STEREOCHEMISTRY OF EPOXIDATION AND HYDROBORATION OF SOME 4,4-DIMETHYL-A-HOMO-5-CHOLESTENE DERIVATIVES*

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Stereochemistry of epoxidation and hydroboration of some 3-substituted 4,4-dimethyl-A-homo--5-cholestene derivatives was studied. These reactions afforded predominantly products of addition from the less hindered β-side of the cyclic system. Reduction of the 5β,6β-epoxide ring in the 3β-acetoxy derivative *IV* led to product of diaxial opening, *i.e.* the 3β,6β-diol *VII*, whereas in the case of the 3α-acetoxy derivative *XIV* the reductive as well as alkaline opening of the 5β,6β-epoxide afforded product of $5(O)^n$ participation of the 3α-substituent, *i.e.* the 3α,5α-transannular epoxide *XV*.

We have recently studied the stereochemistry of epoxidation of the Δ^{4a}-double bond in some 3-substituted 4,4-dimethyl-A-homocholestene derivatives[1] and of opening of the 4a,5-epoxide ring in 4,4-dimethyl-A-homocholestane derivatives bearing an oxygen substituent in the position 3 (ref.[2-4]). In connection with these investigations, it was of interest to examine the course of analogous reactions of 4,4-dimethyl-A--homocholestane derivatives, containing a double bond or an epoxide ring in the position 5–6. This paper concerns stereochemistry of epoxidation and hydroboration of some 3-substituted 4,4-dimethyl-A-homo-5-cholestene derivatives and reaction of the obtained 5β,6β-epoxides with lithium aluminium hydride.

The already known[5] 3β- and 3α-acetoxy derivatives *I* and *II* were treated with 3-chloroperoxybenzoic acid in chloroform at room temperature. Both compounds afforded only one of the two possible epimeric epoxides: compound *I* gave the epoxide *IV* whereas its isomer *II* afforded the epoxide *XIV* in the respective yields 90% and 78%. Alkaline saponification of the 3β-acetoxy derivative *IV* led to the 3β-hydroxy derivative *V* which was converted into the ketone *VI* by oxidation with chromium trioxide--pyridine complex. On the other hand, an analogous alkaline saponification of the 3α-acetoxy derivative *XIV* already under mild conditions (potassium hydrogen carbonate in boiling methanol) gave the hydroxy derivative *XV* (99% yield) instead of the expected 3α-hydroxy-5,6-epoxide; the compound *XV* was characterized as the

