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REARRANGEMENT OF STEROID-14-ENE

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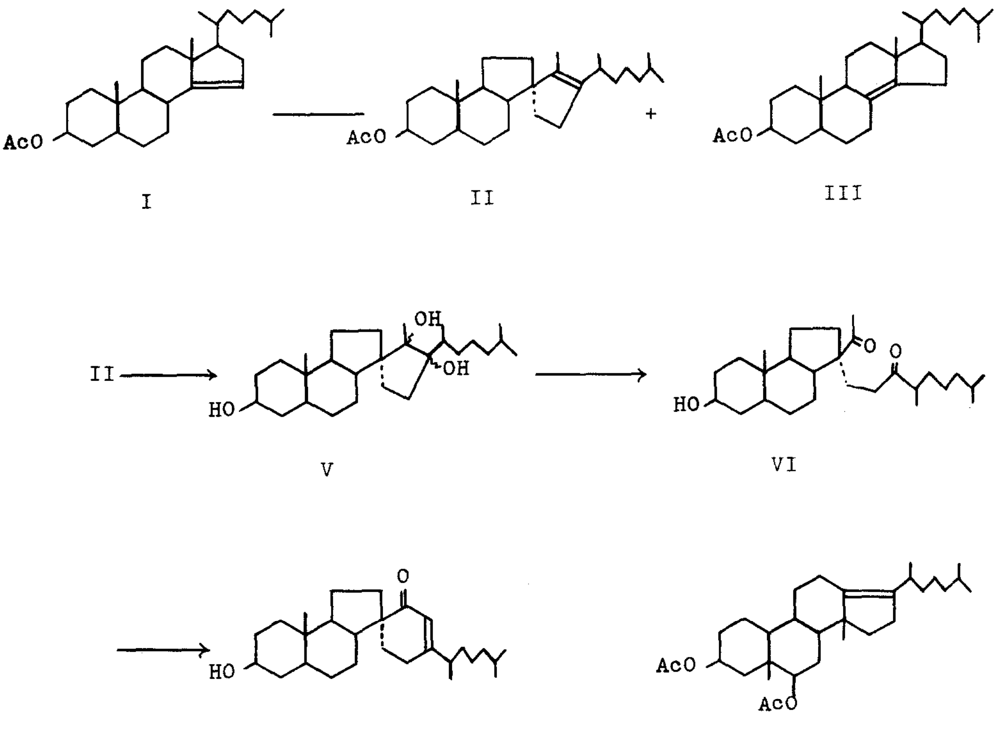
Action of acids on some isolated double bonds such as 4-ene and 5-ene of steroids causes skeletal rearrangements (1). But, rearrangement of steroid-14-ene was not known. We wish to report a skeletal rearrangement reaction of steroid-14-ene.

Treatment of 3β-acetoxycholest-14-ene (I) with an equimolar boron trifluoride etherate in benzene and acetic anhydride for 170 hr., followed by chromatography on silica gel afforded an oily product (II) and a crystalline product (III), mp. 77-78°, in 23 and 6 % yield, respectively. Product (III) was proved to be 3β-acetoxycholest-8(14)-ene by direct comparison with an authentic specimen (2).

The oily product (II) was an isomer of I ($C_{29}H_{48}O_2$, M^+ 428). II had an absorption maximum at 204 mμ (ε=6900) in UV spectrum, which indicated the presence of an double bond. The nmr spectrum had methyl signals at τ 8.54 (t, J=0.8), 9.07 (d, J=7), 9.14(s), 9.20 (s) and 9.22 (s). The signal at τ 8.54 was assigned to a methyl group attaching to a double bond, which was found to be tetra-substituted from absence of a signal due to an olefinic proton. Coupling between the methyl signal at τ 9.07 and a signal at τ 7.54 (m, 1H) was confirmed by spin-spin decoupling experiment. Its mass spectrum showed a strong fragment (m/e 315, $M^+-C_8H_{17}$) due to the fission of its side chain. This is not the case of steroids which have the side chains not attached to double bonds (3). A backbone rearrangement product (IV) possessing its side chain attached to 13(17)-ene was reported to show strong fragmentation of the side chain (4). Therefore, the side chain of II was considered to be attached to a double bond.

The product (II) was oxidized with osmium tetroxide in tetrahydrofuran, followed by reduction with lithium aluminum hydride to yield a mixture of isomeric



cis-triols (V). The mixture (V) was oxidized with lead tetraacetate to give diketone (VI), mp. 52.5-54°. The nmr spectrum of VI had a signal at τ 7.90 due to an acetyl group newly formed and indicated disappearance of the olefinic methyl signal. The IR spectrum showed carbonyl bands at 1712 and 1694 cm^{-1}. When diketone (VI) was treated with sodium methoxide in methanol, an oily product (VII) (3,5-dinitrobenzoate of VII, mp. 168-170°) was obtained. The UV and IR spectra showed an absorption maximum at 240 $m\mu$ (ε=12800) and a carbonyl band at 1650 cm^{-1}, respectively. The nmr spectrum of the 3,5-dinitrobenzoate indicated absence of acetyl group and formation of one olefinic proton (τ 4.18, s). These data were consistent with the structure of α,β-unsaturated ketone for VII, which was produced by aldol condensation of diketone (VI). Therefore, the structure having C/D ring spiran was determined for II. Since II was formed by migration of C_{12-13} carbon bond to C_{14}, the stereochemistry of the spiran ring was inherent.

Generally, reagents attack steroid-14-ene from rear side of the molecule. If it is true in this case, C_{14} carbonium ion would be the intermediate, which would be converted to II by C_{12-13} carbon bond migration and to III by elimination of C_8 proton.

Similar C_{12-13} carbon bond migration to C_{14} had been deduced for the products of elimination of 14β-hydroxy-15-oxo- and 14β-hydroxy-15α-acetoxy-etianic acid derivatives with thionyl chloride (5).

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