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HIGHER ISOPRENOIDS—VII†

A NEW APPROACH TO THE DEGRADATION OF CYCLOLAUDENOL SIDE-CHAIN‡

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Abstract—An efficient new procedure for the degradation of cyclolaudenyl acetate to 3β - acetoxy - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - pregnan - 20 - one and/or 3β - acetoxy - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - androstan - 17 - one is described. The key-step is simultaneous base-catalysed dehydrohalogenation and isomerisation of the resulting olefin, of a suitably derived halide.

Side-chain degradation of certain steroids and tetracyclic triterpenes is of considerable interest both from academic and applied points of view.[1] In recent years there has been increased activity in this field and a number of ingenious routes[1-7] have been described and these are often more efficient and convenient than the classical Barbier-Wieland degradation[8] or its Meystre-Miescher modification.[9] Previously, we described[2] a novel approach to such degradations, which had, as its key-feature, base-catalysed isomerisation of a suitably derived olefin to the $C_{20(22)}/C_{17(20)}$ isomer(s). It was found that the most expedient route to the nor-ketones **2** and **3** from cycloartenol **1**, lay in the application of this isomerisation-oxidation sequence to cycloartenol itself; since then, we have improved and modified the experimental technique, and these details are reported in the Experimental. However, this isomerisation-oxidation sequence cannot be applied directly to cyclolaudenol **4**, another suitable precursor for transformation into **2** or **3**, available from opium marc,[2] as the isomerisation of the olefinic linkage to the $C_{20(22)}/C_{17(20)}$ positions is blocked by the thermodynamically stable olefin **5**, which must lie on the base-catalysed isomerisation pathway. Though, we have already described[2] an indirect application of the isomerisation sequence to cyclolaudenol for the preparation of **2** and **3**, we report, in the present work, more direct pathways.

It is obvious that the prime requirement for the application of the isomerisation-oxidation sequence to cyclolaudenol, is the removal of C_{24}, C_{26} and C_{27} in such a way that the resulting tris-nor derivative is an olefin or can be readily converted into one. The successful routes by which this was accomplished are summarised in Fig. 1; the reaction sequence involving intermediate **7** proved most advantageous in terms of yields.

Cyclolaudenol was first converted into the methyl ketone **6** *via* the $\Delta^{24(25)}$-isomer **5**,[10] by a route, already described.[2] This was next reduced with $NaBH_4$ to furnish alcohol(s) **7**, which without further purification was used in the next step. Attempted dehydration of **7** with $POCl_3$–pyridine (30–100°) gave only the corresponding chloride and practically no olefin was formed. This chloride **8** could be obtained in 75% yield by reacting alcohol **7** with $POCl_3$–pyridine on a steam-bath for 12 h. It may be pointed out that $POCl_3$–pyridine[11] is a well-established reagent for the dehydration of alcohols and has been successfully employed for the dehydration of tertiary[12]

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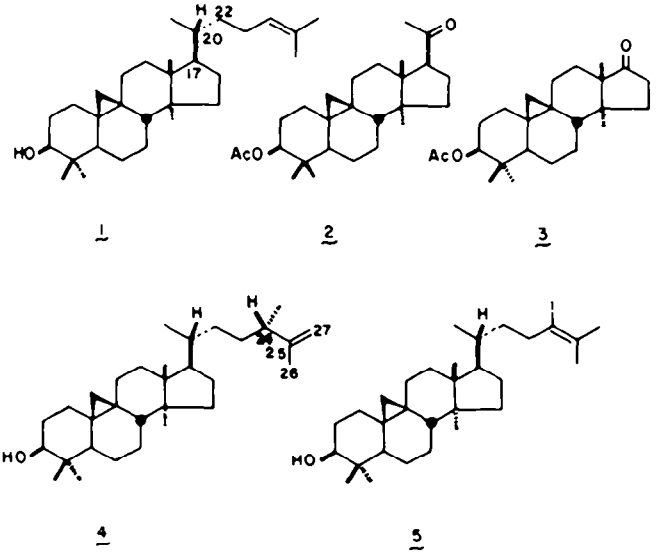
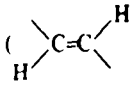
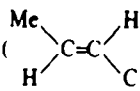


1 2 3

4 5

and secondary alcohols,[13] though with primary alcohols the main product is usually a phosphate ester.[14] In the present instance, the almost exclusive formation of a chloro derivative is rather exceptional,[15] though chlorides have been known to be formed to a minor extent in such reactions.[16] Dehydrohalogenation of **8** and isomerisation of the resulting olefin to the $\Delta^{20(22)}$-position was carried out in a single step using *N*-lithio-ethylenediamine at 120–125° (1 h), when **9** was obtained after acetylation in 90% yield. Ozonolysis of **9** furnished **2**, identical in all respects, with the previously reported[2] preparation.

