Tetrahedron Vol 23, pp 4111 to 4116 Pergamon Press Ltd 1967 Printed in Great Britain

MODIFIED STEROID HORMONES—XLVIII[1]

A NEW ROUTE TO 17α-BROMOETHYNYL- AND 17α-IODOETHYNYL-17β-HYDROXY STEROIDS

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(*Received* 31 *January* 1967; *accepted for publication* 17 *February* 1967)

Abstract Treatment of the lithium derivatives of 17α-ethynyl steroids with bromotrifluoromethane or heptafluoro-1-iodopropane in liquid ammonia afforded, respectively, the corresponding 17α-bromoethynyl or 17α-iodoethynyl steroids in satisfactory yields.

IN EARLIER studies[2,3] on 17α-chloroethynyl-17β-hydroxy steroids we obtained compounds with interesting hormonal properties.[4] Thus, for example, 17α-chloroethynyl-3,17β-dimethoxy-1,3,5(10)-oestratriene proved to have an improved claudogenic oestrogenic index over the parent ethynyl steroid. We therefore extended the work to include novel 17α-bromoethynyl and 17α-iodoethynyl types, examples of which were described in an earlier publication.[3]

Previous workers have employed a variety of reagents to achieve terminal halogenation of ethynyl groups, including alkali-metal hypohalites, organic hypohalites, organic N-halo compounds, free halogens, organic sulphonyl halides and cyanogen bromide.[3,5-12] These reactions generally proceed by an ionic mechanism which may require preliminary formation of a metallic derivative of the ethyne. Thus, for example, the reaction between a lithium ethyne and bromine may be written:

$$R\cdot\ C\equiv C^{(-)}Li^{(+)} + Br^{(\delta-)}—Br^{(\delta+)} \rightarrow R\ \ C\equiv CBr + Li^{(+)}Br^{(-)} \ldots \text{(i)}$$

(where R is an alkyl group).

It is a characteristic of such halogenating agents that the entering halogen atom derives positive character from an electron-attracting atom or group to which it is attached.

[1] Part XLVII, J. M. Allison, D. Burn, F. K. Butcher, M. T. Davies and V. Petrow, *Tetrahedron* **23**, 1515 (1967).
[2] C. Burgess, D. Burn, J. W. Ducker, B. Ellis, P. Feather, A. K. Hiscock, A. P. Leftwick, J. S. Mills and V. Petrow, *J. Chem. Soc.* 4995 (1962).
[3] C. Burgess, D. Burn, P. Feather, M. Howarth and V. Petrow, *Tetrahedron* **22**, 2829 (1966).
[4] J. P. Bennett, K. E. Kendle, D. K. Vallance and B. H. Vickery, *Acta Endocrinol.* **53**, 443 (1966).
[5] F. Straus, L. Kollek and W. Heyn, *Ber. Dtsch. Chem. Ges.* **63**, 1868, (1930).
[6] J. H. Fried, T. S. Bry, A. E. Oberster, R. E. Beyler, T. B. Windholz, J. Hannah, L. H. Sarett and S. L. Steelman, *J. Am. Chem. Soc.* **83**, 4663 (1961).
[7] P. L. Southwick and J. R. Kirchner, *J. Org. Chem.* **27**, 3305 (1962).
[8] T. H. Vaughn and J. A. Nieuwland, *J. Am. Chem. Soc.* **55**, 2150 (1933).
[9] P. A. McCusker and R. R. Vogt, *J. Am. Chem. Soc.* **59**, 1307 (1937).
[10] E. Kloster-Jensen, *Tetrahedron* **22**, 965 (1966).
[11] V. Grignard, F. Bellet and C. Courtot, *Annales de Chimie* **4**, 28 (1915).
[12] R. Truchet, *Annales de Chimie* **16**, 309 (1931).