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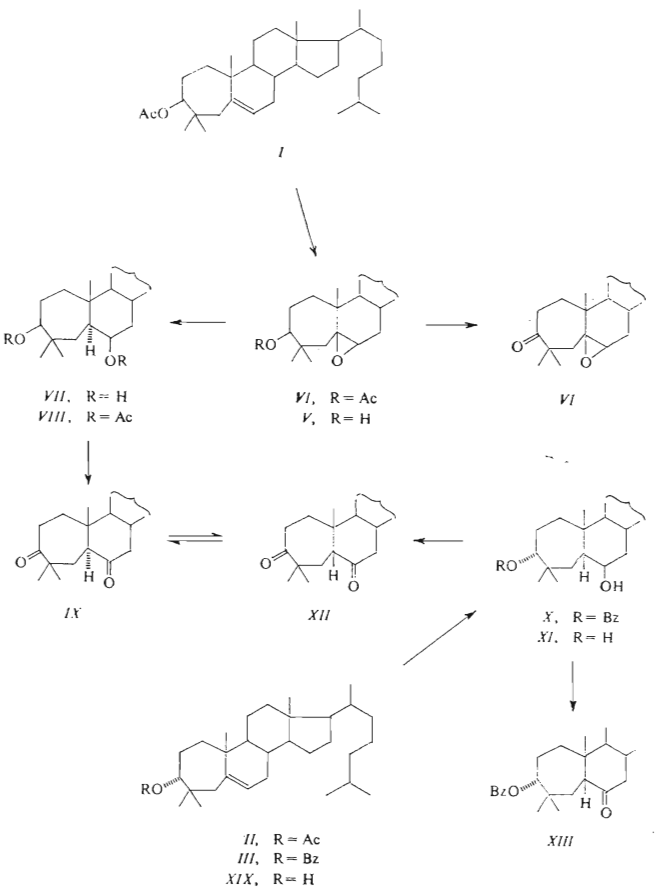
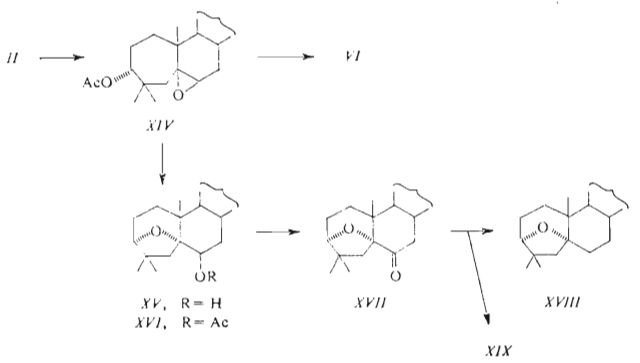
acetoxy derivative XVI. It is known[3,4] that an oxygen-containing 3α-substituent participates through the 5(0)^n process (for notation see ref.[6]) in the opening of the 4aβ,5β-epoxide ring of 4,4-dimethyl-A-homocholestane derivatives under formation of 3α,5α-transannular epoxides. Analogously, the 5,6-epoxide ring in the epoxide *XIV* could be opened with 5(0)^n participation of the 3α-substituent, if the epoxide ring had β-configuration, and the arising transannular epoxide *XV* should be 4,4-dimethyl--3α,5-epoxy-A-homo-5α-cholestan-6β-ol. In accord with this suggested structure, the ^{1}H NMR spectrum of the acetoxy derivative *XVI* exhibits multiplets due to one proton on the carbon atom, bearing the acetoxy group, and one CH—O proton. The structure *XV* was confirmed also by formation of the known 4,4-dimethyl--3α,5-epoxy-A-homo-5α-cholestane (*XVIII*, ref.[3]) and 4,4-dimethyl-A-homo-5-cholesten-3α-ol (*XIX*, ref.[8]) in the Huang–Minlon reduction of ketone *XVII*, obtained in turn by oxidation of the hydroxy derivative *XV* with chromium trioxide–pyridine complex. Since in the alkaline saponification of 3β-acetoxy-5,6-epoxide *IV* no product of 5(0)^n participation of the 3β-substituent was observed, it could be assumed that also in the compound *IV* the 5,6-epoxide ring has the β-configuration. In order to prove this assumption in a chemical way it was necessary to convert also the epoxide *XIV* into the ketone *VI*. The desired 3α-hydroxy-5,6-epoxide could be obtained as the main product (according to thin-layer chromatography) beside some transannular epoxide *XV* by hydride reduction of 3α-acetoxy derivative *XIV*, however, already during the preparative thin-layer chromatography it was converted smoothly into the transannular epoxide *XV*. Therefore, the crude mixture was directly oxidized with the chromium trioxide–pyridine complex affording, in addition to the ketone *XVII*, the ketone *VI* in 50% yield. Hence, the configuration of the 5,6-epoxide ring in the epoxides *IV* and *XIV* is the same and the Δ^5-double bond is epoxidized from the less hindered β-side of the cyclic system. The suggested configuration of *IV* and *XIV* is supported also by their ^{1}H NMR spectra which display a doublet due to one epoxide proton with coupling constant $J_{6,7} = 1{\cdot}5$ Hz. This small coupling constant is in accord with the observation[7] that for 5β,6β-epoxides of normal steroid series the $J_{6,7\beta}$ coupling constant is about 2·1—2·7 Hz whereas for 5α,6α-epoxides the corresponding $J_{6,7\alpha}$ coupling constant ranges from 3·3 to 4·1 Hz.