The above successful dehydrohalogenation-isomerisation prompted us to explore an alternative route, shown in Fig. 1. Cyclolaudenyl acetate **10** on ozonolysis, followed by $NaBH_4$-reductive work-up,[17] gave **11**. β-Fragmentation[18] of this compound with $Pb(OAc)_4$ and I_2, was investigated in an attempt to obtain **12**, which could then be converted into **9**. In practice, it was possible to obtain **12** in 40% yield, the remaining product being the expected ether, which is discussed later. As anticipated, **12** was smoothly converted to **9** on exposure to *N*-lithio-ethylenediamine, followed by acetylation. Compound **12** was subjected to dehydrohalogenation with 1,5 - diazobicyclo[5.4.0]undec - 5 - ene (DBU)[19] in DMSO to get the olefin **13** in 60% yield, which must have the *trans*-configurated: IR (
970 cm^{-1}), PMR (
: 2H, m, 5.35 ppm; *cf.* spectra of *cis*- and *trans* - 4 - methyl - 2 - pentene[20]). This compound was isomerised with *N*-lithio-ethylenediamine and then acetylated to furnish a mixture of **9** and **14**; ozonolysis of this olefin mixture gave the expected 3β - acetoxy - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - pregnan - 20 - one **2**[2] and 3β - acetoxy - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - androstan - 17 - one **3**[2] respectively.

As stated earlier, the major product of the action of $Pb(OAc)_4$–I_2 (hν) on **11** is an ether, which has the expected structure **15**, as revealed by its PMR spectrum. The structure was further confirmed by its acid-catalysed cleavage (*p*-TsOH, Ac_2O and AcOH)[21] to **16** (major) and **17**, the structures of which are consistent with their spectral and analytical data.

EXPERIMENTAL

All m.ps are uncorrected. Light petroleum refers to the fraction b.p. 60–80°. Optical rotations were measured in $CHCl_3$ on a Schmidt and Haensch electronic polarimeter model Polatronic 1. TLC was carried out on SiO_2–gel layers (0.25 mm) containing 15% gypsum and activated for 1 h at 100–110°. Silica-gel for column chromatography was activated at 130–140° (6 h) and then standardised.[22] The following instruments were used for spectral data: Perkin–Elmer Infracord model 267 (IR); Perkin–Elmer model R 32 (90 MHz) NMR spectrometer; CEC mass spec-

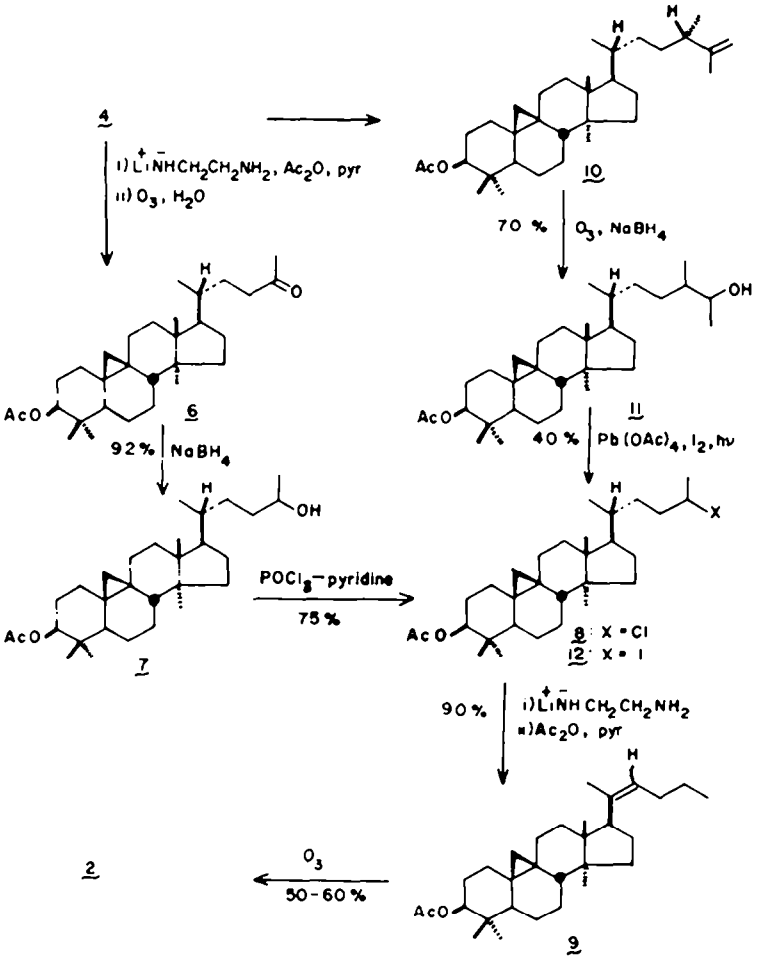
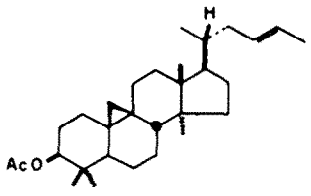


