ANALOGUES OF ANDROGENS WITH A CYCLOPROPANE RING IN 6α,7α-POSITION*

Ladislav KOHOUT and Jan FAJKOŠ

Institute of Organic Chemistry and Biochemistry, Czechoslovak Academy of Sciences, 166 10 Prague 6

Received January 8th, 1980

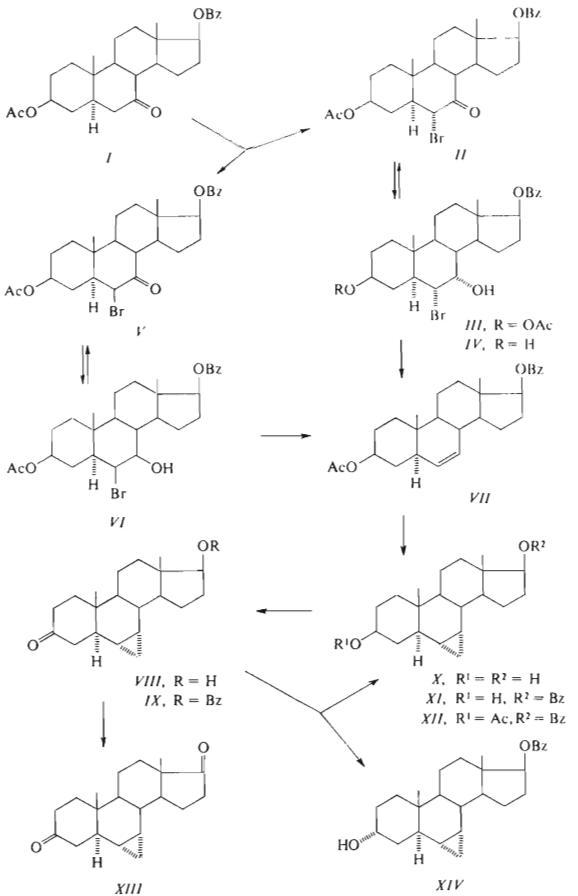
Simmons–Smith methylenation of 5α-androst-6-ene-3β,17β-diol 3-acetate 17-benzoate is described. Using the adduct as the starting material four analogues of androgens were synthetized by standard methods. The structures of products were established by spectral and chemical means.

In one of our papers[1] we dealt with Simmons–Smith methylenation of the 6,7-double bond in the 5α-cholestane series and described syntheses of compounds carrying the cyclopropane ring in the 6α,7α position. Using similar approach we described in the present paper syntheses of some analogues of androgens with cyclopropane ring in the same position.

The starting olefin *VII* desired for the Simmons–Smith methylenation was prepared from the ketone[2] *I* as follows: Bromination with bromine in chloroform afforded the bromo ketone *II* in 82% yield. Only traces (1·5%) of the epimeric bromo ketone *V* were isolated. The structures were assigned on the basis of the ^{1}H-NMR spectra. The 6β-axial proton in the bromo ketone *II* appears as a doublet at 4·6 ppm with a coupling constant J = 12·5 Hz, whereas in the bromo ketone *V* the 6α-equatorial proton is represented by a doublet at 4·1 ppm with a J = 3·5 Hz. Reduction of the bromo ketones afforded the corresponding bromohydrins *III* and *VI* the structures of which follow again from the spectral evidence and was corroborated by their oxidation to the starting bromo ketones. Both bromohydrins afforded on reaction with zinc dust in acetic acid the olefin *VII*. Simmons–Smith methylenation of this olefin proceeded stereospecifically from the α-side of the molecule yielding the 6α,7α--cyclopropano derivative *XII*. The configuration of the cyclopropane ring was assigned – like in the cholestane series[1] – on the basis of the ^{1}H-NMR spectrum. Here again we may expect a strong shielding of the 19 protons by a β-situated cyclopropane ring and a small effect on these protons in the α-isomer. This latter situation is well documented by Table I which shows the chemical shifts of the 18 and 19 protons in the cyclopropano derivative *XII* in comparison with the parent compound.