Whereas the epoxide ring of the 3α-acetoxy-5β,6β-epoxide *XIV* is readily opened with lithium aluminium hydride in boiling dioxane to give a product of 5(0)^n participation of the 3α-substituent, *i.e.* the transannular epoxide *XV*, the analogous reaction of the 3β-acetoxy-5β,6β-epoxide IV is relatively slow affording a product of diaxial cleavage, *i.e.* the 3β,6β-diol *VII*. Structure of the diol *VII* was confirmed by its conversion into the diacetoxy derivative *VIII* and into the diketone *IX*.

Since both hydrogenation[2] and epoxidation of the Δ^5-double bond in 4,4-dimethyl--A-homocholestene derivatives take place predominantly from the less hindered β-side of the cyclic system, an analogous steric course could be assumed also for hydroboration of the 5,6-double bond in these derivatives. This assumption was

confirmed in the case of *in situ* hydroboration of the known[8] 4,4-dimethyl-A-homo--5-cholesten-3α-yl benzoate (*III*). The reaction afforded as the main product (75% yield) the hydroxy derivative *X* which was converted into the ketone *XIII* by oxidation





with chromium trioxide–pyridine complex. The benzoyl group of the compound *X* was removed by reduction with lithium aluminium hydride and the obtained diol *XI* was oxidized with chromium trioxide–pyridine complex to give the diketone *XII*. Equilibration of the diketones *IX* and *XII* with potassium carbonate in boiling methanol afforded the same mixture of 5α- and 5β-derivatives *IX* and *XII* in the ratio of about 4 : 1. The diketone *IX* with *trans*-fused rings A and B is thus the thermodynamically more stable derivative. The CD curves of both the isomeric diketones *IX* and *XII* exhibit a negative Cotton effect, which is much stronger for the 5α-derivative *IX* than for the 5β-isomer *XII* ($\Delta\varepsilon_{294}$ for *IX*: −5·15; for *XII*: −1·79). A negative Cotton effect ($\Delta\varepsilon_{295}$ −2·56) was observed also for 3α-benzoyloxy-4,4-dimethyl--A-homo-5β-cholestan-6-one (*XIII*).

EXPERIMENTAL

Melting points were determined on a Kofler block and are uncorrected. Optical rotations were measured in chloroform. Unless stated otherwise, IR spectra were taken in tetrachloromethane on a Zeiss UR 20 spectrometer, ^{1}H NMR spectra on a Tesla B 476 (60 MHz) instrument in deuteriochloroform with tetramethylsilane as internal standard. Chemical shifts are given in ppm. CD spectra were measured on Jouan-Roussel Dichrographe II in dioxane. Identity of samples prepared by different routes was checked by mixture melting points and IR spectra. The term "usual work-up procedure" means that the solution was washed successively with 5% hydrochloric acid, 5% aqueous solution of potassium hydrogen carbonate, water, dried over sodium sulfate and the solution was taken down *in vacuo*. The crude residue was purified by preparative thin-layer chromatography on silica gel (plates 20 × 20 cm) in ether–light petroleum (1 : 9) unless stated otherwise. The corresponding zones were combined, eluted with ether and the solvent was evaporated *in vacuo*.

4,4-Dimethyl-5,6β-epoxy-A-homo-5β-cholestan-3β-yl Acetate (*IV*)