Fig. 1. Side-chain degradation of cyclolaudenol to 3β - acetoxy - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - pregnan - 20 - one.



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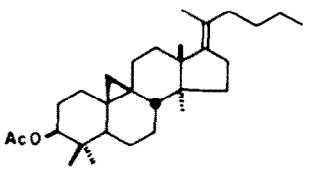

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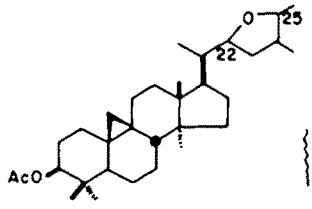

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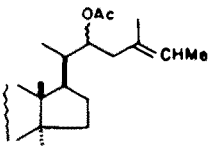

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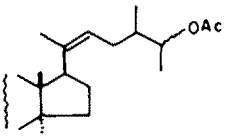

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trometer, model 21-110B (70 eV, direct inlet system). All PMR spectra were recorded using 10–15% soln in CCl_4, unless otherwise stated. While citing PMR data, following abbreviations have been used: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet; b, broad. While summarising mass spectral data, besides the molecular ion, ten most abundant ions (above *m/e* 60) are reported with their relative intensities.

Isomerisation of cycloartenol and subsequent cleavage to 3β - acetoxy - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - pregnan - 20 - one **2** *and 3β - acetoxy - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - androstan - 17 - one* **3**

Cycloartenol (11.0 g) was added to a stirred soln of *N*-lithioethylenediamine in ethylenediamine (Li 11.0 g, anhydrous ethylenediamine 330 ml; N_2) at 120–125° (bath temp.), and the reaction mixture maintained at this temp. for 20 h. The reaction mixture was cooled to 0°, diluted with ice–water (500 ml) and the product was extracted with isopropyl ether (400 ml × 5). The extract was washed with 10% HCl aq, 5% $NaHCO_3$ aq, water and brine, dried (Na_2SO_4) and freed of solvent to give a gum (10.94 g) which was directly acetylated (pyridine 26.4 ml, Ac_2O 13.2 ml) to yield 11.7 g of the product.

The above product (6.50 g) in dry $CHCl_3$ (300 ml) was treated with ozonized oxygen (0.7 g of O_3/h) at −5° till no more O_3 was absorbed (1 h). The solvent was flashed off and the crude "ozonide" taken up in acetone (10 ml), cooled to 0° and treated with Jone's reagent[29] (15 ml) till a brown color persisted. The reaction mixture was allowed to stand at room temp. (30°) for 0.5, diluted with H_2O (100 ml) and the product taken up in isopropyl ether (100 ml × 5), which was separated into acidic (1.36 g) and neutral parts (4.9 g) with 5% NaOH aq. The neutral material was chromatographed over SiO_2–gel/IIB (66.5 × 1.5 cm) with TLC monitoring (solvent: 5% EtOAc in C_6H_6; two major spots with R_f 0.27, 0.22):

Fraction 1	light pet.	200 ml × 5	0.149 g, mixture R_f 0.27
Fraction 2	25% C_6H_6 in light pet.	200 ml × 4	1.47 g, essentially compound with R_f 0.27
	50% C_6H_6 in light pet.	200 ml × 2	
Fraction 3	50% C_6H_6 in light pet.	200 ml × 4	0.55 g, R_f 0.27
Fraction 4	C_6H_6	200 ml × 1	0.06 g, mixture
Fraction 5	C_6H_6	200 ml × 5	1.01 g, R_f 0.22
Fraction 6	EtOAc	200 ml × 1	1.39 g, gum, mixture.
	MeOH	200 ml × 1	

C_{30}-Ketone **2**. Fraction 3 was crystallised from ether–MeOH to furnish **2**, m.p. 152–153° (lit.[2] m.p. 153–154°). Fraction 2 on rechromatogarphy yielded another 1.0 g of **2**.