* Part CCXXXII in the series On Steroids; Part CCXXXI: This Journal *45*, 1850 (1980)

Starting from the acetate-benzoate *XII* the required analogues were prepared by standard procedures. Complete hydrolysis of the diester gave the diol *X* and



partial hydrolysis the benzoate *XI*. Oxidation with Jones' reagent afforded the ketone *IX* which was hydrolysed to the ketol *VIII*. Its oxidation yielded the dione *XIII* whereas reduction of the ketone *IX* led to the 3α-hydroxy derivative *XIV*.

EXPERIMENTAL

Melting points were determined on a Kofler block. Optical measurements were carried out in chloroform with an error of ±3°. The infrared spectra were recorded on the Zeiss UR 20 spectrometer in tetrachloromethane. The ^{1}H-NMR spectra were recorded on the Tesla 60 MHz instrument in deuteriochloroform and corrected to tetramethylsilane. The chemical shift is given in ppm. The mass spectrum was recorded on the mass spectrometer AEI 902. The identity of samples prepared by different routes was checked by mixture melting point determination, by thin-layer chromatography (TLC), and by infrared and ^{1}H-NMR spectra. Plates with 200 × × 200 × 0·7 mm silica gel were used for preparative TLC. Usual working up of a solution implies washing the solution with 5% aqueous hydrochloric acid, water, 5% aqueous potassium hydrogen carbonate solution, water, drying with sodium sulphate or filtration through paper Whatman 1PS and evaporation of the solvent *in vacuo*. Light petroleum refers to the fraction of b p. 40—62°C.

3β-Acetoxy-17β-benzoyloxy-6α-bromo-5α-androstan-7-one (*II*)

a) *From* 3β-*acetoxy*-17β-*benzoyloxy*-5α-*androstan*-7-*one* (I): A solution of the ketone[1] *I* (54 g) in chloroform (350 ml) was treated at room temperature with a solution of bromine (20·7 g) in the same solvent (320 ml) and allowed to stand for 20 min. About 400 ml of chloroform were distilled off under reduced pressure and the residue was poured in water. The product was taken into ether, the ethereal solution was washed with 10% sodium thiosulphate, then with a sodium hydrogen carbonate solution, water, dried, and solvent removed. The residue was crystallized from methanol to yield 50 g of the pure product. The mother liquors were chromatographed over silica gel (500 g) in ligroin–ether (4 : 1) to yield, after working up of the corresponding fractions and crystallization from methanol additional 2·4 g of the product. The overall yield was 52·4 g of the bromo ketone *II*, m.p. 218°C (decomp.), $[\alpha]_D^{20}$ +17° (*c* 1·28). IR spectrum:

TABLE I

^{1}H-NMR Signals of 18-H and 19-H

Compound	18-H	19-H
5α-Androstan-3β,17β-diol 3-acetate 17-benzoate[3]	0·94	0·86
6α,7α-Cyclopropano-5α-androstane-3β,17β-diol 3-acetate 17-benzoate (*XII*)	0·95	0·83

1719, 1287, 1280 (benzoate), 1255, 1730 (acetate), 1719–1730 cm^{-1} (carbonyl). ^{1}H-NMR spectrum: 0·91 (s, 18-H), 1·16 (s, 19-H), 2·00 (s, acetate), 4·60 (d, J = 12·5 Hz, 6β-H), 4·32 to 5·15 (mt, 3α-H and 17α-H), 7·32–7·65 and 7·90–8·18 (two mt, 17β-benzoate). For $C_{28}H_{35}$-BrO_5 (531·5) calculated: 63·28% C, 6·64% H, 15·03% Br; found: 63·42% C, 6·67% H, 15·20% Br.

b) *From 6α-bromo-5α-androstane-3β,7α,17β-triol 3-acetate 17-benzoate* (III): The alcohol *III* (100 mg) in acetone (5 ml) was treated with excess Jones' reagent and set aside for 10 min. The excess agent was removed with methanol, the mixture was diluted with water and the product extracted with ethyl acetate. Usual working up, evaporation of the solvent, and crystallization from methanol yielded 65 mg of the bromo ketone *II*, m.p. 220°C (decomp.), $[\alpha]_D^{20}$ +18° (*c* 1·18).