a) A solution of 4,4-dimethyl-A-homo-5-cholesten-3β-yl acetate (*I*; ref[5]; 330 mg) in chloroform (30 ml) was mixed with 3-chloroperoxybenzoic acid (330 mg). After standing at room temperature for 30 min, the mixture was poured into water and the product was taken up in ether. The ethereal extract was washed with saturated solution of potassium carbonate, water, dried over sodium sulfate and the solvent was evaporated *in vacuo*. Crystallization of the residue (330 mg) from methanol afforded 180 mg of the epoxide *IV*, m.p. 107–109°C, $[\alpha]_D^{20}$ +4° (*c* 0·5). IR spectrum, cm^{-1}: 1 739, 1 249, 1 031. ^1H NMR spectrum: 0·60 (s, 18-CH_3, 3 H); 0·84 (d, 9 H, 21 + 26 + 27-CH_3, J = 6 Hz); 0·90 (s, 6 H, 19-CH_3 + $C_{(4)}$—CH_3 or $C_{(4)}$—CH_3 + $C_{(4)}$—CH_3); 0·96 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 2·05 (s, 3 H, —$OCOCH_3$); 3·075 (d, 1 H, $C_{(6)}$—H, J = 1·5 Hz); 4·71 (mt, 1 H, $C_{(3)}$—H). For $C_{32}H_{54}O_3$ (487·7) calculated: 78·96% C, 11·18% H; found: 78·86% C, 11·04% H.

b) The hydroxy derivative *V* (30 mg) was acetylated with acetic anhydride (0·1 ml) in pyridine (2 ml) overnight. The usual work-up procedure gave 30 mg of the crude product which was preparatively chromatographed on one plate of silica gel. The corresponding zone afforded 24 mg of the acetoxy derivative *IV* which on crystallization from methanol melted at 107–109°C, $[\alpha]_D^{20}$ +4° (*c* 0·5). Yield 18 mg.

4,4-Dimethyl-5,6β-epoxy-A-homo-5β-cholestan-3β-ol (*V*)

Potassium hydroxide (90 mg) was added to a solution of the derivative *IV* (100 mg) in methanol (10 ml). After reflux for 1 h, the mixture was concentrated to one third of the original volume *in vacuo*, poured into water and the product was taken up in ether. The ethereal extract was washed with water, dried over sodium sulfate and taken down *in vacuo*. Chromatography of the residue (100 mg) on 2 plates of silica gel afforded 95 mg of the hydroxy derivative *V*, m.p. 136 to 138°C (heptane); $[\alpha]_D^{20}$ −10° (*c* 0·5). IR spectrum (chloroform, cm^{-1}): 3 630, 1 126, 1 098, 1 048, 950. ^1H NMR spectrum: 0·60 (s, 3 H, 18-CH_3); 0·84 (d, 9 H, 21 + 26 + 27-CH_3, J = = 6 Hz); 0·875 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 0·925 (s, 6 H, 19-CH_3 + $C_{(4)}$—CH_3 or $C_{(4)}$— —CH_3 + $C_{(4)}$—CH_3); 3·01 (d, 1 H, $C_{(6)}$—H, J = 1·5 Hz); 3·46 (mt, 1 H, $C_{(3)}$—H). For $C_{30}H_{52}O_2$ (444·7) calculated: 81·02% C, 11·79% H; found: 81·19% C, 11·56% H.

4,4-Dimethyl-5,6β-epoxy-A-homo-5β-cholestan-3-one (*VI*)

a) Chromium trioxide (30 mg) was added to a solution of the hydroxy derivative *V* (40 mg) in pyridine (3 ml). After standing overnight, the mixture was worked up as usual, affording 40 mg of the crude ketone *VI* which was purified by crystallization from methanol; m.p. 125–127°C; yield 20 mg. IR spectrum (chloroform, cm^{-1}): 1 700, 958, 948. For $C_{30}H_{50}O_2$ (442·7) calculated: 81·39% C, 11·38% H; found: 81·10% C, 11·14% H.

b) An excess of lithium aluminium hydride was added to a solution of the epoxide *XIV* (40 mg) in ether (4 ml). After standing at room temperature for 5 min, the excess hydride was decomposed with saturated sodium sulfate solution and the mixture was filtered through a short column of sodium sulfate. Evaporation of the filtrate *in vacuo* afforded 40 mg of a crude product which was directly oxidized with chromium trioxide (30 mg) in pyridine (3 ml) overnight. The usual work-up procedure furnished 40 mg of a crude product which was preparatively chromatographed on 1 plate of silica gel. The more polar zone gave 18 mg of the ketone *VI* which on crystallization from methanol melted at 125–127°C. The less polar zone afforded 15 mg of 4,4-dimethyl-3α,5-epoxy- -A-homo-5α-cholestan-6-one (*XVII*), m.p. 110·5–112°C (methanol).