C_{17}-Ketone **3**. Recrystallisation of Fraction 5 from aq MeOH yielded pure **3**, m.p. 161.5° (lit.[2] m.p. 162–163°).

25,26,27 - Trisnor - 3β - acetoxy - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - ergostan - 24 - ol **7**

The trisnor-ketone **6**[2] (4.26 g) and $NaBH_4$ (0.3 g) were reacted in EtOH–dioxane (5 : 1, 300 ml) at 25° for 4 h and, then worked up in the usual manner to give a solid (3.92 g, m.p. 157–160°), which was recrystallised (ether–MeOH) to furnish **7**, m.p. 160–167° (possibly a mixture of C_{24}-epimers). IR (Nujol): OAc 1725, 1240 cm^{-1}; OH 3300, 1020 cm^{-1}. PMR: cyclopropyl CH_2 (1H, d, 0.32 ppm; 1H, d, 0.57 ppm; *J* 4 Hz), tertiary Me's (singlets at 0.83, 0.87, 0.89 and 0.96 ppm), $CHMeOH$ (3H, d, 1.12 ppm; *J* 6.5 Hz), OAc (3H, s, 2.0 ppm), CHOH (1H, m, 3.64 ppm), $CHOAc$ (1H, m, 4.51 ppm). Mass: *m/e* 458 (M^+, 4%), 398 (49%), 276 (47%), 175 (56%), 135 (49%), 121 (56%), 109 (55%), 107 (60%), 95 (77%), 69 (100%), 67 (49%). (Found: C, 78.83; H, 11.00. $C_{30}H_{50}O_3$ requires: C, 78.55; H, 10.99%).

25,26,27 - Trisnor - 3β - acetoxy - 24 - chloro - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - ergostane **8**

To a cooled (0°) soln of the above alcohol **7** (10.0 g) in pyridine (50 ml), $POCl_3$ (15 ml) was introduced (10 min) dropwise with swirling. The reaction mixture was heated on a steam-bath for 12 h, after which it was worked up in the usual manner (extraction with isopropyl ether) to give a solid (7.69, m.p. 160–164°), which was crystallised from ether–MeOH, m.p. 170–172°. IR (Nujol): OAc 1725, 1240 cm^{-1}; C–Cl 760 cm^{-1}. PMR: cyclopropyl CH_2 (1H, d, 0.31 ppm; 1H, d, 0.57 ppm; *J* 4 Hz), tertiary Me's (singlets at 0.83, 0.86, 0.89 and 0.96 ppm), $CHMeCl$ (3H, d, 1.48 ppm; *J* 6.5 Hz), OAc (3H, s, 1.97 ppm), CHCl (1H, m, 3.87 ppm), $CHOAc$ (1H, m, 4.47 ppm). Mass: *m/e* 478 (M^+, ^{35}Cl, 2%), 476 (M^+, ^{37}Cl, 4%), 175 (49%), 121 (47%), 109 (51%), 107 (62%), 105 (47%), 95 (100%), 93 (56%), 83 (47%), 81 (56%), 69 (67%). (Found: C, 75.44; H, 10.55; Cl, 7.72. $C_{30}H_{49}O_2Cl$ requires: C, 75.50; H, 10.35; Cl, 7.43%).

