EXPERIMENTAL WORK

The melting points reported are uncorrected. Most of the microanalyses and optical rotations were performed by Drs. G. Weiler and F. B. Strauss (now Dr. F. B. Strauss) Microanalytical Laboratory, Oxford, U.K., and some were done at the microanalytical laboratories of G. D. Searle & Co., Chicago, U.S.A., and Ciba Research Center, Bombay. The optical rotations were measured in chloroform. Alumina for chromatography acc. Brockmann (S. Merck) was used in column chromatography. Plates for TLC were prepared with silica gel G acc. to Stahl (E. Merck) and activated at 110° for 30 min. The plates were developed by exposure to iodine vapours. Thionyl chloride and dioxan were purified before use. Anhydrous sodium sulfate was utilized as drying agent.

The author has been the first to carry out the reactions and to synthesize the compounds marked with an asterisk (*).

17-0XO-5-ANDROSTEN-3β-YL ACETATE (22)

A solution of 3β-hydroxy-5-androsten-17-one (21) (10 g) in dry pyridine (20 ml) and acetic anhydride (10 ml) was heated on a steam bath for 2 hr and poured into water (600 ml) with stirring. The separated solid was filtered at the pump, washed
freely with water, and recrystallized (dil MeOH); yield 10 g (90%), mp 169-171° (lit193 171-172° cor).

17-OXIMINO-5-ANDROSTEN-3β-YL ACETATE (23)

A solution of sodium acetate trihydrate (31.0 g) and hydroxylamine hydrochloride (12.28 g) in water (152 ml) was added to a refluxing solution of 17-oxo-5-androsten-3β-y1 acetate (22) (12.5 g) in aldehyde free ethanol (385 ml). After 4 hr, the refluxing solution was gradually diluted with water (385 ml) and allowed to cool. The separated crystals were filtered at the pump, washed with 30% aq ethanol (60 ml) and allowed to dry; yield 12.5 g (95%), mp 184-185° (lit147 162-163°, dil MeOH).

17-OXO-17a-aza-D-HOMO-5-ANDROSTEN-3β-YL ACETATE (24)

A mixture of thionyl chloride (10 ml) and dioxan (50 ml) was added dropwise to a stirred solution of 17-oximo-5-androsten-3β-y1 acetate (23) (20.0 g) in thiophene-free benzene (350 ml) at 15-17°. After 15 min at 20°, water (~45 ml) was added with stirring to the cooled reaction mixture which was then basified by addition of a dilute solution of ammonia (90 ml). The organic layer was separated and the aqueous layer extracted with chloroform (3 x 50 ml). The combined organic layer was washed with water, dried and the solvent removed under reduced pressure. The brownish crystalline residue so obtained, was recrystallized (MeOH); yield 12.0 g (60%), mp 292-294° (lit146 289-292°).
3β-HYDROXY-17α-AZA-D-HOMO-5-ANDROSTEN-17-ONE (25)

A solution of 17α-aza-17-oxo-D-homo-5-androsten-3β-yl acetate (24) (22.0 g) in methanol (330 ml) containing potassium hydroxide (4.6 g) was refluxed for 70 min. The reaction mixture was acidified with glacial acetic acid (4.6 ml) and concentrated to induce crystallization. The separated crystals were washed with 40% aq methanol (~90 ml) and crystallized twice (MeOH-CH₂Cl₂); yield 18.0 g (93%), mp 298-300° (lit**6 295-297°).

17α-AZA-D-HOMO-4-ANDROSTEN-3,17-DIONE (26)

A solution of 3β-hydroxy-17α-aza-D-homo-5-androsten-17-one (25) (7.2 g) in cyclohexanone (72 ml), dioxan (300 ml) and dry toluene (255 ml), was slowly distilled as a solution of aluminum isopropoxide (7.2 g) in toluene (36 ml) was added gradually. Distillation was continued for 2 hr as more toluene (180 ml) was added and 480 ml of distillate collected. The reaction mixture was then refluxed for 8 hr, allowed to stand over-night at room temperature and filtered. The filtrate was steam-distilled until complete removal of organic solvents was effected. The aqueous suspension was extracted with chloroform (3 x 50 ml). The combined chloroform layer was washed with water, dried, and the solvent removed under reduced pressure. The creamy semicrystalline residue was recrystallized (EtOAc); yield 5.6 g (78%), mp 261-263° (lit**6 261-263°).
Anal.:  
UV max (MeOH): 240 nm (ε 16,200) (lit 146 240 nm, ε 16,600)  
Calcd for C₁₉H₂₇NO₂: C, 75.75; H, 8.97; N, 4.65. Found:  
C, 75.72; H, 9.09; N, 4.49.

3-OXIMINO-17a-AZA-D-HOMO-4-ANDROSTEN-17-ONE (27)*

A solution of 17a-aza-D-homo-4-androstene-3,17-dione (26) (2.0 g) and hydroxylamine hydrochloride (0.7 g) in pyridine (16.5 ml) containing water (0.35 ml) was heated on a steam bath for 100 min and gradually poured into iced water (~300 ml) with stirring. The separated solid was filtered, washed free of pyridine with water and dried in a vacuum desiccator; yield 2.0 g (95%), mp 280-281° (dec). Two crystallizations gave an analytical sample, mp 290-291° (dec).  
Anal.:  
UV max (MeOH): 240 nm (ε 34,000)  
IR (KBr): 3333, 3226, 1653 and 1626 cm⁻¹  
[α]D²⁰ +102.5° (ε 1.28)  
Calcd for C₁₉H₂₇NO₂: C, 72.11; H, 8.92; N, 8.85. Found:  
C, 71.94; H, 8.63; N, 8.97.

3,17a-DIAZA-A,D-BISHOMO-4a-ANDROSTENE4,17-DIONE (28)*

*Schmidt Reaction with  
17a-Aza-D-homo-4-androstene-3,17-dione (26)

Powdered sodium azide (175 mg) was added during 1.5 hr to a stirred mixture of 17a-aza-D-homo-4-androstene-3,17-dione
(26) (600 mg) and freshly prepared polyphosphoric acid (20 g) at 60°. After occasional stirring during the following 10.5 hr at 60°, the reaction mixture was poured in a thin stream onto crushed ice, made slightly alkaline with 50% aqueous potassium hydroxide solution, and extracted with chloroform (4 x 50 ml). The combined chloroform extract was washed with water, dried and concentrated to approximately 6 ml. The separated solid was filtered, washed with cold chloroform (~6 ml), and dried; yield 230 mg (36%), mp >300°. Recrystallization (CHCl₃-EtOH) afforded a sample for analysis.

**Anal.:**

UV max (MeOH): 219.5 nm (ε 20,520)

IR (KBr): 3333, 3125, 1653, 1623 and 1587 cm⁻¹

[α]²⁰ D +37.2° (c 0.33)

Calcd for C₁₉H₂₈N₂O₂: C, 72.11; H, 8.92; N, 8.85. Found: C, 71.97; H, 9.08; N, 8.76.