4,4-Dimethyl-A-homo-5α-cholestane-3β,6β-diol (*VII*)

Lithium aluminium hydride (100 mg) was added to a solution of the epoxide *IV* (95 mg) in dioxane (3 ml). The mixture was refluxed for 10 h and the excess hydride decomposed with a saturated sodium sulfate solution. After filtration through a column of sodium sulfate, the filtrate was taken down and the residue (90 mg) chromatographed on 2 plates of silica gel in ether–light petroleum (2 : 8). The combined less polar zones afforded 20 mg of the epoxide *V* which on crystallization from heptane melted at 136–138°C; $[\alpha]_D^{20}$ −10° (*c* 0·5). The combined more polar zones gave 60 mg of the diol *VII*, m.p. 113–115°C (heptane). IR spectrum (chloroform, cm^{-1}): 3 625, 1 126, 1 099, 1 040. For $C_{30}H_{54}O_2$ (446·7) calculated: 80·65% C, 12·18% H; found: 80·25% C, 12·30% H.

4,4-Dimethyl-A-homo-5α-cholestane-3β,6β-diol Diacetate (*VIII*)

The diol *VII* (55 mg) was acetylated with acetic anhydride (0·2 ml) in pyridine (3 ml) overnight. The usual work-up procedure gave 55 mg of a crude product which was subjected to preparative chromatography on one plate of silica gel. The corresponding zone yielded 48 mg of the diacetate *VIII* which resisted all crystallization attempts; $[\alpha]_D^{20}$ −21° (*c* 0·5). IR spectrum, cm^{-1}: 1 740, 1 244, 1 026, 986, 948. ^{1}H NMR spectrum: 0·66 (s, 3 H, 18-CH_3); 0·85 (d, 9 H, 21 + 26 + 27-CH_3, J = 6 Hz); 0·89 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 0·965 (s, 6 H, 19-CH_3 + $C_{(4)}$—CH_3 or $C_{(4)}$ + $C_{(4)}$—CH_3); 2·03 (s, 6H, 2 × —$OCOCH_3$); 4·63 (mt, 1 H, $C_{(3)}$—H); 4·89 (mt, 1 H, $C_{(6)}$—H). For $C_{34}H_{58}O_4$ (520·8) calculated: 78·40% C, 11·23% H; found: 78·24% C, 11·30% H.

4,4-Dimethyl-A-homo-5α-cholestane-3,6-dione (*IX*)

Chromium trioxide (40 mg) was added to a solution of the diol *VII* (40 mg) in pyridine (2 ml). After standing overnight, the mixture was worked up as usual, affording 40 mg of a crude product which was purified by chromatography on one plate of silica gel. The obtained diketone *IX* (30 mg) was crystallized from methanol, m.p. 160–161·5°C. IR spectrum: 1 711 cm^{-1}. CD spectrum: $\Delta\varepsilon_{294}$ −5·15. For $C_{30}H_{50}O_2$ (442·7) calculated: 81·39% C, 11·38% H; found: 81·16% C, 11·11% H.