6α-Bromo-5α-androstane-3β,7α,17β-triol 3-Acetate 17-Benzoate (*III*)

a) *From 3β-acetoxy-17β-benzoyloxy-6α-bromo-5α-androstan-7-one* (II) *with lithium tri-tert-butoxyaluminium hydride*: The ketone *II* (2 g) in ethyl acetate (200 ml) was treated at room temperature with solid lithium tri-tert-butoxyaluminium hydride (4 g) and allowed to stand for 2·5 h. The mixture was then poured in water, acidified with 2% hydrochloric acid, and the product was extracted with ethyl acetate. Usual working up afforded 1·9 g of a product which on crystallization from methanol yielded 1·42 g of the bromohydrin *III*, m.p. 174–176°C, $[\alpha]_D^{20}$ +52° (*c* 2·72). IR spectrum: 3575 (hydroxyl), 1738, 1248 (acetate), 1724, 1277 cm^{-1} (benzoate). ^{1}H-NMR spectrum: 0·89 (s, 18-H and 19-H), 2·00 (s, 3β-acetate), 3·91 (mt, $W_{1/2}$ = = 4·5 Hz, 7β-H), 4·25 (dd, J_1 = 2 Hz, J_2 = 12 Hz, 6β-H), 4·47–5·11 (mt, 3α-H and 17α-H), 7·29–7·62 and 7·94–8·14 (two mt, 17β-benzoate). For $C_{28}H_{37}BrO_5$ (533·5) calculated: 63·03% C, 6·99% H, 14·97% Br; found 63·12% C, 6·98% H, 15·03% Br.

b) *From the ketone* II *with sodium borohydride*: The bromo ketone *II* (200 mg) in methanol (50 ml) was treated with sodium borohydride (400 mg) and allowed to stand for 2 h. The mixture was treated with another portion of sodium borohydride (400 mg) and after 4 h the rest of the hydride (400 mg) was added. After 18 h at room temperature the mixture was poured in water, acidified with 1% hydrochloric acid and the product was taken into ether. The ethereal solution was worked up and the residue after evaporation of the solvent was chromatographed preparatively on 4 plates of silica gel in ligroin–ether (1 : 1). The zones with the lipophilic bromohydrin were worked up and the product (18 mg) was crystallized from methanol to yield 11 mg of the bromohydrin *III*, m.p. 174 to 176°C, $[\alpha]_D^{20}$ +50° (*c* 1·16).

6α-Bromo-5α-androstane-3β,7α,17β-triol 17-Benzoate (*IV*)

The zones with the polar product from the preparative TLC (foregoing experiment) were worked up to yield 145 mg of a product which was crystallized from methanol to yield 120 mg of the diol *IV*, m.p. 220–223°C, $[\alpha]_D^{20}$ +63° (*c* 1·27). IR spectrum: 3610, 3580 (hydroxyl), 1712, 1280 cm^{-1} (benzoate). ^{1}H-NMR spectrum: 0·87 and 0·90 (two s, 18-H and 19-H), 1·91 and 3·45 (two s, hydroxyls), 3·56 (mt, $W_{1/2}$ = 25 Hz, 3α-H), 3·94 (mt, $W_{1/2}$ = 4 Hz, 7β-H), 4·30 (dd, J_1 = 3 Hz, J_2 = 11·5 Hz, 6β-H), 4·91 (mt, $W_{1/2}$ = 18 Hz, 17α-H), 7·36–7·66 and 7·95–8·18 (two mt, 17β-benzoate). For $C_{26}H_{35}BrO_4$ (491·5) calculated: 63·53% C, 7·17% H, 16·26% Br; found: 63·29% C, 7·14% H, 16·01% Br.

3β-Acetoxy-17β-benzoyloxy-6β-Bromo-5α-androstan-7-one (*V*)

a) *From 3β-acetoxy-17β-benzoyloxy-5α-androstan-7-one* (I): Elution of the chromatography after isolation of the bromo ketone *II* under *a*) with ligroin–ether (4 : 1) afforded 832 mg of a pro-