26 - Nor - 3β - acetoxy - 4,4,14α - trimethyl - 9,19 - cyclo - 5α - ergostan - 25 - ol **11**

Cyclolaudenyl acetate **10** (5.0 g, m.p. 120–121°) in $CHCl_3$ (200 ml) was ozonised at −5° in the usual fashion. The soln was concentrated to 50 ml by solvent removal under vacuum at room temp., and then cooled (0°) and, a soln of $NaBH_4$ (4.0 g in 75 ml of 85% aq EtOH) added (N_2) under stirring. After stirring for 5 h at 30°, the reaction mixture was worked up in the usual manner

to give semi-solid product (5.04 g), which was chromatographed on SiO_2-gel/IIB (65 × 1.5 cm) using light petroleum, light petroleum with increasing amounts of C_6H_6 and pure C_6H_6 as eluants. C_6H_6 cuts (200 ml × 8) gave the required product (3.15 g, m.p. 143–145°, epimeric pair), which was crystallised from light petroleum, colorless needles, m.p. 147.5–150°, $[\alpha]_D$ +57.0°. (c, 0.8%). IR (Nujol): OAc 1730, 1240 cm^{-1}; OH 3350, 1095 cm^{-1}. PMR: cyclopropyl CH_2 (1H, d, 0.32 ppm; 1H, d, 0.59 ppm; J 4 Hz), tertiary Me's (singlet at 0.86, 0.88, 0.91 and 0.97 ppm), CHMeOH (C_{23}-epimers; 3H, two doublets centred at 1.05 and 1.12 ppm, J 7 Hz each), OAc (3H, s, 2.0 ppm), CHOH (1H, m, 3.64 ppm), CHOAc (1H, m, 4.50 ppm). Mass: *m/e* 486 (M^+, 8%), 426 (87%), 304 (56%), 175 (58%), 121 (48%), 119 (45%), 109 (65%), 107 (64%), 95 (100%), 81 (53%), 69 (80%). (Found: C, 78.86; H, 10.87. $C_{32}H_{54}O_3$ requires: C, 78.96; H, 11.18%).

Action of lead tetraacetate–iodine on **11**

A mixture of the above alcohol **11** (0.972 g, 0.002 mole), Pb $(OAc)_4$ (0.986 g, 0.0022 mole) and iodine (0.289 g, 0.0022 g atom) in dry cyclohexane (100 ml) was stirred (N_2) and exposed to a 250 Watt tungsten lamp from below, when refluxing ensued. After stirring and refluxing for a total of 3 h, ethylene glycol (5.0 ml) was added to destroy any excess $Pb(OAc)_4$. The reaction mixture was diluted with water (100 ml), the upper layer separated and the aq phase extracted with isopropyl ether (50 ml × 4). The combined organic phases were washed with 10% $Na_2S_2O_3$ aq, water, brine and dried (Na_2SO_4). The solvent was flashed off and the residue (1.47 g) in isopropyl ether (10.0 ml) filtered through a bed (10.0 cm × 1.5 cm) of Al_2O_3/III, which was further washed with the same solvent (200 ml). The ether soln was freed of the solvent and the residue (1.4 g) chromatographed over SiO_2 gel/IIB (30.0 × 2.5 cm), while monitoring with TLC (solvent: 5% EtOAc in C_6H_6).

Fraction 1	light pet.	200 ml	
	25% C_6H_6 in light pet.	200 ml × 2	0.1 g, mixture
Fraction 2	25% C_6H_6 in light pet.	200 ml	0.349 g, pure,
	50% C_6H_6 in light pet.	200 ml	R_f 0.66
Fraction 3	50% C_6H_6 in light pet.	200 ml	0.250 g, mixture
Fraction 4	C_6H_6	200 ml × 3	0.337 g, pure, R_f 0.48
Fraction 5	C_6H_6	200 ml × 3	0.05 g, mixture
Fraction 6	C_6H_6	200 ml	0.16 g, R_f 0.22 unchanged **11**

25,26,27 - *Trisnor* - 3β - *acetoxy* - 24 - *iodo* - 4,4,14α - *trimethyl* - 9,19 - *cyclo* - 5α - *ergostane* **12**

Recrystallisation of Fraction 2 from isopropyl ether yielded **12**, m.p. 114–116° (dec.), $[\alpha]_D$ +33.55° (c, 0.77%). IR (Nujol): OAc 1730, 1250 cm^{-1}. PMR: cyclopropyl CH_2 (1H, d, 0.32 ppm; 1H, d, 0.57 ppm; J 4 Hz), tertiary Me's (singlets at 0.85, 0.90, 0.92 and 0.97 ppm), CHMeI (3H, d, 1.93 ppm; J 6.5 Hz), OAc (3H, s, 1.99 ppm), CHI (1H, m, 4.1 ppm), CHOAc (1H, m, 4.5 ppm). Mass: *m/e* 568 (M^+, 15%), 508 (66%), 175 (63%), 121 (63%), 109 (73%), 107 (82%), 105 (54%), 95 (100%), 93 (63%), 81 (70%), 69 (79%). (Found: C, 63.24; H, 8.95; I, 20.88. $C_{30}H_{49}O_2I$ requires: C, 63.36; H, 8.68; I, 22.31%).