4,4-Dimethyl-A-homo-5β-cholestane-3α,6β-diol 3-Benzoate (*X*)

Sodium borohydride (180 mg), followed by boron trifluoride etherate (0·35 ml), was added to a stirred solution of 4,4-dimethyl-A-homo-5-cholesten-3α-yl benzoate (*XIX*; ref.[8]; 260 mg) in tetrahydrofuran (8 ml). After stirring under nitrogen for 2 h, an alkaline solution of hydrogen peroxide (13 ml; prepared from 27 ml of 10% KOH and 18 ml of 30% H_2O_2) was added dropwise during 20 min with cooling (ice) and stirring which was continued for 1 h more. After extraction of the product with ether, the ethereal extract was washed with water, dried over sodium sulfate and taken down *in vacuo*. Chromatography of the residue (260 mg) on 5 plates of silica gel in ether–light petroleum (2 : 8) afforded 200 mg of the glassy hydroxy derivative *X*, $[\alpha]_D^{20}$ −21° (*c* 1·0). IR spectrum (chloroform, cm^{-1}): 1 712, 1 694, 1 238, 3 615. ^{1}H NMR spectrum: 0·675 (s, 3 H, 18-CH_3); 0·86 (d, 6 H, 26 + 27-CH_3, J = 6 Hz); 0·91 (d, 3 H, 21-CH_3, J = 6 Hz); 0·90 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 1·03 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 1·14 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 3·76 (mt, 1 H, $C_{(6)}$—H, $W_{1/2}$ = 6 Hz); 4·84 (mt, 1 H, $C_{(3)}$—H). For $C_{37}H_{58}O_3$ (550·8) calculated: 80·67% C, 10·61% H; found: 80·46% C, 10·33% H.

4,4-Dimethyl-A-homo-5β-cholestane-3α,5β-diol (*XI*)

Lithium aluminium hydride (40 mg) was added to a solution of the benzoyloxy derivative *X*, (80 mg) in ether (5 ml) and the mixture was set aside at room temperature for 15 min. The excess hydride was destroyed with saturated sodium sulfate solution and the mixture was passed through a column of sodium sulfate. Evaporation of the solvent *in vacuo* afforded 80 mg of a crude product which was purified by preparative thin-layer chromatography on 2 plates of silica gel in ether–light petroleum (2 : 8). The combined corresponding zones gave 60 mg of the diol *XI*, m.p. 74—75° (aqueous methanol). IR spectrum (chloroform, cm^{-1}): 1 040, 1 024, 987, 3 620. For $C_{30}H_{54}O_2$ (446·7) calculated: 80·65% C, 12·18% H; found: 80·28% C, 12·23% H.

4,4-Dimethyl-A-homo-5β-cholestane-3,6-dione (*XII*)

Chromium trioxide (30 mg) was added to a solution of the diol *XI* (30 mg) in pyridine (2 ml). Standing at room temperature overnight followed by the usual work-up procedure afforded 30 mg of a crude product which was crystallized from methanol to give 20 mg of the dione *XII*, m.p. 141—143°C. IR spectrum: 1 710 cm^{-1}. CD spectrum: $\Delta\varepsilon_{294}$ −1·79. For $C_{30}H_{50}O_2$ (442·7) calculated: 81·39% C, 11·38% H; found: 81·05% C, 11·10% H.

3α-Benzoyloxy-4,4-dimethyl-A-homo-5β-cholestan-6-one (*XIII*)

Chromium trioxide (50 mg) was added to a solution of the hydroxy derivative *X* (60 mg) in pyridine (3 ml). The mixture was set aside at room temperature overnight and worked up as usual, affording 60 mg of a crude product which was subjected to preparative chromatography on one plate of silica gel. The corresponding zone gave 50 mg of the ketone *XII* which resisted all crystallization attempts. IR spectrum, cm^{-1}: 1 720, 1 275, 1 710. CD spectrum: $\Delta\varepsilon_{295}$ −2·65. For $C_{37}H_{56}O_3$ (548·8) calculated: 80·97% C, 10·28% H; found: 80·66% C, 10·09% H.