duct which on crystallization from methanol yielded 521 mg of the bromo ketone *V*, m.p. 167–158°C, $[\alpha]_D^{20}$ +13° (*c* 1·21). IR spectrum: 1 739, 1 250, 1 244 (acetate), 1 725, 1 278 (benzoate), 1 715 cm^{-1} (carbonyl). ^{1}H-NMR spectrum: 0·95 (s, 18-H), 1·31 (s, 19-H), 2·02 (s, 3β-acetate), 3·19 (dd, J_1 = 10 Hz, J_2 = 10 Hz, 8β-H), 4·10 (d, *J* = 3·5 Hz, 6α-H), 4·63–5·07 (mt, 3α-H and 17α-H), 7·36–7·61 and 7·92–8·18 (two mt, 17β-benzoate). For $C_{28}H_{35}BrO_5$ (531·5) calculated: 63·28% C, 6·64% H, 15·03% Br; found: 63·22% C, 6·98% H, 15·54% Br.

b) *From* 6β-*bromo*-5α-*androstane*-3β,7β,17β-*triol* 3-*acetate* 17-*benzoate* (VI): A solution of the bromohydrin *VI* (400 mg) in acetone (10 ml) was treated with excess Jones' reagent and allowed to stand at room temperature for 10 min. The excess reagent was removed with methanol, the mixture was diluted with water, and the product was isolated with ethyl acetate. Usual working up and crystallization from methanol afforded 204 mg of the bromo ketone *V*, m.p. 167–168°C, $[\alpha]_D^{20}$ +13° (*c* 1·11).

6β-Bromo-5α-androstane-3β,7β,17β-triol 3-Acetate 17-Benzoate (*VI*)

A solution of the bromo ketone *V* (155 mg) in ethyl acetate (20 ml) was treated with lithium tri-tert-butoxyaluminium hydride (300 mg) and allowed to stand at room temperature for 1 h. The mixture was decomposed with 5% acetic acid, diluted with water, and the product was taken into ether. The ethereal solution was worked up as usual, and ether removed. The residue (145 mg) was crystallized from methanol to yield 95 mg of the bromohydrin *VI*, m.p. 96–99°C, $[\alpha]_D^{20}$ +13° (*c* 1·79). IR spectrum: 3 560 (hydroxyl), 1 738, 1 245 (acetate), 1 725, 1 276 cm^{-1} (benzoate). ^{1}H-NMR spectrum: 0·96 (s, 18-H), 1·11 (s, 19-H), 2·02 (s, 3β-acetate), 3·24 (dd, J_1 = 4 Hz, J_2 = 9·5 Hz, 7α-H), 4·45 (dd, $J_1 = J_2$ = 3 Hz, 6α-H), 4·57–5·06 (mt, 3α-H and 17β-H), 7·37 to 7·63 and 7·84–8·01, (two mt, 17β-benzoate). For $C_{28}H_{37}BrO_5$ (533·5) calculated: 63·03% C, 6·99% H, 14·97% Br; found: 63·83% C, 6·75% H, 15·13% Br.

5α-Androst-6-ene-3β,17β-diol 3-Acetate 17-Benzoate (*VII*)

a) *From* 6α-*bromo*-5α-*androstane*-3β,7α,17β-*triol* 3-*acetate* 17-*benzoate* (III): The bromohydrin *III* (140 mg) in acetic acid (10 ml) was refluxed with zinc dust (300 mg) for 6 h. After cooling off to room temperature the metal was filtered off, washed with ethyl acetate, and the filtrate was diluted with water. The product was isolated by extraction with ethyl acetate. The organic layer was washed with a sodium hydrogen carbonate solution, water, dried, and solvents removed *in vacuo*. The residue (125 mg) was chromatographed preparatively on 3 plates of silica gel in ligroin–ether (4 : 1). Working up of the corresponding zones yielded 75 mg of a product which on crystallization from methanol gave 43 mg of the olefin *VII*, m.p. 182–186°C, $[\alpha]_D^{20}$ –58° (*c* 1·17). IR spectrum: 1 733, 1 248 (acetate), 1 725, 1 275 cm^{-1} (benzoate). ^{1}H-NMR spectrum: 0·80 and 0·95 (two s, 18-H and 19-H), 2·00 (s, 3β-acetate), 4·40–5·06 (mt, 3α-H and 17α-H), 5·26 and 5·46 (two d, AB system, *J* = 10 Hz, 6-H and 7-H), 7·38–7·64 and 7·96–8·18 (two mt, 17β-benzoate). For $C_{28}H_{36}O_4$ (436·6) calculated: 77·03% C, 8·31% H; found: 76·78% C, 8·45% H.