26 - *Nor* - 3β - *acetoxy* - 22,25 - *epoxy* - 4,4,14α - *trimethyl* - 9,19 - *cyclo* - 5α - *ergostane* **15**

Fraction 4 on crystallisation from isopropyl ether–MeOH gave the ether **15**, m.p. 162.5–164°, $[\alpha]_D$ +35.11° (c, 0.65%). IR (Nujol): OAc 1725, 1240 cm^{-1}; C–O–C 1080, 1100 cm^{-1}. PMR: cyclopropyl CH_2 (1H, d, 0.32 ppm; 1H, d, 0.58 ppm; J 4 Hz), tertiary Me's (3H, singlets at 0.85, 1.0 ppm; 6H, s, 0.90 ppm), MeHCOC (3H, d, 1.16 ppm; J 6.5 Hz), OAc (3H, s, 1.99 ppm), HC_{25}–O–C (1H, m, 3.25 ppm), HC_{22}–O–C (1H, m, 3.88 ppm), CHOAc (1H, m, 4.48 ppm). Mass: *m/e* 484 (M^+, 5%), 469 (1.5%), 424 (11%), 302 (5%), 203 (4%), 175 (5%), 147 (5%), 126 (22%), 99 (100%), 81 (12%), 69 (8%). (Found: C, 79.65; H, 10.09. $C_{32}H_{52}O_3$ requires: C, 79.28; H, 10.81%).

25,26,27 - *Trisnor* - 3β - *acetoxy* - 4,4,14α - *trimethyl* - 9,19 - *cyclo* - 5α - *ergost* - 20(22) - *ene* **9**

From C_{24}*-chloride* **8**. To a soln of *N*-lithio-ethylenediamine in ethylenediamine (Li, 3 g; $NH_2CH_2CH_2NH_2$, 90 ml), chloride **8** (4.9 g) was added with stirring at 125° (bath temp). The reaction mixture was heated at that temp. for 1 h and then worked up in the usual manner to give a gum, which was acetylated (Ac_2O, pyridine) to furnish a product (4.3 g), which soon crystallised. Recrystallisation from ether–MeOH gave pure **9**, m.p. 102–105°. IR (Nujol): OAc 1725, 1240 cm^{-1}. PMR: cyclopropyl CH_2 (1H, d, 0.33 ppm; 1H, d, 0.59 ppm; J 4 Hz), Me's (singlets at 0.83, 0.87, 0.89, 0.96 and 0.98 ppm), Me–C=C (bs, 1.64 ppm), OAc (3H, s, 1.98 ppm), CHOAc (1H, m, 4.48 ppm), C=CH (1H, m, 5.22 ppm). Mass: *m/e* 440 (M^+, 30%), 380 (64%), 175 (68%), 121 (83%), 107 (84%), 105 (65%), 93 (94%), 91 (71%), 83 (100%), 81 (80%), 69 (65%). (Found: C, 82.26; H, 11.10. $C_{30}H_{48}O_2$ requires: C, 81.76; H, 10.98%).

From C_{24}*-iodide* **12**. C_{24}-iodide **12** (0.3 g) was likewise treated (Li, 1.0 g; $NH_2CH_2CH_2NH_2$, 45 ml) as above to give, after acetylation, 0.213 g of crude **9**, which was purified as above.

25,26,27 - *Trisnor* - 3β - *acetoxy* - 4,4,14α - *trimethyl* - 9,19 - *cyclo* - 5α - *ergost* - 23 - *ene* **13**