*Beckmann Rearrangement of 3-Oximino-17α-aza-D-homo-4-androsten-17-one (27)*

A solution of 3-oximino-17α-aza-D-homo-4-androsten-17-one (27) (2.0 g) in dioxan (200 ml) was cooled to 10° and thionyl chloride (9 ml) was added with stirring at such a rate that temperature of the reaction mixture could be controlled below 15°. After 75 min at room temperature, the mixture was stirred vigorously, made slightly alkaline with saturated solution of sodium bicarbonate, and extracted with methylene chloride. The organic layer was washed with water,
dried, and the solvent removed under reduced pressure. The residue was washed free of color with cold acetone and dried; yield 1.28 g (64%), mp >330°. Crystallization (CHCl₃-EtOH) afforded the analytical sample, mp >330°.

**Anal.:**

UV max (MeOH): 220 nm (ε 20,380)

IR (KBr): Essentially the same as above

Calcd for C₁₉H₂₈N₂O₂: C, 72.11; H, 8.92; N, 8.85. Found: C, 72.27; H, 9.23; N, 8.61.

*Beckmann Rearrangement of 17-Oximino-3-aza-A-homo-4a-androsten-4-one (46)*

A solution of 17-oximino-3-aza-A-homo-4a-androsten-4-one (46) (90 mg) in dioxan (9 ml) was cooled to 15°, stirred and treated dropwise with thionyl chloride (0.45 ml). After allowing the mixture to stand for 75 min at room temperature, it was made slightly alkaline with saturated aqueous sodium bicarbonate solution, and extracted with methylene chloride. The organic layer was washed with water, dried, and the solvent removed under reduced pressure to give a cream colored residue; yield 69 mg (77%), mp >330°. It was crystallized (CHCl₃-EtOH) before analysis.

**Anal.:**

UV max (MeOH): 219 nm (ε 18,300)

IR (KBr): Essentially the same as above

Calcd for C₁₉H₂₈N₂O₂: C, 72.11; H, 8.92; N, 8.85. Found: C, 71.82; H, 8.64; N, 8.63.
Beckmann Rearrangement of 4-Androstene-3,17-dione dioxime (48)

Thionyl chloride (1.0 ml) was added to a stirred solution of 4-androstene-3,17-dione dioxime (48) (450 mg) in dioxan (21 ml) at 15°. After 1 hr at 20°, the reaction mixture was basified with saturated aqueous sodium bicarbonate solution (25 ml) and extracted with chloroform (4 x 25 ml). The chloroform extract was washed with water, dried, and the solvent distilled off under reduced pressure. The residue was washed free of color with few milliliters of cold ethanol; yield 100 mg (22%), mp >330°; and crystallized (CHCl₃-EtOH).

Anal.: UV max (MeOH): 220 nm (ε 20,400)
IR (KBr): Essentially the same as above

3,17a-Diacetyl-3,17a-diaza-A,D-bishomo-4a-androstene-4,17-dione (29)*

A mixture of 3,17a-diaza-A,D-bishomo-4a-androstene-4,17-dione (28) (200 mg), dry pyridine (15 ml) and acetic anhydride (7.5 ml) was heated on a steam bath for 4 hr, allowed to cool, and poured into cold water (350 ml) with stirring. The separated solid was filtered, washed with water and dried; yield 200 mg (80%), mp 148-152°. Crystallization (petroleum ether, 60-80°) raised the melting point to 152-155°.

Anal.:
UV max (EtOH): 235 nm (ε 21,065)
IR (Nujol): 1730, 1700 and 1670 cm⁻¹

\[ [\alpha]_D^{25.5} = 0^\circ \ (c 0.16) \]

Calcd for C₂₃H₃₂N₂O₄: C, 68.97; H, 8.05; N, 7.00. Found: C, 69.38; H, 8.26; N, 7.37.

3-OXIMINO-4-ANDROSTEN-3β-YL ACETATE (33)*

A solution of testosterone acetate (32) (4.0 g) and hydroxylamine hydrochloride (1.8 g) in pyridine (32 ml) containing water (1.3 ml) was heated on a steam bath. After 75 min, the solution was cooled and poured into cold water (400 ml) with stirring. The separated solid was filtered at pump, washed free of pyridine with water, and dried; yield 4.15 g (99%), mp 183-186°. Three crystallizations (MeOH) afforded a fraction in 30% yield, mp 201.5-202.5°.

Anal.:
UV max (MeOH): 240 nm (ε 18,600)
IR (CHCl₃): 3597, 3280, 1725, 1639 and 1600 cm⁻¹
NMR (CDCl₃): 348 cps

\[ [\alpha]_D^{26} = +106.5^\circ \ (c 1.0) \]

Calcd for C₂₁H₃₁NO₃: C, 73.00; H, 9.05; N, 4.05. Found: C, 73.18; H, 9.00; N, 3.04.

The combined mother liquors from above gave a product, mp 185-187.5°.

Anal.:
UV max (MeOH): 240 nm (ε 20,200)
IR (CHCl₃): Essentially the same as above
NMR (CDCl₃): 390 and 348 cps
\[ \alpha \]D²⁶ +150.50° (c 1.0)
Calcd for C₂₁H₃₁NO₅: C, 73.00; H, 9.05; N, 4.05. Found:
C, 72.74; H, 8.70; N, 4.05.

4-OXO-3-aza-a-homo-4α-androstene-17β-yl acetate (34)*

To a stirred solution of 3-oximino-4α-androstene-17β-yl acetate (33) (4.0 g, mp 193-196°) in dioxan (100 ml) at 10°, thionyl chloride was added at such a rate that temperature of the reaction mixture remained below 15°. After 1 hr at 20°, the mixture was made slightly alkaline with saturated aqueous sodium bicarbonate solution, and extracted with chloroform (4 x 60 ml). The combined chloroform extract was washed once with water, dried, and the solvent distilled off under reduced pressure. The reddish brown residue (3.9 g) so obtained could not be purified through repeated crystallizations and was chromatographed on alumina. Elution with benzene and benzene-chloroform mixtures gave the product; yield 2.4 g, mp 239-242°. Crystallization (Me₂CO) afforded the analytical sample, mp 250°.

Anal.:  
UV max (MeOH): 221 nm (ε 16,950)  
IR (CHCl₃): 3448, 1739, 1664 and 1613 cm⁻¹
\[ \alpha \]D²⁶ +70° (c 1.0)
Calcd for C₂₁H₃₁NO₅: C, 73.00; H, 9.05; N, 4.05. Found:
C, 72.88; H, 8.50; N, 3.73.
The pure anti-isomer of the oxime (33b) (2.5 g, mp 201-202°) when submitted to Beckmann rearrangement under the same conditions (using dioxan or benzene as solvent) gave 1.4 g (56%) of the lactam (34).