b) *From* 6β-*bromo*-5α-*androstane*-3β,7β,17β-*triol* 3-*acetate* 17-*benzoate* (VI): The bromohydrin *VI* (200 mg) in acetic acid (12 ml) was treated with zinc dust (400 mg) as described in the foregoing experiment. Similar working up afforded 180 mg of a product which was chromatographed on a silica gel column (10 g) in ligroin–ether (4 : 1). Working up of the corresponding fractions gave 160 mg of a product which was crystallized from methanol to yield 102 mg of the olefin *VII*, m.p. 182–185°C, $[\alpha]_D^{20}$ –58° (*c* 1·12).

17β-Hydroxy-6α,7α-cyclopropano-5α-androstan-3-one (*VIII*)

The benzoate *IX* (1·1 g) in methanol (500 ml) was treated with a solution of potassium hydroxide (4·4) g) in the minimum amount of water and set aside for 20 h at 18°C. The solvent was removed *in vacuo*, the residue was diluted with water, and the product taken into ether. Usual working up and crystallization from methanol afforded 525 mg of the alcohol *VIII*, m.p. 215–218°C, $[\alpha]_D^{20}$ −25° (*c* 0·92). IR spectrum: 3630, 1071, 1049, 1023 (hydroxyl), 3070 (cyclopropane), 1719, 1712 cm^{-1} (carbonyl). ^{1}H-NMR spectrum: −0·14–0·07 and 0·28–0·63 (two mt, cyclopropane protons), 0·83 (s, 18-H), 1·02 (s, 19-H), 3·63 (mt, $W_{1/2}$ = 21 Hz, 17α-H). For $C_{20}H_{30}O_2$ (302·4) calculated: 79·42% C, 10·00% H; found: 78·99% C, 10·01% H.

17β-Benzoyloxy-6α,7α-cyclopropano-5α-androstan-3-one (*IX*)

A solution of the alcohol *XI* (350 mg) in acetone (15 ml) was treated with excess Jones' reagent and set aside for 10 min. The excess reagent was removed with methanol, the mixture was diluted with water, and the product extracted into ethyl acetate. The extract was washed with a sodium hydrogen carbonate solution, water, dried, and solvent removed. The residue (325 mg) was crystallized from methanol to yield 260 mg of the ketone *IX*, m.p. 209–211°C, $[\alpha]_D^{20}$ +27° (*c* 2·09). IR spectrum: 3065 (cyclopropane), 1723, 1277 (benzoate), 1715 cm^{-1} (carbonyl). ^{1}H-NMR spectrum: 0·36–0·65 (mt, two cyclopropane protons), 1·01 (s, 18-H and 19-H), 4·87 (mt, $W_{1/2}$ = 17 Hz, 17α-H), 7·28–7·62 and 7·91–8·21 (two mt, 17β-benzoate). For $C_{27}H_{34}O_3$ (406·5) calculated: 79·76% C, 8·43% H; found: 79·73% C, 8·67% H.

6α,7α-Cyclopropano-5α-androstane-3β,17β-diol (*X*)

The diester *XII* (520 mg) in methanol (50 ml) was treated with a solution of potassium hydroxide (500 mg) in the same solvent (10 ml) and refluxed for 2 h. The mixture was diluted with water, the product taken into ether, and the ethereal solution was worked up. The residue (440 mg) was crystallized from methanol to yield 330 mg of the diol *X*, m.p. 171–173°C, $[\alpha]_D^{20}$ −67° (*c* 0·81). IR spectrum: 3615, 1058, 1048 (hydroxyl), 3065 cm^{-1} (cyclopropane). ^{1}H-NMR spectrum: −0·21 to −0·03 and 0·38–0·77 (two mt, cyclopropane protons), 0·80 and 0·82 (two s, 18-H and 19-H), 3·32–3·96 (mt, 3α-H and 17α-H). For $C_{20}H_{32}O_2$ (304·5) calculated: 78·89% C, 10·60% H; found: 78·82% C, 10·67% H.