It is known that the inductive effect of the fluorine atoms in perfluoroalkyl bromides and iodides enforces relative positive character upon the bromine or iodine atoms present in these compounds. From analogy with Eq. (i), it seemed possible that this situation might be exploited to provide a novel route to the haloethynes, as indicated in Eq. (ii):

$$R-C\equiv C^{(-)}Li^{(+)} + CF_3{}^{(-)}Br^{(+)} \rightarrow R-C\equiv CBr + CF_3{}^{(-)}Li^{(+)} \quad \text{...(ii)}$$

(where R is a steroidal moeity).

Accordingly, the lithium derivatives of some 17α-ethynyl steroids, obtained by reacting the parent ethynes with lithamide in liquid ammonia, were treated with a perfluoroalkyl bromide or iodide. In each case, the desired 17α-bromoethynyl- and 17α-iodoethynyl-steroids were formed, generally in favourable yield. Further study indicated that this novel method of preparing bromo- and iodo-ethynes may be of general application. It may thus find utility outside the steroidal field.

Bromotrifluoromethane and heptafluoro-1-iodopropane were the perfluoroalkyl halides of choice on grounds of cost and availability. It may be expected, moreover, that other perfluoroalkyl halides will prove to be equally suitable.

Unchanged steroidal starting material was recovered from an attempt to apply the reaction directly to a 17α-ethynyl-17β-hydroxy steroid and it was found necessary to protect the 17β-hydroxy group by tetrahydropyranyl ether formation and subsequent regeneration. 4-En-3-one groups were protected as ketals and subsequently regenerated.

The following 17α-ethynyl steroids used as starting materials are believed to be new: 17α-ethynyl-17β-methoxy-4-methyl-1,3,5(10)-oestratriene (I, X = H) was prepared by methylating the 17β-ol[13] with sodamide and methyl iodide in liquid ammonia;[3, 14] 3,3-ethylenedioxy-17α-ethynyl-6-methyl-5-androsten-17β-ol (IV, X = H, R = H, R′ = Me) was prepared from the appropriate 4-androsten-3-one,[15] and converted into the 17β-tetrahydropyranyl ether (IV, X = H, R = C_5H_9O, R′ = Me).

Using the above procedure, the following have been prepared: 17α-bromoethynyl steroids (I, X = Br; II,[3] X = Br, R = Me; II, X = Br, R = H; III,[16] X = Br, R = H, R′ = H; V,[16] X = Br, R = H) and 17α-iodoethynyl steroids (I, X = I; II,[3] X = I, R = Me; III, X = I, R = H, R′ = H; III, X = I, R = H, R′ = Me; V, X = I, R = H).

An experiment in which bromotrichloromethane was used in place of bromotrifluoromethane gave the 17α-bromoethynyl steroid in low yield.

An attempt to extend this type of reaction to the preparation of 17α-chloroethynyl steroids proved unsuccessful. When chlorotrifluoromethane was employed as a chlorinating agent, the steroidal starting-material was recovered unchanged. Although the CF_3 group in chlorotrifluoromethane is known to possess electronegative character relative to the chlorine atom,[17] chlorotrifluoromethane is much less

[13] Brit. Pat. 928,897
[14] Ger. Pat. 1,062,698
[15] M. Ackroyd, W. J. Adams, B. Ellis, V. Petrow and I. A. Stuart-Webb, *J. Chem. Soc.* 4099 (1957).
[16] cf. US Pat. 3,067,214, 3,092,622, 3,100,204, 3,121,079, 3,211,725.
[17] J. J. Lagowski, *Quart. Rev.* 13, 233 (1959).

reactive than its bromo analogue.[18] In addition, the halide is gaseous at the reaction temperature (b.p.[19] −82°) and is of low solubility in the solvents used, so that its failure to react was not entirely unexpected.