17β-HYDROXY-3-AZA-A-HOMO-4a-ANDROSTEN-4-ONE (35)

*Hydrolysis of 4-Oxo-3-aza-A-homo-4a-androsten-17β-yl acetate (34)

A solution of 4-oxo-3-aza-A-homo-4a-androsten-17β-yl acetate (34) (2.4 g) in 0.25 N methanolic potassium hydroxide (120 ml) was refluxed for 100 min and diluted with 0.25 N aqueous acetic acid (120 ml). The crystals that separated upon gradual cooling were filtered, washed with a few milliliters of cold 50% aqueous methanol, and dried; yield 2.0 g (95%), mp 289-291°. A single crystallization (EtOH) gave analytical sample, mp 294-295° (lit1148 288-291°).

Anal.:
UV max (MeOH): 221.5 nm (ε 17,700) (lit1148 221 nm, ε 17,700)
IR (CHCl3): 3731, 3663, 3448, 1656 and 1610 cm⁻¹
Calcd for C_{19}H_{29}NO₂:  C, 75.20; H, 9.63; N, 4.62. Found: C, 75.01; H, 9.63; N, 4.95.

3-ACETYL-4-OXO-3-AZA-A-HOMO-4a-ANDROSTEN-17β-YL ACETATE (36)*

*Acetylation of 4-Oxo-3-aza-A-homo-4a-androsten-17β-yl acetate (34)

A mixture of 4-oxo-3-aza-A-homo-4a-androsten-17β-yl acetate (34) (250 mg), dry pyridine (4 ml) and acetic
anhydride (2 ml) was heated on a steam bath for 100 min. The solution was cooled and poured into cold water (80 ml) with stirring. The separated solid was filtered, washed freely with water and dried; yield 280 mg (100%), mp 138-140°. A sample for analysis was obtained upon crystallization (petroleum ether, 60-80°), mp 142°.

**Anal.**

UV max (MeOH): 236 nm (ε 16,600)

IR (CHCl₃): 1730, 1695, 1675 and 1618 cm⁻¹

\[ \alpha \]D₂⁶ -22° (ε 0.53)

Calcd for C₂₃H₃₅NO₄: C, 71.29; H, 8.58; N, 3.61. Found: C, 71.52; H, 8.48; N, 3.49.

*Acetylation of 17β-Hydroxy-3-aza-A-homo-4a-androsten-4-one (35)*

A solution of 17β-hydroxy-3-aza-A-homo-4a-androsten-4-one (35) (150 mg) in dry pyridine (2.4 ml) and acetic anhydride (1.2 ml) was heated on a steam bath for 100 min. Work up as above gave 184 mg (96%) of the diacetate (36), mp 138-141°. Crystallization (petroleum ether, 60-80°) raised the melting point to 141.5-142.5°.

**Anal.**

UV max (MeOH): 236.5 nm

IR (CHCl₃): Essentially the same as above

Calcd for C₂₃H₃₅NO₄: C, 71.29; H, 8.58; N, 3.61. Found: C, 71.06; H, 8.67; N, 3.61.
Oppenauer Oxidation of 17β-Hydroxy-3-aza-A-homo-4α-androsten-4-one (35)

A solution of 17β-hydroxy-3-aza-A-homo-4α-androsten-4-one (35) (1.5 g) in cyclohexanone (15 ml), dioxan (150 ml) and dry toluene (130 ml) was distilled slowly as a solution of aluminum isopropoxide (2.25 g) in dry toluene (12.5 ml) was gradually added (during 1 hr). Distillation was continued for 3 hr as more toluene was added and 300 ml of distillate collected. After 5 hr at reflux and 15 hr at room temperature, the mixture was steam-distilled, extracted with ether (4 x 100 ml) and then with chloroform (3 x 50 ml). The ether extract was washed with water, dried, and concentrated to induce crystallization; yield 830 mg (55%). Crystallization (benzene-ether) provided an analytical sample, mp 222-223.5°.

Anal.:  
UV max (MeOH): 221 nm (ε 15,300)  
IR (CHCl₃): 3448, 1742, 1658 and 1610 cm⁻¹  
(KBr): 3185, 1724, 1645 and 1585 cm⁻¹  
[α]²⁰°D +93.6° (c 1.07)  
Calcd for C₁₉H₂₇NO₂: C, 75.71; H, 9.03; N, 4.65. Found: C, 76.32; H, 8.92; N, 4.45.  

The chloroform extract obtained above, on usual follow up gave back the starting material (650 mg), mp and mmp 295°.
*Beckmann Rearrangement of 3-Oximino-4-androsten-17-one (41)

To a solution of crude 3-oximino-4-androsten-17-one (41) (450 mg) in dioxan (12.5 ml) at 10° was added thionyl chloride (0.75 ml) with stirring at such a rate that temperature of the reaction mixture remained below 15°. After 1 hr at 20°, the mixture was stirred, made alkaline with saturated aqueous sodium bicarbonate solution, and extracted with ether. The ethereal extract was washed with water, dried and the solvent removed under reduced pressure. The residue was digested with petroleum ether (60-80°) and the extract concentrated to induce crystallization; yield 150 mg (33%), mp 213-216°. Recrystallization (ether) gave material with melting point 218-220°.

Anal.:
UV max (MeOH): 220 nm (ε 15,300)
IR (CHCl₃): Essentially the same as obtained above

*Hydrolysis of the Rearrangement Product of 20-Oximino-3-aza-A-homo-1,6-pregnadien-4-one (44)

A cooled mixture of phosphoryl chloride (2 ml) and dry pyridine (6 ml) was added dropwise to a well shaken solution of 20-oximino-3-aza-A-homo-1,6-pregnadien-4-one (44) (500 mg) in pyridine (5 ml), maintaining the temperature of the reaction mixture below 0°. After occasional shaking during 3 hr at 0°, the mixture was poured with stirring onto
a mixture of crushed ice (15 g) and concentrated hydrochloric acid (15 ml). The resulting mixture was allowed to stand for 30 min at 20°, diluted with an equal volume of water, and extracted with chloroform (4 x 25 ml). The organic layer was washed with water, dried and the solvent removed under reduced pressure to leave an oil which solidified on addition of a few milliliters of ether; yield 400 mg (87%), mp 216-220°. Recrystallization (benzene-ether) provided a sample for analysis, mp 222-224°.

**Anal.**:
UV max (EtOH): 219 nm (€ 16,600)
IR (KBr): Essentially the same as obtained above
Calcd for C₁₉H₂₇NO₂: C, 75.71; H, 9.03; N, 4.65. Found: C, 75.67; H, 8.95; N, 4.66.