6α,7α-Cyclopropano-5α-androstane-3β,17β-diol 17-Monobenzoate (*XI*)

a) *From* 6α,7α-*cyclopropano*-5α-*androstane*-3β,17β-*diol* 3-*acetate* 17-*benzoate* (XII): A solution of the acetate *XII* (1 g) in chloroform (15 ml) and methanol (60 ml) was treated with concentrated hydrochloric acid (1·2 ml) and allowed to stand at 22°C for 20 h. The solvents were partly removed *in vacuo* and the residue was diluted with water. The product was extracted with ethyl acetate, the extract was worked up, and the residue was crystallized from methanol to yield 720 mg of the diol *XI*, m.p. 174–176°C, $[\alpha]_D^{20}$ −18° (*c* 1·24). IR spectrum: 3065 (cyclopropane), 3625 (hydroxyl), 1722, 1278 cm^{-1} (benzoate). ^{1}H-NMR spectrum: −0·14 to −0·01 and 0·47 to 0·64 (two mt, cyclopropane protons), 0·82 (s, 19-H), 0·96 (s, 18-H), 3·45 (s, hydroxyl), 3·52 (mt, $W_{1/2}$ = 20 Hz, 3α-H), 4·84 (mt, $W_{1/2}$ = 27 Hz, 17α-H), 7·29–7·62 and 7·95–8·18 (two mt, 17β-benzoate). For $C_{27}H_{36}O_3$ (408·6) calculated: 79·37% C, 8·88% H; found: 79·42% C, 9·36% H.

b) *From* 17β-*benzoyloxy*-6α,7α-*cyclopropano*-5α-*androstan*-3-*one* (IX): Further elution of the chromatography after isolation of the 3α-epimer *XIV* with the same solvent mixture afforded fractions with the polar component. Working up and crystallization from methanol yielded 485 mg of the alcohol *XI*, m.p. 172–175°C, $[\alpha]_D^{20}$ −18° (*c* 1·16).

6α,7α-Cyclopropano-5α-androstane-3β,17β-diol 3-Acetate 17-Benzoate (*XII*)

The Zn–Cu couple (0·7%) was prepared by adding zinc dust (5·2 g) into a solution of cupric acetate monohydrate (119 mg) in acetic acid (5 ml) at 50–60°C, shaking until the solution decolorized, and decanting the metal with eight portions of ether (5 ml each). A solution of the olefin *VII* (1·5 g) in ether (15 ml) was treated with diiodomethane (4·6 ml) in ether (10 ml) and heated with the couple in a 100 ml autoclave for 7 h in boiling water bath. After standing overnight at room temperature the couple was filtered off, washed with ether, and the filtrate was poured into 5% potassium hydrogen carbonate solution. The ethereal layer was washed with water, 5% hydrochloric acid, 5% sodium hydrogen carbonate, 10% sodium thiosulphate, water, dried, and solvent was removed *in vacuo*. The residue was chromatographed on a silica gel column (50 g) in ligroin–ether (4 : 1). Fractions corresponding in their polarity to the starting material were combined and evaporated to yield 1 g of an oily product. It was dissolved in ether (15 ml) and treated with a solution of perphthalic acid (1·4 g) in ether (18 ml) and allowed to stand at room temperature for 20 h. The excess peracid was extracted with 5% sodium carbonate solution, washed with water, dried, and ether distilled off. The residue (0·92 g) was chromatographed over silica gel (50 g) in ligroin–ether (9 : 1). Fractions with the lipophilic component were worked up and the residue (265 mg) was crystallized from methanol to yield 182 mg of the cyclopropano derivative *XII*, m.p. 92–96°C, $[\alpha]_D^{20}$ −1° (*c* 1·83). IR spectrum: 3070 (cyclopropane), 1733, 1249 (acetate), 1728, 1278 cm^{-1} (benzoate). Mass spectrum: M^+ 450. ^{1}H-NMR spectrum: −0·19–0·01 and 0·27–0·63 (two mt, cyclopropane protons), 0·83 (s, 19-H), 0·95 (s, 18-H), 2·00 (s, 3β-acetate), 4·32–5·01 (mt, 3α-H and 18α-H), 7·36–7·62 and 7·95–8·22 (two mt, 17β-benzoate). For $C_{29}H_{38}O_4$ (450·6) calculated: 77·30% C, 8·50% H; found: 77·44% C, 8·07% H.