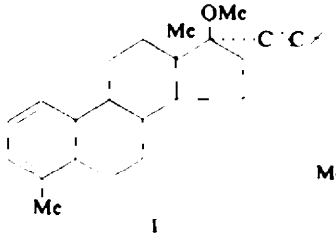
The formation of bromoethynyl and iodoethynyl compounds according to Eq. (ii) resembles the reaction of heptafluoro-1-iodopropane with phenyl magnesium bromide[20] or with methyl, n-butyl and phenyl lithium[21] in which, in addition to a perfluoroalkyl organometallic derivative, the corresponding phenyl or alkyl halide is formed:

$$C_6H_5MgBr + C_3F_7I \rightarrow C_3F_7MgBr + C_6H_5I \quad \ldots(iii)$$

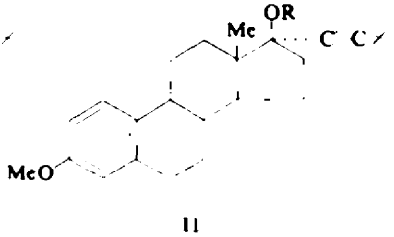
$$\text{e.g.} \quad LiMe + C_3F_7I \rightarrow LiC_3F_7 + MeI \quad \ldots(iv)$$

The liquid ammonia used as reaction medium has a high dielectic constant and would consequently increase the tendency of the perfluoroalkyl halides to participate in ionic reactions.

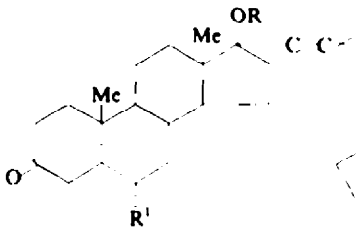
The reaction (ii) of a steroidal lithium derivative with a perfluoroalkyl bromide or



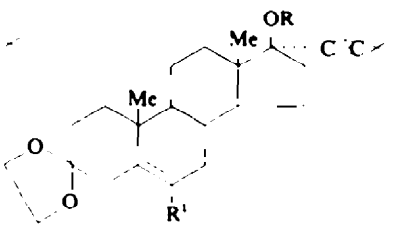
I



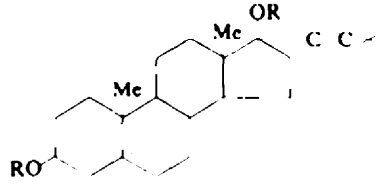
II



III



IV



V

[18] J. W. Hodgins and R. L. Haines, *Canad. J. Chem.* **30**, 4733 (1952). For the reaction between sodium and iodo-, bromo-, and chlorotrifluoromethane, the activation energy is shown to be 1·7, 2·3, and 7·4 kcl. per mole, respectively.

[19] O. Ruff and R. Keim, *Z. anorg. u. allgemein. Chem.* **201**, 245 (1931).

[20] O. R. Pierce, A. F. Meiners and E. T. McBee, *J. Am. Chem. Soc.* **75**, 2516 (1953).

[21] O. R. Pierce, E. T. McBee and G. F. Judd, *J. Am. Chem. Soc.* **76**, 474 (1954).

iodide may therefore be envisaged as a nucleophilic attack by the steroidal ethynyl anion upon the relatively positive bromine or iodine atom.

Solid 17α-bromoethynyl-17β-hydroxy and 17β-alkoxy steroids were, in general, stable at room temperature. Some of the 17α-iodoethynyl-17β-hydroxy and 17β-alkoxy steroids showed some decomposition when stored at room temperature in the dark for a few months.

17α-Iodoethynyl steroids passed readily into the corresponding 17α-ethynyl steroids, for example when treated with pyridine. Their acetylation was achieved, however, by use of acetic acid, acetic anhydride and *p*-toluenesulphonic acid.

EXPERIMENTAL

UV absorption spectra (in EtOH), IR absorption spectra and optical rotations were determined under the supervision of Mr. M. T. Davies, B.Sc., FRIC.

General procedure for the preparation of 17α-*bromoethynyl and* 17α-*iodoethynyl steroids*

Lithium (0·05 g) and a trace of $Fe(NO_3)_3$ were added to anhyd liquid NH_3 (100 ml) and the mixture was stirred under reflux until the blue colour disappeared. The 17α-ethynyl steroid (1·00 g) in anhyd THF (25–75 ml) was added and the mixture stirred under reflux for between 15 min and 2 hr. In preparing 17α-bromoethynyl steroids, a slow stream of bromotrifluoromethane (approximately 10 g) was then passed into the stirred, refluxing solution during 2–3 hr. In preparing 17α-iodoethynyl steroids, heptafluoro-1-iodopropane (5 g) in anhyd THF (50 ml) was added slowly and the mixture was stirred under reflux for a further 3–4 hr.