*Hydrolysis of the Rearrangement Product of 4,16-Pregnadiene-3,20-dione dioxime (45)*

A stirred solution of 4,16-pregnadiene-3,20-dione (45) (500 mg) in dry pyridine (10 ml) at -20° was treated dropwise with a mixture of phosphoryl chloride (6 ml) in dry pyridine (18 ml). The temperature of the reaction mixture was maintained below -10° during the addition. After occasional shaking at 0° during 3 hr, this mixture was poured into a stirred mixture of crushed ice (45 g) and concentrated hydrochloric acid (45 ml). External cooling was necessary to maintain the temperature below 40°. After 30 min at room temperature, the contents were diluted with water (90 ml) and
extracted with chloroform (3 x 50 ml). The chloroform extract was washed with water, dried and the solvent removed under reduced pressure. The residue was crystallized twice (benzene-ether); yield 100 mg (23%), mp 224-225°.

**Anal.:**

UV max (MeOH): 220 nm (ε 16,000)

IR (KBr): Essentially the same as obtained above

Calcd for C_{19}H_{27}NO_{2}: N, 4.65. Found: N, 4.45.

17,17-ETHYLENEDI0XY-5-ANDROSTEN-3β-OL (38)

A solution of 3β-hydroxy-5-androsten-17-one (21) (8.0 g) in benzene (800 ml) and ethylene glycol (80 ml) was distilled in a Dean-Stark apparatus until dry. p-Toluene-sulfonic acid monohydrate (800 mg) was added to the hot mixture which was immediately brought to boiling. Refluxing was continued until no more water separated (~30 hr). The reaction mixture was cooled, treated with a few milliliters of saturated aqueous sodium bicarbonate solution, and extracted with ether. The combined organic layer was washed with water, dried, and the solvent distilled off under reduced pressure. The residue was crystallized (aq MeOH contg a drop of pyridine); yield 7.0 g (76%), mp 164-169° (lit\textsuperscript{158} 161-165°; lit\textsuperscript{159} 165.5-166.5°).

17,17-ETHYLENEDI0XY-4-ANDROSTEN-3-ONE (39)

A solution of aluminum isopropoxide (13.0 g) in toluene
(555 ml) was added to a solution of 17,17-ethylenedioxy-5-androsten-3β-ol (38) (6.5 g) in cyclohexanone (92 ml), and the mixture immediately brought to boiling. After refluxing for 2.5 hr, the reaction mixture was steam-distilled and extracted with ether. The organic layer was washed with water, dried, and the solvent removed. Repeated crystallizations of the residue (petroleum ether, 60-80°) gave a pure sample; yield 3.5 g (54%), mp 145-147.5° (lit159 148-149°, aq EtOH).

17,17-ETHYLENEDIOXY-4-ANDROSTEN-3-ONE OXIME (40)

A mixture of 17,17-ethylenedioxy-4-androsten-3-one (39) (3.15 g), pyridine (24 ml) and hydroxylamine hydrochloride (1.1 g) was heated on a steam bath for 100 min and poured into cold water (400 ml) with stirring. The crude oxime was filtered, washed with water, and dried in a vacuum desiccator; yield 3.2 g (97%), mp 197-200°. Repeated crystallizations (MeOH) gave an analytical sample, mp 220-222°.

Anal.:
UV max (MeOH): 241 nm (ε 20,700)
IR (CHCl₃): 3597, 3226, 1624 and 1613 cm⁻¹
NMR (CDCl₃): 390 and 348 cps
[α]D²⁶ +97° (c 0.48)
Calcd for C₂₁H₃₁NO₃: C, 73.00; H, 9.05; N, 4.05. Found: C, 72.82; H, 8.71; N, 4.11.

Another fraction, mp 205-208°, was obtained from the combined
mother liquors.

**Anal.:**

UV max (MeOH): 241 nm (ε 19,300)

IR (CHCl₃): Essentially the same as above

NMR (CDCl₃): 390 and 348 cps

\[ [\alpha]_D^{26} +94.5^\circ (c 1.2) \]

Calcd for C₂₁H₃₁N₂O₃: C, 73.00; H, 9.05; N, 4.05. Found:

C, 73.03; H, 9.28; N, 4.44.

3-OXIMINO-4-ANDROSTEN-17-ONE (41)*

To a solution of 17,17-ethylenedioxy-4-androstene-3-one oxime (40) (1.0 g) in ethanol (500 ml) was added water and sodium citrate buffer (pH 3.5, 20 ml). The solution was refluxed for 25 hr, cooled, and extracted with methylene chloride. The extract was washed with water, dried (K₂CO₃) and the solvent removed under reduced pressure. The crude oxime (870 mg) could not be crystallized satisfactorily.

**Anal.:**

UV max (MeOH): 240 nm (ε 17,100)

IR (CHCl₃): 3600, 1745, 1668 and 1635 cm⁻¹

NMR (CDCl₃): 390 and 348 cps

(25R)-4-SPirosten-3-one

A solution of aluminum isopropoxide (7.5 g) in toluene (50 ml) was added to a refluxing solution of diosgenin (crystallized from acetone, mp 207-208.5°; 10.0 g) in
cyclohexanone (75 ml) and toluene (150 ml), and the mixture refluxed for 1 hr. When cold, the reaction mixture was filtered at the pump and the residue washed with toluene (~20 ml). The combined filtrate and washings were steam-distilled to remove the organic solvents and extracted with chloroform (4 x 30 ml). The chloroform extract was once washed with water, dried, and the solvent removed under reduced pressure. The cream colored residue thus obtained was crystallized (ether-petroleum ether, 40-60°); yield 7.85 g (78%), mp 185-186.5° (lit1 186-188°, ether-pentane).

(25R)-4-SPIROSTEN-3-ONE OXIME

A solution of (25R)-4-spirosten-3-one (7.6 g) and hydroxylamine hydrochloride (1.9 g) in pyridine (46 ml) containing water (1.9 ml) was heated on a steam bath for 1 hr, cooled and poured into cold water (500 ml) with stirring. The separated semicrystalline solid was filtered, washed with water, dried, and crystallized (EtOH); yield 7.8 g (98%), mp 234-236° (lit1 235-238°).

(25R)-3-AZA-A-HOMO-4a-SPIROSTEN-4-ONE (42)

To a stirred solution of (25R)-4-spirosten-3-one oxime (7.8 g) in dioxan (136 ml) cooled to 12°, was added dropwise a mixture of thionyl chloride (3.9 ml) and dioxan (19.5 ml), the reaction temperature being maintained below 15°. After letting stand for 1 hr at 20°, the reaction mixture was
treated with a cube of ice, basified with dilute solution of ammonia (40 ml), and diluted with water (1.5 l). The separated solid was filtered at the pump, washed freely with water and then acetone (~40 ml), and dried. Two crystallizations (EtOH and then MeOH) of the light brown powder gave a light buff colored product; yield 3.5 g (45%), mp 300-303° (lit\textsuperscript{160} 303-305.5°).

