

Novel Direct Rearrangement of a $9\beta,11\beta$ -Epoxy lanostan-7-one into a B-Homo-derivative with Incorporation of the C-10 Angular Methyl Group

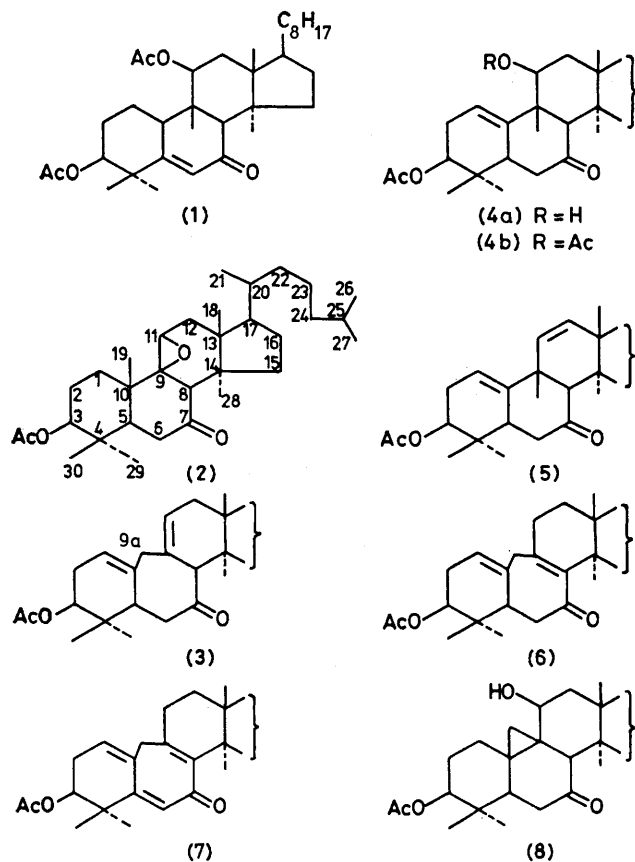
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Summary The rearrangement by boron trifluoride-diethyl ether of 3β -acetoxy- $9\beta,11\beta$ -epoxy lanostan-7-one (**2**) leads to the ring B enlarged product (**3**) as well as to the cucurbitane derivatives (**1**), (**4a**), and (**4b**).

THE synthesis of a cucurbitane derivative (**1**) has been described¹ which utilises the rearrangement of the β -epoxide (**2**) by boron trifluoride-diethyl ether. We report that in our hands the products of rearrangement were more complex

and contained components of interest with regard to both their structure and mechanism of formation involving a novel functionalisation of C-19.

The rearrangement of (2) by boron trifluoride-diethyl ether in benzene during 6 h at 10 °C afforded a mixture of four products, 3 β -acetoxy lanostane-7,11-dione (34%), 3 β -acetoxy-9 α -homo-19-norlanosta-1(10),9(11)-dien-7-one (3) (m.p. 130–131.5 °C, $[\alpha]_D + 24.5^\circ$; yield 33%),[†] a minor product formulated as 3 β -acetoxy-9 α -homo-19-norlanosta-9 α (10), 9(11)-dien-7-one (m.p. 171–172 °C, $[\alpha]_D + 262^\circ$; yield 1%), and 3 β -acetoxy-11 β -hydroxy-19-(10 \rightarrow 9 β)abeo-lanost-1(10)-en-7-one (4a) (m.p. 180–182 °C, $[\alpha]_D - 6^\circ$; yield 4%). Rearrangement by boron trifluoride-diethyl ether in acetic anhydride during 5 min at 0 °C gave the 7,11-dione (14%), the cucurbitane (1), (m.p. 189–190 °C, $[\alpha]_D + 94.5^\circ$; yield 47%; cf. ref. 1), and the diacetate (4b) ($[\alpha]_D - 9^\circ$; yield 24%).



The proof of the structures for the products (4a) and (4b) relied upon their interrelation through acetylation and the dehydration of (4a) by phosphorus oxide chloride-pyridine to the diene (5) which had ¹H n.m.r.† (C₆D₆) δ 5.46 (1H, m), 5.61 (1H, d, *J* 10 Hz), and 6.01 (1H, d, *J* 10 Hz). The absence of additional coupling and the magnitude of the vicinal coupling in these doublets indicated unsaturation flanked by quaternary carbons in a six-membered ring, *i.e.* at C-11(12) in (5).

The proof of structure for the product (3) followed in part from the constitution C₃₂H₅₀O₃ (by elemental and m.s. analysis), ν_{\max} 1735, 1698, 1668, and 1274 cm⁻¹, λ_{\max} 296 nm (ϵ 38) with strong end absorption, and δ (270 MHz) 2.04 (3H, s), 4.75 (3 α -H, d of d, *J* 6 and 10 Hz), 5.39 (1H, d of d, *J* 2.5 and 5.5 Hz) and 5.45 (1H, d of d, *J* 4 and 7 Hz). The 3 α -H signal was at significantly lower field (*ca.* 0.3 p.p.m.) than in lanosterol derivatives lacking unsaturation in ring A and in addition only seven skeletal methyl groups were discernible at δ 0.72 (s), 0.80 (s), 0.83 (s), 0.86 (d, *J* 6 Hz), 0.87 (d, *J* 6 Hz), 0.89 (d, *J* 6 Hz), and 0.90 (s). The natural abundance ¹³C n.m.r. spectrum revealed an additional resonance for a saturated methylene group and the absence of the resonances for one saturated quaternary carbon and one methyl group. Importantly, the signal for C-9 α (C-19) at δ 42.0 p.p.m. remained as a clean triplet (with large residual coupling) during off-resonance decoupling at δ -2.0 and the resonances for C-3 and C-5 moved upfield due to the absence of the 1 α -H.² The ketone (3) was characterised as the corresponding alcohol (*via* reduction with sodium borohydride) and the derived acetate.

Isomerisation of (3) by acid or base gave the conjugated ketone (6), λ_{\max} 252 nm (ϵ 8000), the ¹³C n.m.r. spectrum of which was consistent with the migration of the C-9(11)-olefinic linkage and the retention of that at C-1(10). Oxidation of (6) by selenium dioxide in acetic acid gave, not the expected tropone in ring B, but the trienone (7) showing a large perturbation of the ¹³C n.m.r. shifts for the C-4 methyl groups. As expected, the conjugated ketone (6) formed (acetic anhydride-toluene-*p*-sulphonic acid) the enol acetate 3 β ,7-diacetoxy-9 α -homo-19-norlanosta-1(10),7,9(11)-triene, λ_{\max} 248 nm (ϵ 13,500). The ring B enlarged ketone (3) is considered most likely to be formed *via* an intermediate cyclopropane such as (8).

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[†] All new compounds gave elemental analyses, *i.r.*, *u.v.*, ¹H n.m.r., ¹³C n.m.r., and mass spectra in accord with the structures proposed. Optical rotations are for CHCl₃ solutions.

[‡] ¹H and ¹³C n.m.r. spectra are for CDCl₃ solutions unless otherwise stated. The complete assignment of carbon shifts to the compounds (1) to (7) together with those for other rearranged lanostane skeletons will be discussed in the full publication.

¹ Z. Paryzek, *Tetrahedron Letters*, 1976, 4761.

² J. W. ApSimon, H. Beierbeck, and J. H. Saunders, *Canad. J. Chem.*, 1977, 55, 2813.