the ethynyl carbinol 1.



The formation of compound 4 from ketol acetate 3b can be rationalized as follows:

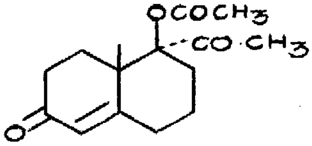


The cleavage of C_1-C_{8a} bond, involved in the formation of the phenol 4, undoubtedly is due both to the strain around that bond and the presence of the α,β -enone unit. The cyclization of the enolate A can occur as depicted in the above mechanism or can involve the carbonyl attached to the methyl group leading to a seven membered ring as in structure 7.



The exclusive formation of 4 must be due to the preferential formation of a six atom ring rather than a seven atom ring from the species A.

The epimeric[6b] ketol acetate 3c was also found to rearrange but less readily than acetate 3b when refluxed with methanolic potassium hydroxide (5%) for 2 hr to the phenol 4 in 50-55% yield. The formation of phenol 4 from both 3b and 3c is consistent with the postulated mechanism.



3c

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REFERENCES

* To whom all correspondence should be made.

1. Part X in the series on rearrangements of bicyclic enones. For part IX see *Tetrahedron Lett.*, 1577 (1980).
2. J.P.John, S.Ramachandran and S.Swaminathan, *Tetrahedron*, 729 (1962).
3. K.G. Srinivasan, P.S.Venkataramani, J.P.John and S.Swaminathan, *Tetrahedron*, 25, 2661 (1969).
4. S.Chandrasekharan, P.S.Venkataramani, K.G.Srinivasan and S.Swaminathan, *Tetrahedron Lett.*, 991 (1973).
5. "Steroids", Ed. Fieser, Reinhold Publishing Corporation, p.577.
6. a) S.K.Sankarappa, S.Ramachandran and S.Swaminathan, *Tetrahedron*, 20, 1119 (1964).
   b) V.T.Ramakrishnan, S.Ramachandran, P.S.Venkataramani and S.Swaminathan, *Tetrahedron*, 23, 2453 (1967).
7. R.K.Natarajan, S.K.Sankarappa, S.Ramachandran and S.Swaminathan, J. Org. Chem., 31, 656 (1966).

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