3-AZA-A-HOMO-\(\Delta^4\)a,16-PREGNADIENE-\(\Delta^4,20\)-DIONE (43)\textsuperscript{*}

A mixture of (25R)-3-aza-A-homo-\(\Delta^4\)a-spirosten-\(\Delta^4\)-one (42) (17.0 g) and acetic anhydride (114 ml) was heated in a hard glass sealed ampoule, in an oil bath maintained at 200° (\textsuperscript{\textdegree}C) for 1 hr. It was allowed to cool, the ampoule broken and contents poured into water (1 l) with stirring. The supernatant aqueous layer was decanted from the dark brown oil. To a solution of this oil in glacial acetic acid (220 ml) was added a solution of chromium trioxide (5.5 g) in 90% acetic acid (96 ml). After letting stand for 2 hr at room temperature, ethanol (5 ml) was added to the reaction mixture to destroy the excess of chromic acid. The mixture was diluted to 2.5 l with water and extracted with solvent ether (6 x 250 ml). The organic layer was washed with water and aqueous sodium bicarbonate solution till neutral, dried, and the solvent removed. A solution of the residue in acetone (170 ml) and water (68 ml) containing potassium hydroxide (8.5 g), was refluxed for 30 min, diluted to 1.5 l with water, and extracted with chloroform (4 x 100 ml). The total
chloroform extract was washed with water, dried, and the solvent removed under reduced pressure to leave a residue (15 g) which resisted attempts at its crystallization. Chromatography over a column of alumina and elution with benzene-chloroform mixture (3:2) afforded the product; yield 5.89 g (42%), mp 222-225°. A sample for analysis was obtained through crystallizations (Me₂CO), mp 236-239°.

**Anal.:**

UV max (EtOH): around 226 nm (ε 20,420)

IR (Nujol): 3265, 3160, 1727, 1663, 1638 and 1597 cm⁻¹

[α]D²⁴ +92° (c 0.12)

Calcd for C₂₁H₂₉NO₂: C, 77.02; H, 8.93; N, 4.28. Found: C, 77.53; H, 9.09; N, 4.07.

20-OXIMINO-3-AZA-A-HOMO-4a,16-PREGNADIEN-4-ONE (44)*

A solution of 3-aza-A-homo-4a,16-pregnadiene-4,20-dione (43) (800 mg) and hydroxylamine hydrochloride (270 mg) in pyridine (5.4 ml) containing water (0.25 ml) was heated on a steam bath for 1 hr. The cooled reaction mixture was poured into ice-cold water (~60 ml) with stirring. The separated product was filtered, washed freely with water, and dried; yield 820 mg (97%), mp 274-276° (dec). Recrystallization (EtOH) gave needles, mp 276-279° (dec).

**Anal.:**

UV max (EtOH): around 226 nm (ε 28,160)

IR (Nujol): 3370, 3130, 1638 and 1595 cm⁻¹
Calcd for C_{21}H_{30}N_{2}O_{2}: C, 73.68; H, 8.77; N, 8.18. Found: C, 73.60; H, 8.72; N, 8.12.

3β-HYDROXY-5,16-PREGNADIEN-20-ONE

A solution of 20-oxo-5,16-pregnadien-3α-yl acetate (10.0 g) in 95% ethanol (500 ml) containing concentrated hydrochloric acid (50 ml) was refluxed for 45 min and poured into water (3 l). The resulting fine precipitate was filtered at the pump, washed with water, and crystallized (MeOH); yield 7.0 g (80%), mp 214-215° (lit 195 211-213°).

Alkaline hydrolysis using 2% ethanolic or methanolic sodium hydroxide at reflux or room temperatures were found to give much lower yields of the product.

4,16-PREGNADIENE-3,20-DIONE

A solution of aluminum isopropoxide (5.0 g) in dry toluene (50 ml) was added gradually during 30 min to a constantly distilling solution of 3β-hydroxy-5,16-pregnadien-20-one (5.0 g) in cyclohexanone (50 ml) and dry toluene (150 ml). The resulting mixture was refluxed for another 4 hr. After allowing to stand over-night at room temperature, the reaction mixture was filtered at the pump, the precipitate washed with a few milliliters of toluene, and the combined filtrate and washings steam-distilled to remove the organic solvents. The aqueous suspension was extracted with ether (4 x 50 ml). The ether layer was washed with water, dried,
and the solvent removed. Crystallizations of the residue (4.9 g) did not yield a sharp melting product. It was, therefore, dissolved in a mixture of chloroform (150 ml) and pyridine (50 ml), and gradually treated under ice cooling with chlorosulfonic acid (15 ml). The mixture was then brought to reflux for 15 min after addition of a further quantity of chloroform (60 ml). A 30% aqueous sodium carbonate solution (250 ml) was added to the reaction mixture which was then extracted with ether (4 x 50 ml). The organic layer was washed with water, dried, and the solvent distilled off. The deep red residue could not be crystallized satisfactorily. A solution of the residue in benzene was passed through a column of alumina, and the product left after removal of the solvent was crystallized (acetone-petroleum ether, 60-80°); yield 2.5 g (50%), mp 185-186° (lit 162-186°).

4,16-PREGNADIENE-3,20-DIONE DIOXIME (45)*

A mixture of 4,16-pregnadiene-3,20-dione (1.0 g), hydroxylamine hydrochloride (0.67 g) and pyridine (14 ml) was heated on a steam bath for 1 hr, cooled and poured into ice cold water (150 ml) with stirring. The separated solid was filtered, washed with water and dried in a vacuum desiccator; yield 1.09 g (100%), mp 222-224°. Crystallization (EtOH and then MeOH) raised the melting point to 231.5-233°.

Anal.:  
UV max (EtOH): 238 nm (ε 17,920)  
IR (KBr): 3333, 1639 and 1603 cm⁻¹
[α]_{D}^{24.5} +132.99° (c 0.37)
Calcd for C_{21}H_{30}N_{2}O_{2}: C, 73.68; H, 8.77; N, 8.18. Found:
C, 74.01; H, 8.98; N, 7.70

17-OXIMINO-3-AZA-A-HOMO-4a-ANDROSTENE-17-ONE (46)*

Heating a solution of 3-aza-A-homo-4a-androsten-17-dione (37) (200 mg) and hydroxylamine hydrochloride (70 mg) in pyridine (1.6 ml) containing a drop of water on a steam bath for 75 min, followed by usual work up, gave 201 mg (96%) of the oxime, mp 258-259° (dec). Crystallization (MeOH) gave analytical sample, mp 264-265.5° (dec).