4,4-Dimethyl-5,6β-epoxy-A-homo-5β-cholestan-3α-yl Acetate (*XIV*)

3-Chloroperoxybenzoic acid (100 mg) was added to a solution of 4,4-dimethyl-A-homo-5-cholesten-3α-yl acetate (*II*; ref.[5]; 100 mg) in chloroform (5 ml). After standing at room temperature for 30 min the mixture was poured into water and the product extracted into ether. The ethereal extract was washed with saturated aqueous solution of potassium carbonate and water, dried over sodium sulfate and taken down *in vacuo*. Preparative chromatography of the residue (100 mg) on two plates of silica gel afforded 80 mg of the epoxide *XIV* which was crystallized from methanol: m.p. 144—146°C; $[\alpha]_D^{20}$ −29° (*c* 0·5). IR spectrum, cm^{-1}: 1 740, 1 245, 1 028, 951. ^1H NMR spectrum: 0·61 (s, 3 H, 18-CH_3); 0·86 (d, 9 H, 21 + 26 + 27-CH_3, J = 6 Hz); 0·89 (6 H, s, 19-CH_3 + $C_{(4)}$—CH_3 or $C_{(4)}$—CH_3 + $C_{(4)}$—CH_3); 0·95 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 2·025 (s, 3 H, —$OCOCH_3$); 3·01 (d, 1 H, $C_{(6)}$—H, J = 1·5 Hz); 4·71 (mt, 1 H, $C_{(3)}$—H). For $C_{32}H_{54}O_3$ (486·75) calculated: 78·96% C, 11·18% H; found: 78·75% C, 11·01% H.

4,4-Dimethyl-3α,5-epoxy-A-homo-5α-cholestan-6β-ol (*XV*)

a) An aqueous solution of potassium hydrogen carbonate (100 mg in 1 ml H_2O) was added to a solution of the epoxide *XIV* (100 mg) in methanol (10 ml). The mixture was refluxed for 1 h, concentrated to one third of its volume *in vacuo*, poured into water and extracted with ether. The ethereal extract was washed with water, dried over sodium sulfate and taken down *in vacuo*. Preparative chromatography of the residue on two plates of silica gel afforded 90 mg of the epoxide *XV* which could not be induced to crystallization; $[\alpha]_D^{20}$ −12° (*c* 0·5). IR spectrum (chloro-

form, cm^{-1}): 3 625, 1 014, 910, 886. ^1H NMR spectrum: 0·66 (s, 3 H, 18-CH_3); 0·84 (d, 6 H, 26 + 27-CH_3, $J = 6$ Hz); 0·908 (d, 3 H, 21-CH_3, $J = 6$ Hz); 0·89 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 1·08 (s, 6 H, 19-CH_3 + $C_{(4)}$—CH_3 or $C_{(4)}$—CH_3 + $C_{(4)}$—CH_3); 3·575 (mt, 2 H, $C_{(3)}$—H + + $C_{(6)}$—H). For $C_{30}H_{52}O_2$ (444·7) calculated: 81·02% C, 11·78% H; found: 80·88% C, 11·5% H.

b) Lithium aluminium hydride (50 mg) was added to a solution of epoxide *XIV* (50 mg) in dioxane (3 ml) and the mixture was refluxed for 1 h. The excess hydride was decomposed with saturated sodium sulfate solution. After filtration through a short column of sodium sulfate, the filtrate was taken down *in vacuo* and the residue (50 mg) was preparatively chromatographed on one plate of silica gel. The corresponding zone afforded 47 mg of the epoxide *XV*, resistant to all crystallization attempts; $[\alpha]_D^{20} - 12°$ (*c* 0·5).