The reaction mixture was cautiously poured onto ice, or, after evaporation of the ammonia, ammonium chloride and water were added. The crude steroidal product was isolated by filtration or by extraction with ether.

17α-*Bromoethynyl*-3,17β-*dimethoxy*-1,3,5(10)-*oestratriene*[9] (II, X = Br, R = Me). (A) This compound was prepared by reacting 17α-ethynyl-3,17β-dimethoxy-1,3,5(10)-oestratriene[14] with $CBrF_3$ and crystallized from MeOH in plates (yield = 73%), m.p. 131° not depressed on admixture of a sample prepared[9] using N-bromo-succinimide as brominating reagent. (B) 17α-Ethynyl-3,17β-dimethoxy-1,3,5(10)-oestratriene (5·0 g) was reacted with lithamide (from 0·25 g of Li) and $CBrCl_3$ (16·6 g) by a similar procedure. The product was separated from unreacted steroidal starting-material by TLC on silica-gel (pretreated with $AgNO_3$[22]) and crystallized from MeOH, affording 20% of II (X = Br, R = Me), m.p. 128–129° not depressed on admixture of a sample prepared by method (A).

17α-*Bromoethynyl*-3-*methoxy*-1,3,5(10)-*oestratrien*-17β-*ol* (II, X = Br, R = H), prepared by reaction of 17α-ethynyl-3-methoxy-17β-(tetrahydro-2-pyranyloxy)-1,3,5(10)-oestratriene[23] (19·12 g) with $CBrF_3$, followed by treatment with conc HCl (0·4 ml) in EtOH (400 ml), warming gently, was purified from aqueous EtOH as minute grains (yield, 17·8 g = 94%), m.p. 167·5°; $[\alpha]_D^{23}$ −15° (*c*, 1·20 in dioxan); λ_{inf} 218 mμ (*ε*, 8910); λ_{max} 278 mμ (*ε*, 2070), 287 mμ (*ε*, 1970); $\nu_{max}^{CCl_4}$ 3600 cm^{-1} (OH), 2185 cm^{-1} (C≡C) (Found: C, 65·1; H, 6·6. $C_{21}H_{23}BrO_2$ requires: C, 64·8; H, 6·5%).

17α-*Ethynyl*-17β-*methoxy*-4-*methyl*-1,3,5(10)-*oestratriene** (I, X = H). Sodamide was prepared from Na (0·70 g) and a trace of $Fe(NO_3)_3$ in liquid NH_3 (250 ml) and the stirred mixture was cooled to −60°. 17α-Ethynyl-4-methyl-1,3,5(10)-oestratrien-17β-ol[13] (6·00 g) in anhyd THF (100 ml) was added, followed by MeI (4·8 g) in THF (10 ml). The mixture was stirred for 3½ hr and poured onto ice. The ppt was collected and purified by chromatography on alumina, eluting the steroidal product with toluene, and unreacted starting-material (3·21 g) with ether. Crystallization from MeOH afforded needles (yield 2·52 g = 86% based on 17β-ol consumed), m.p. 149°; $[\alpha]_D^{24}$ −10° (*c*, 0·9 in $CHCl_3$); λ_{inf} 219 mμ (*ε*, 9040), 260 mμ (*ε*, 210); λ_{max} 263 mμ (*ε*, 234), 270 mμ (*ε*, 161), $\nu_{max}^{CCl_4}$ 3300 cm^{-1} (≡CH), 1098 cm^{-1} (C–O) (Found: C, 85·9; H, 8·95. $C_{22}H_{28}O$ requires: C, 85·7; H, 9·15%).