Anal.:
UV max (MeOH): 220 nm (ε 17,700)
IR (KBr): 3333, 1672, 1653 and 1610 cm^{-1}
[α]_{D}^{24} +2.22° (c 0.09)
Calcd for C_{19}H_{28}N_{2}O_{2}: C, 72.11; H, 8.92; N, 8.85. Found:
C, 72.35; H, 9.19; N, 8.75.

4-ANDROSTEN-3,17-DIONE (47)

3β-Hydroxy-5-androsten-17-one (21) (5.0 g) was dissolved in cyclohexanone (55 ml) and a solution of aluminum isopropoxide (10 g) in toluene (325 ml) added to it. The mixture was refluxed for 2.5 hr and the organic solvents removed by steam distillation. The aqueous suspension was extracted with ether (4 x 75 ml). The organic layer was washed with water, dried, and the solvent distilled off.
Recrystallization (acetone-petroleum ether, 60-80°) of the residue gave the product; yield 3.2 g (65%), mp 173-174° (lit196 173-174°).

4-ANDROSTENE-3,17-DIONE DIOXIME (48)

A solution of sodium acetate trihydrate (26.35 g) and hydroxylamine hydrochloride (12.14 g) in water (75 ml) was added to a refluxing solution of 4-androstene-3,17-dione (47) (6.2 g) in 95% ethanol (186 ml). After refluxing for 2.5 hr, the reaction mixture was diluted with water (186 ml) and allowed to cool to 0°. The separated crystals were filtered, washed with 40% ethanol (~40 ml), and dried in a vacuum desiccator; yield 6.77 g (98%), mp 200-215° (lit147 195-210°).

Anal.:
UV max (EtOH): 241.4 nm
Calcd for C_{19}H_{28}N_{2}O_{2}: C, 72.11; H, 8.92; N, 8.85. Found: C, 72.35; H, 9.12; N, 8.07.

An attempt at the resolution of this oxime on a column of alumina did not succeed.

16α,17α-OXIDO-3-AZA-A-HOMO-4a-PREGNENE-4,20-DIONE (49)*

A stirred solution of 3-aza-A-homo-4a,16-pregnadiene-4,20-dione (43) (2.0 g) in methanol (140 ml) cooled to 0° was treated successively with cold aqueous sodium hydroxide solution (4N, 4.0 ml) and hydrogen peroxide (30%, 10.0 ml). After keeping at 5-7° for 24 hr, the reaction mixture was poured into cold water (~700 ml) with stirring. The separated
crystals were filtered at the pump, washed with water and
dried in a vacuum desiccator; yield 2.0 g (95%), mp 284-287°.
A sample for analysis was obtained upon recrystallization
(MeOH), mp 286-287.5°.

**Anal.:**

UV max (EtOH): 222 nm (ε 15,840)

IR (KBr): 3390, 1700, 1650 and 1605 cm⁻¹

[α]²⁴.⁵ D +62.62° (c 0.5)

Calcd for C₂₁H₂₉NO₃: C, 73.44; H, 8.51; N, 4.08. Found:
C, 73.39; H, 8.46; N, 4.42.

**16β-BROMO-17α-HYDROXY-3-aza-A-homo-4α-pregnene-4,20-dione (50)**

A solution of 16α,17α-oxido-3-aza-A-homo-4α-pregnene-
4,20-dione (49) (250 mg) in glacial acetic acid (6.25 ml) was
treated with a solution (30%, 6.5 ml) of freshly distilled
hydrobromic acid in glacial acetic acid. After allowing to
stand at 30° for 70 min, the solution was poured into cold
water (~140 ml) with stirring. The separated product was
filtered, washed with water, dried, and crystallized (Me₂CO);
yield 240 mg (78%), mp 195-196°. A further crystallization
provided the analytical sample, mp 197-198°.

**Anal.:**

IR (KBr): 3375, 1715, 1645 and 1600 cm⁻¹

[α]²⁰ D +21.75° (c 1.01)

Calcd for C₂₁H₃₀NO₃Br: C, 59.29; H, 7.29; N, 3.29;
Br, 18.82. Found: C, 58.75; H, 7.59; N, 3.52; Br, 18.52.
16β-CHLORO-17α-HYDROXY-3-aza-A-homo-4α-pregnene-4,20-dione (51)*

16α,17α-Oxido-3-aza-A-homo-4α-pregnene-4,20-dione (49) (200 mg) was dissolved in glacial acetic acid (5.0 ml) saturated with dry hydrochloric acid gas. The solution was allowed to stand at room temperature for 2.5 hr and poured into ice cold water (~100 ml) with stirring. The separated solid was filtered at the pump, washed with water, and recrystallized (Me₂CO); yield 150 mg (68%), mp 228-229° (dec).

Anal.: IR (KBr): 3380, 1720, 1640 and 1595 cm⁻¹
[α]D  No rotation found
Calcd for C₂₁H₅₀N₀₅Cl:  N, 3.69; Cl, 9.33. Found: N, 3.41; Cl, 8.84.

17α-HYDROXY-16β-IOIDO-3-aza-A-homo-4α-pregnene-4,20-dione (52)*

Sodium iodide (4.0 g) was added to a solution of 16α,17α-oxido-3-aza-A-homo-4α-pregnene-4,20-dione (49) (1.0 g) in glacial acetic acid (10 ml) and the mixture heated on a steam bath for 2.5 hr. The cooled reaction mixture was diluted with methylene chloride (70 ml) and water (70 ml). The organic layer was separated and washed with saturated aqueous sodium thiosulfate solution and water. The methylene chloride layer was dried and the solvent removed under reduced pressure (on a warm water bath). The pale yellow syrupy residue was
crystallized (acetone-petroleum ether, 60-80°); yield 950 mg (62%), mp 158-160° (dec). Repeated crystallizations (Me₂CO) afforded the analytical sample, mp 194-195° (dec, pre-heated bath).

**Anal.**

IR (KBr): 3300, 1700, 1645 and 1600 cm⁻¹

[α]D²⁰ +44.2° (c 1.0)

Calcd for C₂₁H₃₀NO₃I: C, 53.51; H, 6.42; N, 2.97; I, 26.92. Found: C, 54.24; H, 6.6; N, 3.08; I, 28.51.

17α-HYDROXY-16β-THIOCYANATO-3-AZA-A-HOMO-4α-PREGNENE-4,20-DIONE (53) *

Potassium thiocyanate (4.0 g) was added to a solution of 16α,17α-oxido-3-aza-A-homo-4α-pregnene-4,20-dione (49) (1.0 g) in glacial acetic acid (30 ml) and the mixture heated on a steam bath for 5 hr. The cooled reaction mixture was poured into cold water (~600 ml) with stirring. The separated solid was filtered, washed successively with water, aqueous sodium bicarbonate solution and water, dried in a vacuum desiccator, and crystallized (Me₂CO); yield 750 mg (64%), mp 261° (dec).