C_{24}-iodide **12** (0.5 g) in DMSO (5.0 ml) containing DBU (0.17 g) was stirred and heated at 80–90° for 13 h (N_2) and then worked up in the usual manner to give a product, which was chromatographed on Al_2O_3/III (20.0 × 1.5 cm). Light petroleum (100 ml) eluted a product (TLC pure; solvent, 5% EtOAc in C_6H_6; R_f 0.66; 0.235 g) which was crystallised from isopropyl ether–MeOH: m.p. 119.5–120.5°. PMR: Cyclopropyl CH_2 (1H, d, 0.33 ppm; 1H, d, 0.53 ppm; J 4 Hz), tertiary Me's (12H, bs, 0.86 ppm), Me–CH=CH (bd, 1.65 ppm; J 7 Hz), OAc (3H, s, 1.97 ppm), CHOAc (1H, m, 4.43 ppm), –CH=CH– (2H, m, 5.35 ppm). Mass: *m/e* 440 (M^+, 38%), 425 (45%), 380 (14%), 365 (34%), 297 (5%), 215 (27%), 175 (38%), 121 (65%), 95 (100%), 81 (79%), 69 (93%). (Found: C, 81.85; H, 10.76. $C_{30}H_{48}O_2$ requires: C, 81.76; H, 10.98%).

3β - *Acetoxy* - 4,4,14α - *trimethyl* - 9,19 - *cyclo* - 5α - *pregnan* - 20 - *one* **2**

A soln of olefin **9** (4.3 g) in $CHCl_3$ (200 ml) was treated with ozonised O_2 (0.48 g O_3/h) at 10° till O_3 passed freely. This was worked up and oxidised by Jones reagent, as detailed earlier, to give a neutral fraction (gum, 3.0 g), which after chromatographic purification (see above) furnished pure **2** (2.0 g), m.p. 153–154° (lit.[3] m.p. 153–154°).

3β - *Acetoxy* - 4,4,14α - *trimethyl* - 9,19 - *cyclo* - 5α - *androstan* - 17 - *one* **3**

Olefin **13** (0.15 g) was isomerised (Li, 1.0 g; $NH_2CH_2CH_2NH_2$, 40 ml) at 120–125° (bath) for 25 h and the product, acetylated, ozonolyzed and the product (neutral, 0.12 g) separated by chromatography exactly as described earlier to give **2** (0.035 mg, m.p. 152–153°) and **3** (0.048 g, m.p. 160–163°).

Cleavage of ether **15**

Ether **15** (0.5 g) in gl. AcOH (15.0 ml) containing Ac_2O (7.5 ml) and *p*-TsOH (0.049 g) was heated (60–65°) with stirring for 43 h (N_2). On usual work-up a semi-solid (0.52 g), showing on TLC (solvent: 5% EtOAc in C_6H_6) essentially two spots (R_f, 0.60 major; R_f, 0.38, minor), was obtained. This was chromatographed on SiO_2-gel/IIB (43.0 × 2.0 cm) using light petroleum, light petroleum containing increasing quantities of C_6H_6, C_6H_6 and C_6H_6 containing increasing amounts of EtOAc, as eluant.

26 - *Nor* - 3β,22ξ - *diacetoxy* - 4,4,14α - *trimethyl* - 9,19 - *cyclo* - 5 - *ergost* - 24 - *ene* **16**

The material eluted with 50% C_6H_6 in light petroleum (200 ml × 2; 0.331 g, m.p. 175–178°) on crystallisation gave pure **16**, m.p. 184–186°, $[\alpha]_D$ +26.06° (c, 0.53%). IR (Nujol): OAc 1735, 1245 cm^{-1}. PMR: cyclopropyl CH_2 (1H, d, 0.33 ppm; 1H, d,

0.61 ppm; J 4 Hz), tertiary Me's (singlets at 0.86, 0.87, 0.90 and 0.99 ppm), Me–CH=C (d, 1.75 ppm; J 7 Hz), OAc (3H, s, 1.93 ppm; 3H, s, 2.0 ppm), HC_3–OAc (1H, m, 4.48 ppm), HC_{22}–OAc (1H, m, 5.14 ppm), C=CH (1H, m, 5.22 ppm). (Found: C, 77.47; H, 10.04. $C_{34}H_{54}O_4$ requires: C, 77.60; H, 10.27%).

5% EtOAc in C_6H_6 (200 ml) eluted 0.12 g of a material (R_f, 0.38) which, though essentially pure (TLC), could not be induced to crystallise. From its PMR data (cyclopropyl CH_2, 1H doublets at 0.33, 0.61 ppm; four tertiary Me's, 0.86, 0.90, 0.90, 0.97 ppm; MeCHOAc, d, 1.13 ppm, J 6.5 Hz; Me–C=C, 1.7 ppm; two OAc, singlets at 2.04, 2.06 ppm; HC_3–OAc, m, 4.50 ppm; HC_{24}–OAc, m, 5.0 ppm; C=CH, m, 5.10 ppm) it is clearly **17**.

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