17α-*Bromoethynyl*-17β-*methoxy*-4-*methyl*-1,3,5(10)-*oestratriene** (I, X = Br), prepared from the fore-

* Preparation by Mr. J. V. Syms of this Department.

[22] A. Ercoli, R. Vitali and R. Gardi, *Steroids* **3**, 479 (1964).

[23] A. D. Cross, I. T. Harrison, F. A. Kincl, F. Farkas, R. Kraay and R. I. Dorfman, *Steroids* **4**, 423 (1964).

going compound, was purified from MeOH as hexagonal plates (yield = 83%), m.p. 122·5°; $[\alpha]_D^{29}$ −26° (*c*, 0·80 in $CHCl_3$); λ_{max} 262 mμ (ε, 232); λ_{inf} 269 mμ (ε, 181), $\nu_{max}^{CCl_4}$ 2193 cm^{-1} (C≡C); $\nu_{max}^{CS_2}$ 1095 cm^{-1} (C–O). (Found: C, 67·6; H, 7·1; Br, 21·1. $C_{22}H_{29}BrO$ requires: C, 68·2; H, 7·0; Br, 20·6%.)

17α-*Bromoethynyl*-5-*androsten*-3β,17β-*diol*[16] (V, X = Br, R = H), prepared by reaction of 3β,17β-bis-(tetrahydro-2-pyranyloxy)-17α-ethynyl-5-androstene[24] (14·70 g) with $CBrF_3$ according to the general procedure, followed by treatment with 4N HCl (10 ml) in MeOH (1500 ml) at room temp for 1 hr, was purified from aqueous MeOH (yield, 8·64 g = 72%), m.p. 209° (dec.), $[\alpha]_D^{25}$ −97° (*c*, 0·96 in dioxan); $\nu_{max}^{CH_2Cl_2}$ 3590 cm^{-1} (OH); ν_{max}^{Nujol} 2180 cm^{-1} (C≡C). (Found: C, 64·3; H, 7·4; Br, 20·8. $C_{21}H_{29}BrO_2$ requires: C, 64·1; H, 7·4; Br, 20·3%.)

17α-*Bromoethynyl*-17β-*hydroxy*-4-*androsten*-3-*one*[16,†] (III, X = Br, R = H, R′ = H) was prepared by application of the general procedure to 3,3-ethylenedioxy-17α-ethynyl-17β-(tetrahydro-2-pyranyloxy)5-androstene[24] followed by treatment in MeOH with 3N HCl with gentle heating, and purified from acetone–hexane and ether (yield = 42%), m.p. 181°; $[\alpha]_D^{25}$ −5·5° (*c*, 0·67 in dioxan); λ_{max} 244 mμ (ε, 16,200). (Found: C, 64·5; H, 7·1; Br, 20·4. $C_{21}H_{27}BrO_2$ requires: C, 64·45; H, 7·0; Br, 20·4%.)

3,17β-*Dimethoxy*-17α-*iodoethynyl*-1,3,5(10)-*oestratriene*[3] (II, X = I, R = Me), prepared from 3,17β-dimethoxy-17α-ethynyl-1,3,5(10)-oestratriene,[14] was purified by chromatography on silica-gel, eluting with toluene, and by crystallization from aqueous MeOH as needles (yield = 52%), m.p. 120°, not depressed on admixture of a sample prepared[3] using the morpholine iodine adduct.

17α-*Iodoethynyl*-17β-*methoxy*-4-*methyl*-1,3,5(10)-*oestratriene*[*] (I, X = I), prepared from 17α-ethynyl-17β-methoxy-4-methyl-1,3,5(10)-oestratriene was purified by chromatography on alumina, eluting with toluene, and by crystallization from aqueous MeOH as hexagonal plates (yield = 93%), m.p. 166·5°; $[\alpha]_D^{26}$ −30° (*c*, 0·73 in $CHCl_3$), λ_{max} 219 mμ (ε, 9250), 261 mμ (ε, 432), 269 mμ (ε, 314); $\nu_{max}^{CCl_4}$ 2171 cm^{-1} (C≡C), 1099 cm^{-1} (C–O). (Found: C, 60·9; H, 6·6; I, 28·5. $C_{22}H_{29}IO$ requires: C, 60·8; H, 6·3; I, 29·2%.)