4,4-Dimethyl-3α,5-epoxy-A-homo-cholestan-6β-yl Acetate (*XVI*)

The hydroxy derivative *XV* (115 mg) was acetylated with acetic anhydride (1 ml) in pyridine (5 ml) overnight. The usual work-up procedure afforded 110 mg of a crude product which was preparatively chromatographed on 2 plates of silica gel. The corresponding zones gave 99 mg of the acetate *XVI*, m.p. 80–82°C (methanol); $[\alpha]_D^{20} - 24°$ (*c* 0·5). IR spectrum, cm^{-1}: 1 742, 1 246, 1 092, 1 086, 879. ^1H NMR spectrum: 0·65 (s, 3 H, 18-CH_3); 0·83 (d, 9 H, 21 + 26 + 27-CH_3, J = = 6 Hz); 0·85 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 1·03 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 1·075 (s, 3 H, 19-CH_3 or $C_{(4)}$—CH_3); 2·00 (s, 3 H, —$OCOCH_3$); 3·55 (mt, 1 H, $C_{(3)}$—H); 4·775 (mt, 1 H, $C_{(6)}$—H). For $C_{32}H_{54}O_3$ (486·75) calculated: 78·96% C, 11·18% H; found: 78·76% C, 11·10% H.

4,4-Dimethyl-3α,5-epoxy-A-homo-5α-cholestan-6-one (*XVII*)

Chromium trioxide (150 mg) was added to a solution of the hydroxy derivative *XV* (200 mg) in pyridine (6 ml). After standing at room temperature overnight and the usual work-up procedure, the crude product (200 mg) was crystallized from methanol to give 147 mg of the ketone *XVII*, m.p. 107–109°C, $[\alpha]_D^{20} - 22°$ (*c* 0·5). IR spectrum (chloroform, cm^{-1}): 1 716, 1 009. For $C_{30}H_{50}O_2$ (442·7) calculated: 81·39% C, 11·38% H; found: 81·22% C, 11·15% H.

4,4-Dimethyl-3α,5-epoxy-A-homo-5α-cholestane[3] (*XVIII*)

To a solution of the ketone *XVII* (120 mg) in triethylene glycol (9 ml) 90% hydrazine hydrate (0·9 ml) and potassium hydroxide (240 mg) were added and the mixture was heated to 140°C. An air condenser was then attached and the mixture was kept at 140°C for 30 min. Then, the heating was continued without the condenser until the temperature reached 200°C. The mixture was then heated at this temperature for 3 h (again under the air condenser), cooled and poured into water. The product was taken up in ether, the ethereal extract was washed with water and dried over sodium sulfate. After evaporation of the solvent *in vacuo*, the residue (100 mg) was preparatively chromatographed on two plates of silica gel to give 23 mg of the epoxide *XVIII*, m.p. 97–98°C (methanol). Work-up of the more polar zones afforded 80 mg of the olefin *XIX* (ref.[8]) which resisted all crystallization attempts; $[\alpha]_D^{20} + 18°$ (*c* 0·5).

Equilibration of Diketones *IX* and *XII*

An aqueous 10% solution of potassium hydroxide (0·4 ml) was added to a solution of the diketone *IX* (39·1 mg) in methanol (5 ml). After refluxing for 8 h, the mixture was poured into water and extracted with ether. The organic layer was washed with water, dried over sodium sulfate and taken down *in vacuo*. The residue (37 mg) was preparatively chromatographed on one plate

of silica gel. The less polar zone gave 34·5 mg of the diketone *IX* whereas the more polar one afforded 9·5 mg of the compound *XII*. In an analogous way, a solution of the diketone *XII* (35 mg) in methanol (5 ml) was refluxed with 10% potassium hydroxide solution (0·4 ml). The same treatment as described above afforded 32 mg of *IX* and 7·5 mg of *XII*.

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REFEEENCES

1. Velgová H., Trka A.: This Journal *47*, 315 (1982).
2. Velgová H., Trka A.: This Journal *48*, 937 (1983).
3. Velgová H.: This Journal *47*, 2530 (1982).
4. Velgová H., Trka A.: This Journal *47*, 2007 (1982).
5. Velgová H., Smolíková J.: This Journal *46*, 607 (1981).
6. Kočovský P., Černý V., Synáčková M.: This Journal *44*, 1483 (1979).
7. Cross A. D.: J. Amer. Chem. Soc. *84*, 3206 (1962).
8. Velgová H., Černý V.: This Journal *41*, 3131 (1976).

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