**Anal.**

UV max (MeOH): 219 nm (ε 16,630)

IR (KBr): 3420, 2145, 1700, 1645 and 1595 cm⁻¹

Calcd for C₂₂H₃₀N₂O₃S: N, 6.96; S, 7.97. Found: N, 6.69; S, 7.72.
A solution of potassium carbonate (2.8 g) in water (80 ml) was added to a vigorously stirred solution of 17a-aza-D-homo-4-androstene-3,17-dione (26) (3.95 g) in 90% aqueous tert-butanol (300 ml), immediately followed by sodium metaperiodate solution (50 ml; 20 g in 250 ml water) and then potassium permanganate solution (5 ml; 120 mg in 15 ml water). Stirring of the mixture was continued and the periodate solution was added at a rate of 11 ml/min during the first 10 min and 3 ml/min during the next 30 min. The permanganate solution was added when necessary to maintain the permanganate color. The mixture was stirred for another 2 hr, treated with sodium bisulfite to obtain iodine color (complete disappearance of permanganate color), acidified with ice cold 50% sulfuric acid, diluted with water (125 ml), and extracted with chloroform (5 x 80 ml). The combined chloroform extract was successively washed with water (125 ml), sodium bisulfite solution (4%, 100 ml), and water (3 x 50 ml). The organic layer was then extracted with aqueous potassium carbonate solution (4%, 3 x 50 ml). The combined aqueous layer was once washed with chloroform (50 ml) and acidified with cold 10% sulfuric acid. The separated fine needles were filtered at the pump, washed with water, and dried in a vacuum desiccator; yield 3.2 g (77%), mp 265-266°. Recrystallization (MeOH) afforded an analytical sample, mp 266-267°.
Anal.:
IR (KBr): 3320, 2970, 2930, 2860, 1700 and 1610 cm\(^{-1}\)
Calcd for C\(_{18}\)H\(_{27}\)NO\(_4\): C, 67.26; H, 8.47; N, 4.36. Found:
C, 66.92; H, 8.43; N, 4.11.

4-BENZYL-1\(\alpha\)-17a-DIAZA-D-HOMO-5-ANDROSTENE-3,17-DIONE (55)*

A solution of 5,17-dioxo-17a-aza-D-homo-3,5-seco-1\(\alpha\)-norandrostan-3-oic acid (54) (600 mg) in freshly distilled benzylamine was refluxed for 6 hr and allowed to stand overnight at room temperature. After dilution with water, the mixture was extracted with chloroform (4 x 10 ml). The combined chloroform layer was washed successively with water (10 ml), 5% hydrochloric acid (2 x 10 ml), water (10 ml), 5% sodium bicarbonate solution (2 x 10 ml), and water (2 x 10 ml). The organic layer was dried and the solvent removed under reduced pressure. The residue was crystallized (Me\(_2\)CO); yield 440 mg (62%), mp 277-279\(^\circ\). Recrystallization (Me\(_2\)CO) afforded an analytical sample, mp 278-280\(^\circ\).

Anal.:
UV max (MeOH): 234 nm (ε 10,110)
IR (KBr): 1655 and 1625 cm\(^{-1}\)
[\(\alpha\)]\(_D\)\(^{20}\) -127.2\(^\circ\) (c 1.05)
Calcd for C\(_{25}\)H\(_{32}\)NO\(_2\): C, 76.50; H, 8.22; N, 7.14. Found:
C, 76.78; H, 7.87; N, 6.99.
4- (β-HYDROXYETHYL)-4,17a-DIAZA-D-HOMO-5-ANDROSTENE-3,17-DIONE (56)*

A solution of 5,17-dioxo-17a-aza-D-homo-3,5-seco-4-norandrostan-3-oic acid (54) (700 mg) in freshly distilled ethanolamine (2.8 ml) was gently refluxed for 6 hr. The solution was cooled, diluted with water (~70 ml) and extracted with chloroform (5 x 15 ml). The organic layer was washed successively with 5% hydrochloric acid, water, 3% sodium carbonate solution and water, and dried. Removal of the solvent and repeated crystallization (Me₂CO) of the residue afforded the product; yield 150 mg (21%), mp 238-240°.

Anal.:
UV max (MeOH): 235 nm (ε 10,200)
IR (KBr): 3335 and 1645 cm⁻¹
Calcd for C₂₀H₃₀N₂O₃: C, 69.33; H, 8.73; N, 8.09. Found: C, 69.67; H, 8.80; N, 8.46.

5-OXIMINO-17-OXO-17a-AZA-D-HOMO-3,5-SECO-4-NOR-ANDROSTAN-3-OIC ACID (57)*

A mixture of 5,17-dioxo-17a-aza-D-homo-3,5-seco-4-norandrostan-3-oic acid (54) (680 mg), hydroxylamine hydrochloride (230 mg) and pyridine (7 ml) was heated on a steam bath for 100 min. The cooled solution was diluted with petroleum ether (60-80°, 20 ml). The separated solid was filtered, washed with water (20 ml), and dried in a vacuum desiccator; yield 600 mg (84%), mp 240-243°. Repeated crystallizations
(MeOH) gave the analytical sample, mp 247-248°.

**Anal.**

IR (KBr): 3270, 1680 and 1610 cm⁻¹
Calcd for C₁₈H₂₈N₂O₄: C, 64.26; H, 8.39; N, 8.33. Found: C, 63.97; H, 8.82; N, 7.99.

**4-HYDROXY-Á4,17a-DIAZA-D-HOMO-5α-ANDROSTANE-3,17-DIONE (58)**

A solution of 5-oximino-17-oxo-17a-aza-D-homo-3,5-seco-4-norandrostan-3-olic acid (54) (600 mg) in glacial acetic acid (~15 ml) was heated on a steam bath and treated with zinc dust (1.5 g). The reaction mixture was cooled after 2 hr, filtered, and the residue washed with glacial acetic acid (~15 ml). The combined filtrate and washings were diluted with water (450 ml) and extracted with chloroform (6 x 20 ml). The chloroform extract was washed successively with water, 3% sodium bicarbonate solution, and water. The organic layer was dried and the solvent removed under reduced pressure to leave a light pink residue; yield 400 mg (70%), mp >300°. A sample for analysis was obtained through crystallization (CHCl₃-MeOH-Me₂CO), mp >300°. A dilute solution of the product in methanol gave an instantaneous pink-violet color changing to green, on addition of a drop of methanolic ferric chloride solution.