6α,7α-Cyclopropano-5α-androstane-3,17-dione (*XIII*)

a) *From* 6α,7α-*cyclopropano*-5α-*androstan*-3β,17β-*diol* (X): A solution of the diol *X* (250 mg in acetone (40 ml) was treated with excess Jones' reagent and allowed to stand at room temperature for 10 min. The excess reagent was removed with methanol, the reaction mixture was diluted with water, and the product was taken into ether. The ethereal solution was washed with a sodium hydrogen carbonate solution, water, dried, and solvent removed. The residue was crystallized from methanol to yield 170 mg of the dione *XIII*, m.p. 172–174°C, $[\alpha]_D^{20}$ +39° (*c* 0·92). IR spectrum: 3070 (cyclopropane), 1742, 1719 cm^{-1} (carbonyl groups). ^{1}H-NMR spectrum: 0·38–0·72 (mt, cyclopropane protons), 0·96 (s, 18-H), 1·05 (s, 19-H). For $C_{20}H_{28}O_2$ (300·4) calculated: 79·95% C, 9·39% H; found: 79·62% C, 9·32% H.

b) *From* 17β-*hydroxy*-6α,7α-*cyclopropano*-5α-*androstan*-3-*one* (VIII): The alcohol *VIII* (80 mg) in acetone (5 ml) was oxidized with Jones' reagent as described above. Similar working up and crystallization from methanol gave 42 mg of the dione *XIII*, m.p. 170–174°C, $[\alpha]_D^{20}$ +38° (*c* 1·12).

6α,7α-Cyclopropano-5α-androstane-3α,17β-diol 17-Benzoate (*XIV*)

A solution of the ketone *IX* (720 mg) in ethyl acetate (400 ml) was treated with lithium tri-tert-butoxyaluminium hydride (1·5 g) and allowed to stand at room temperature for 10 min. The excess hydride was decomposed with water and 2% hydrochloric acid and the product taken into ethyl acetate. Working up and evaporation of the solvent afforded 700 mg of a mixture containing two products which were separated by column chromatography over silica gel (200 g) in ligroin–ether (9 : 1). Fractions with the lipophilic component were worked up and the resi-

due after evaporation of the solvents (17 mg) was crystallized from methanol to yield 8·5 mg of the alcohol *XIV*, m.p. 212–215°C, $[\alpha]_D^{20}$ +5° (*c* 0·78). IR spectrum: 3630 (hydroxyl), 3065 (cyclopropane), 1721, 1278 cm^{-1} (benzoate). ^{1}H-NMR spectrum: 0·44–0·69 (mt, cyclopropane protons), 0·74 (s, 19-H), 0·91 (s, 18-H), 4·01 (mt, $W_{1/2}$ = 7·5 Hz, 3β-H), 4·82 (mt, $W_{1/2}$ = 18 Hz, 17α-H), 7·32–7·56 and 7·90–8·14 (two mt, 17β-benzoate). For $C_{27}H_{36}O_3$ (408·6) calculated: 79·37% C, 8·88% H; found: 79·20% C, 8·86% H.

The analyses were carried out in the Analytical Laboratory of this Institute by Mrs E. Sýkorová, Mrs V. Rusová, Mrs E. Šípová and Mrs A. Froňková under the direction of Dr J. Horáček. The infrared spectra were recorded by Mrs K. Matoušková and Mr P. Formánek under the direction of Dr J. Smolíková. The mass spectrum was recorded by Dr A. Trka. ^{1}H-NMR *spectra were recorded by Dr M. Synáčková, Mrs J. Jelínková and Mrs M. Snopková. Technical assistance was provided by Mrs J. Mašková.*

REFERENCES

1. Kohout L., Fajkoš J.: This Journal *40*, 3924 (1975).
2. Joska J., Fajkoš J., Šorm F.: This Journal *26*, 1646 (1961).
3. Arnold K., Meister K., Englert G.: Helv. Chim. Acta *57*, 1559 (1974).

Translated by the author (J. F.).