3β-17β-*Bis*(*tetrahydro*-2-*pyranyloxy*)-17α-*iodoethynyl*-5-*androstene* (V, X = I, R = C_5H_9O) prepared from the 17α-ethynyl analogue,[24] was purified from MeOH as prisms (yield = 64%), m.p. 147·5°; $[\alpha]_D^{24}$ −127° (*c*, 0·83 in dioxan); $\nu_{max}^{CCl_4}$ 2161 cm^{-1} (C≡C). (Found: C, 61·0; H, 7·35; I, 21·2. $C_{31}H_{45}IO_4$ requires: C, 61·2; H, 7·45; I, 20·85%.)

17α-*Iodoethynyl*-5-*androstene*-3β,17β-*diol*, (V, X = I, R = H), prepared from the foregoing compound (0·51 g) by treatment in EtOH (10 ml) with conc HCl (0·02 ml) with gentle heating, was purified from aqueous EtOH as blades, m.p. 186° (dec); $[\alpha]_D^{25}$ −120° (*c*, 0·83 in dioxan); ν_{max}^{Nujol} 3560, 3360 cm^{-1} (OH), 2157 cm^{-1} (C≡C). (Found: C, 57·0; H, 6·8; I, 28·6. $C_{21}H_{29}IO_2$ requires: C, 57·3; H, 6·6; I, 28·8%.)

3β,17β-*Diacetoxy*-17α-*iodoethynyl*-5-*androstene* (V, X = I, R = Ac), prepared by treating the foregoing compound with AcOH, Ac_2O and *p*-toluenesulphonic acid at room temp for 3 hr, was purified from MeOH as prisms, m.p. 149°; $[\alpha]_D^{24}$ −105° (*c*, 0·51 in dioxan); $\nu_{max}^{CCl_4}$ 2170 cm^{-1} (C≡C), 1745, 1735 cm^{-1} (C–O). (Found: C, 57·95; H, 6·3. $C_{25}H_{33}IO_4$ requires: C, 57·25; H, 6·3%.)

3,3-*Ethylenedioxy*-17α-*iodoethynyl*-5-*androsten*-17β-*ol* (IV, X = I, R = H, R′ = H) was obtained directly by application of the general procedure to 3,3-ethylenedioxy-17α-ethynyl-17β-(tetrahydro-2-pyranyloxy)-5-androstene[24] followed by crystallization from acetone–hexane containing a trace of pyridine, as prisms (yield = 86%), m.p. 140° (dec); $[\alpha]_D$ −80° (*c*, 0·73 in dioxan); ν_{max}^{Nujol} 3360 cm^{-1} (OH); 2159 cm^{-1} (C≡C). (Found: C, 56·95; H, 6·5; I, 25·7. $C_{23}H_{31}IO_3$ requires: C, 57·3; H, 6·5; I, 26·3%.)

3,3-*Ethylenedioxy*-17α-*iodoethynyl*-17β-(*tetrahydro*-2-*pyranyloxy*)5-*androstene* (IV, X = I, R = C_5H_9O, R′ = H) was obtained in an attempted repetition of the above preparation as prisms (yield = 21%), m.p. 96°; $[\alpha]_D^{30}$ −86° (*c*, 0·69 in dioxan). (Found: C, 55·8; H, 6·9; I, 22·8. $C_{28}H_{39}IO_4$ requires: C, 55·4; H, 6·6; I, 22·4%.)