**Anal.**

IR (KBr): 3175 and 1640 cm⁻¹
Calcd for C₁₈H₂₈N₂O₃: N, 8.74. Found: N, 8.33.
Liquor ammonia was added dropwise to formic acid (98%, 1.0 ml) till the mixture just became alkaline. A suspension of 5,17-dioxo-17a-aza-D-homo-3,5-seco-4-norandrostan-3-oic acid (54) (900 mg) in nitrobenzene (1.65 ml) was then added to the ammonium formate, previously brought to 165° in an oil bath. The mixture was occasionally stirred during 24 hr at 175-195°, cooled, washed gently with water, refluxed with ethanol (5 ml) and concentrated hydrochloric acid (2.8 ml) for 2.5 hr, and steam-distilled to remove the nitrobenzene. The aqueous solution was then extracted with chloroform (5 x 25 ml). The combined organic layer was washed successively with 5% sodium sulfite solution, water, 2% sodium carbonate solution, and water, and dried. The solvent was distilled off to leave an amorphous residue; yield 90 mg (11%), mp >300°. A sample for analysis was obtained upon crystallization (CHCl₃-Me₂CO), mp >330°.

Anal.:
IR (KBr): 3440 and 1650 cm⁻¹

3β-METHOXY-5α-ANDROSTAN-17-ONE OXIME (60)*

A mixture of 3β-methoxy-5α-androstane-17-one (500 mg), hydroxylamine hydrochloride (170 mg) and dry pyridine (5 ml) was heated on a steam bath for 1 hr, cooled, and poured into cold water (~50 ml) with stirring. The separated oxime was
filtered, washed with water, and dried in a vacuum desiccator; yield 525 mg (100%), mp 196-197.5°. Crystallization (aq EtOH and aq MeOH) afforded an analytical sample, mp 198-199°.

**Anal.:**
IR (KBr): 3356 and 1664 cm\(^{-1}\)
\([\alpha]_D^0\)
Calcd for C\(_{20}\)H\(_{23}\)NO\(_2\): C, 75.19; H, 10.41; N, 4.38. Found: C, 74.99; H, 10.31; N, 4.30.

**3β-METHOXY-17a-AZA-D-HOMO-5α-ANDROSTAN-17-ONE (61)**

To a stirred solution of 3β-methoxy-5α-androstan-17-one oxime (60) (400 mg) in dioxan (7 ml) was added a mixture of thionyl chloride (0.2 ml) and dioxan (1 ml) at such a rate that temperature of the reaction mixture remained below 15°. After 35 min at room temperature, the mixture was cooled in ice, diluted with water and slightly basified with a dilute solution of ammonia. The solid which separated upon further dilution with water was filtered, washed thoroughly with water, and dried at the pump. The crude product was further washed with petroleum ether (60-80°) and crystallized (Me\(_2\)CO); yield 200 mg (50%), mp 246-247°.

**Anal.:**
IR (KBr): 3165, 3049, 1660 and 1605 cm\(^{-1}\)
\([\alpha]_D^0\)
Calcd for C\(_{20}\)H\(_{23}\)NO\(_2\): C, 75.19; H, 10.41; N, 4.38. Found: C, 75.08; H, 10.30; N, 4.37.
3-(1-PYRROLIDINYL)-17a-AZA-D-HOMO-3,5-ANDROSTADIEN-17-ONE (64)*

Freshly distilled pyrrolidine (0.5 ml) was added to a well shaken boiling solution of 17a-aza-D-homo-4-androstene-3,17-dione (26) (1.2 g) in pure methanol (20 ml). The yellow needles that crystallized out on cooling, were filtered, washed repeatedly with methanol, and dried in a vacuum desiccator; yield 1.4 g (98%), mp 320-324° (dec).

Anal.:
UV max (MeOH): 275 nm (ε 16,000)
IR (KBr): 1645 and 1600 cm\(^{-1}\)
Calcd for C\(_{23}\)H\(_{34}\)N\(_2\): N, 7.90. Found: N, 7.46.

3α-(1-PYRROLIDYL)-17a-AZA-D-HOMO-5-ANDROSTEN-17-ONE (65)*

Powdered sodium borohydride was added to a stirred suspension of 3-(1-pyrrolidinyl)-17a-aza-D-homo-3,5-androstadien-17-one (64) (750 mg) in methanol (9 ml) during 30 min. The mixture was stirred for another 100 min and allowed to stand overnight. Solvent was removed from the mixture and the residue taken up in 20% acetic acid (20 ml) and filtered. The filtrate was basified with cold 15% sodium hydroxide solution. The separated solid was filtered and washed with water. Repeated crystallizations (MeOH-Me\(_2\)CO) afforded a single entity; yield 15 mg (2%), mp 279-283° (dec).

Anal.:
IR (KBr): 3150 and 1660 cm\(^{-1}\)
Calcd for C\(_{23}\)H\(_{36}\)N\(_2\): N, 7.86. Found: N, 7.56.
A solution of hydrazoic acid (approx 6-10%) in chloroform was freshly prepared: Sodium azide (10 g) was dissolved in water (25 ml), cooled to -5°, and stirred vigorously with chloroform (50 ml). Concentrated sulfuric acid (9.3 ml) was added dropwise to the cooled and stirred mixture during 30 min. The mixture was stirred for another half an hour below 0° and the chloroform layer was separated and dried.

To the chloroform solution of hydrazoic acid (37.5 ml) kept at 0°, was added freshly distilled boron trifluoride etherate (0.55 ml). A solution of 17a-aza-D-homo-4-androst-3-one (26) (1.17 g) in chloroform (19 ml) was added in parts to this mixture during 4 hr and the mixture was shaken after every addition. The reaction mixture was allowed to stand for 20 hr at room temperature and filtered. The filtrate was washed with water (5 x 50 ml), dried and the solvent evaporated at reduced pressure. The residue was crystallized (MeOH-Et2O); yield 400 mg (30%), mp 306-308° (dec). Further crystallizations (MeOH) gave the analytical sample, mp 308° (dec).

Anal.:
UV max (EtOH): 245 nm (ε 16,700)
IR (KBr): 3475, 3245, 1645, 1520 and 1445 cm⁻¹
[α]_D ^20 0° (ε 1.09)
Calcd for C_{19}H_{27}N_{5}O: C, 66.83; H, 7.97. Found: C, 66.22; H, 8.23.
A solution of 4-androstene-3,17-dione (47) (1.1 g) in chloroform (19 ml) was added during 4 hr to a cooled (0°) solution (75 ml) of hydrazoic acid in chloroform (prepared as above) containing boron trifluoride etherate (1.1 ml). The reaction mixture was allowed to stand for 15 hr at room temperature and filtered. The filtrate was washed with water (5 x 50 ml), dried, and the solvent removed at reduced pressure. The residue was crystallized (MeOH-Et₂O); yield 400 mg (28%), mp 170°/300° (dec). Analytical sample was obtained through repeated crystallizations (MeOH), mp 172-173°/299-300° (dec).

**Anal.:**

UV max (EtOH): 245 nm (ε 16,020)

IR (KBr): 2245, 2090, 1645, 1520 and 1445 cm⁻¹

[α]_D^20 +25.85 (c 1.08)