17α-*Iodoethynyl*-17β-*hydroxy*-4-*androsten*-3-*one* (III, X = I, R = H, R′ = H) was prepared from the foregoing 3,3-ethylenedioxy compounds by treatment in EtOH with conc HCl (trace), with gentle heating, and purified from aqueous EtOH as flat needles (yield = 70%), m.p. 155° (dec); $[\alpha]_D^{24}$ −17° (*c*, 0·80 in dioxan); λ_{max} 240 mμ (ε, 16,500); ν_{max}^{Nujol} 3320 cm^{-1} (OH), 2160 cm^{-1} (C≡C). (Found: C, 57·35; H, 6·4; I, 28·6. $C_{21}H_{27}IO_2$ requires: C, 57·5; H, 6·2; I, 28·95%.)

3,3-*Ethylenedioxy*-17α-*ethynyl*-6-*methyl*-5-*androsten*-17β-*ol* (IV, X = H, R = H, R′ = Me) was prepared by heating a mixture of benzene (500 ml), ethylene glycol (12 ml), III,[15] (X = H, R = H, R′ = Me; 10 g) and *p*-toluenesulphonic acid (0·2 g) under reflux for 4 hr with continuous removal of water. The cooled soln was neutralized, washed, dried, and freed from solvent at reduced press. Crystallization of the residue from MeOH containing a trace of pyridine afforded prisms, m.p. 186°; $[\alpha]_D^{25}$ −92° (*c*, 1·17 in $CHCl_3$);

† Preparation by Mr. G. H. Jess of this Department.

[24] S. P. Barton, D. Burn, G. Cooley, B. Ellis and V. Petrow, *J. Chem. Soc.* 1957 (1959).

ν_{max}^{Nujol} 3410 cm^{-1} (OH), 3220 cm^{-1} (≡CH). (Found: C, 77·6; H, 9·1. $C_{24}H_{34}O_3$ requires: C, 77·8; H, 9·25%.)

3,3-*Ethylenedioxy*-17α-*ethynyl*-6-*methyl*-17β-(*tetrahydro*-2-*pyranyloxy*)-5-*androstene* (IV, X = H, R = C_5H_9O, R' = Me) was obtained by treating the foregoing compound (2·0 g) in anhyd THF (100 ml) with 2,3-dihydropyran (5 ml) and $POCl_3$ (0·04 ml) at room temp for 2½ hr. The steroidal product was isolated by pouring the reaction mixture into $NaHCO_3$ aq and purified from aqueous acetone containing a trace of pyridine as needles, m.p. 105·5°, $[\alpha]_D^{24}$ −98° (*c*, 0·60 in $CHCl_3$). (Found: C, 76·3; H, 9·4. $C_{29}H_{42}O_4$ requires: C, 76·6; H, 9·3%.)

3,3-*Ethylenedioxy*-17α-*iodoethynyl*-6-*methyl*-17β-(*tetrahydro*-2-*pyranyloxy*)-5-*androstene* (IV, X = I, R = C_5H_9O, R' = Me), prepared from the foregoing compound, was crystallized from aqueous acetone containing a trace of pyridine as needles (yield = 53%), m.p. 139° (dec); $[\alpha]_D^{24}$ −88° (*c*, 1·04 in dioxan); $\nu_{max}^{CCl_4}$ 2170 cm^{-1} (C≡C). (Found: C, 59·7; H, 7·1; I, 21·85. $C_{29}H_{41}IO_4$ requires: C, 60·0; H, 7·1; I, 21·9%.)

17α-*Iodoethynyl*-6α-*methyl*-4-*androsten*-17β-*ol*-3-*one* (III, X = I, R = H, R' = Me), prepared from the foregoing compound by treatment in EtOH with conc HCl (trace) with gentle heating, was crystallized from aqueous EtOH as flat needles, m.p. 145·5° (dec), $[\alpha]_D^{24}$ −19° (*c*, 0·97 in dioxan); λ_{max}^{EtOH} 240 mμ (ε, 15,400); ν_{max}^{Nujol} 3270 cm^{-1} (OH), 2155 cm^{-1} (C≡C), 1667 cm^{-1} (C=O), 1608 cm^{-1} (Δ4). (Found: C, 58·15; H, 6·4; I, 28·6. $C_{22}H_{29}IO_2$ requires: C, 58·4; H, 6·5; I, 28·1%.)